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Roll Call
Minutes Committee
Standing Rules #1

MINUTES
Interim Board Meeting, March 13, 2016 #2
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Region IX
Region X
New Professionals and New Members Forum
Awards
Scientific Assembly
Education Scientific Assembly
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NEW BUSINESS
Approval of CACMLE Educational Activities Business Plan #18

OPEN FORUM

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It is with great pleasure that I submit my first report to the ASCLS Board of Directors.

**Issues**

**Transition:** With the considerable assistance of Elissa Passiment, who graciously spent more than three months, side by side with me, we have successfully completed the transition in staff leadership. All legal agreements have been updated and financial institutions/accounts are secure. During this time, I have also had the opportunity to meet and begin working with key partners, with whom ASCLS has long term relationships.

**Finance:** The May 2016 month-end financial statements, that were supplied to the board has some changes to the formatting to make interpretation easier. Based on those statements, we can begin projecting our financial performance at year end. A number of key areas representing a large portion of our budget are showing positive net variances.

<table>
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<th>Program</th>
<th>Projected Net</th>
<th>Budgeted Net</th>
<th>Variance</th>
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<td>$352,501</td>
<td>$338,501</td>
<td>+$14,000</td>
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<tr>
<td>P.A.C.E.</td>
<td>$256,150</td>
<td>$246,150</td>
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</tr>
<tr>
<td>CLEC</td>
<td>$20,417</td>
<td>$11,932</td>
<td>+$8,485</td>
</tr>
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</table>

There are some concerns around the financial performance of the Annual Meeting. Based on current registration trends, I am anticipating registration revenue of between $140,000-$145,000. The approved budget for this year is $183,300, which is well above the revenue for either of the previous two years. We are doing our best to be prudent in our expenditures for the Annual Meeting, cutting back where possible, without impacting the experience our members will have at the meeting.

Gross revenue year to date in May was $1,027,159 compared to $954,849 at the same point in 2015. Expenses are up as well, showing an overall negative net revenue of $77,000 versus negative net revenue of $7,000 last year. As we get to the year end, the board is reminded of the fairly significant one-time expenses related to the EVP search and the overlapping salaries for two executives during the transition. This will push ASCLS into the red for just FY2016. Projecting into next year, we are in a good position to achieve the FY2017 budgeted, positive net approved by the board in March.

**Systems**

**Member Management System/Online Community:** On Friday April 1st, ASCLS officially transitioned to our new membership management system, which we’ll refer to as Timberlake, and our online membership community, which we’ll refer to as Higher Logic. Over the course of three days, our membership data was converted and after a day of quality assurance, the staff felt comfortable going live. Within a week, we also had the most recent three years of former (dropped) members added to the database. We have already identified other data sources that we will attempt to integrate in this single data warehouse, including BOC certificate holders and those who have requested P.A.C.E. certificates through CE Organizer.

Our long term goal is to centralize our data and documentation of all interactions with our members and our potential members to better measure organizational effectiveness and to better serve those individuals.
The transition has had its challenges. For instance, as we transitioned from one online community system to the other, we discovered that the old system had information that only flowed one way from the membership software to the community, but not back. The communities allowed for self-management and additions to SA’s without feeding that back to the membership system. As a result, it appears a number of “members” of the Scientific Assemblies in the old online communities did not transition to the new communities. The staff continues to address these kinds of issues.

As with any complex system, there are “bugs” that show up from time to time. Though the Timberlake system seems to be stable, there have been instances of intermittent issues with a variety of foci. In each case, our vendor has addressed the issues.

**Website:** The www.ascls.org website is currently hosted on a web server with old, no longer supported software. Staff have been working with an external vendor to move the website to an updated software platform. Either at the Annual Meeting, or soon after, the new ascls.org will be launching with a cleaner interface, a responsive design that will make it possible to navigate on a mobile device, and a more search engine optimized structure. New features will allow greater access to and utilization of the website by volunteer who are leading initiatives within ASCLS.

**Strategy**

**Utilization of Social Media/Other Communications:** As ASCLS updates it’s visual identity with a new logo, the Society is also approaching communications and marketing differently. We have been experimenting with the utilization of social media and search engine advertising and remarketing. Our broadcast email audience has been expanded to include former members and BOC certified professionals who are not yet members of ASCLS.

With a new member management system, we also have a new delivery system for broadcast email. New responsive design email templates that render properly on both desktops and mobile devices have been developed. Currently, we have about 500 members without an email address in their record. There is another 500 who have malformed email addresses or have addresses (mostly Comcast.net, Verizon.net, and Aol.com) where those systems are not delivering the email to the user’s inbox. We will be working on our email list hygiene and testing some alternative vendors for broadcast email delivery to maximize getting information into our members’ inboxes.

**Government Relations:** While Congress and the Administration continue to exist in a state of perpetual gridlock, federal regulatory issues have been on the forefront of the Society’s government relations work.

- **PAMA:** After months of waiting, CMS finally announced rules for collection of data that will be used to determine reimbursements for lab tests under Medicare and Medicaid. The implantation of new pricing was delayed by one year to 2018.
- **CLFS:** ASCLS provided comments to CMS as the Clinical Laboratory Fee Schedule and offered a number of suggestions for pricing that seem to be in line with the rest of the laboratory community.
- **CMS-CLIA:** ASCLS is partnering with the other sponsoring organizations on the Board of Certification to address a new interpretation of the CLIA statute and rules allowing nurses to perform high complexity testing. ASCLS and ASCP are leading this effort and have already had a robust discussion with CMS-CLIA on our concerns.
- **VA:** Somewhat related to the CMS issue with nurse qualifications is the VA, who has proposed a rule that would similarly allow nurses to play rules for which they are not qualified, and based on some conversations with nursing associations, roles nurses are unwilling to play. An alert was sent to the laboratory community and ASCLS has provided comments to the VA on our objections to the rule.

As we move into a new Congress in January, there is an opportunity to have a more proactive legislative agenda. Though there are a number of issues we anticipate we will need to address, the greatest
opportunity to galvanize the laboratory community is finding a way to increase federal funding of laboratory education and begin to address the looming workforce shortage.

Activities
Annual Meeting: At five weeks out from the Annual Meeting with the early registration rate having ended on 6/16 there were 446 registrants. This tracks at 103% of the registrants during the same time frame last year. Those trends have continued and both revenue and attendance in 2016 will exceed that of the 2015 Annual Meeting in Atlanta.

We did have issues with the headquarters hotel selling out early. The last two years in Atlanta and Chicago, our room block had about 260 rooms on peak night. When the room block was contracted in Philadelphia, it was before the Democratic Convention announced its location and before ASCLS shifted days to overlap with AACC.

In what I hope will be a trend in future years, the response to the 2016 call for poster and oral presentation abstracts was very strong. We received 36 abstracts, compared to 25 in 2015 and 24 in 2014. The response to the undergrad call for posters was more dramatic. In 2014, we accepted 6 undergraduate abstracts, and in 2015, we accepted 4 abstracts (and 2 of them withdrew before the meeting). This year, we received 18 abstracts for poster presentations in the undergraduate category. The increase in submissions did not come at a cost of quality. This year 11 undergraduate abstracts were accepted as well 28 Grad Student/Professional abstracts. The number accepted was up versus previous years as well. I believe there is a real opportunity to expand this even more in coming years.

Membership: As of July 1, ASCLS had recorded 9,125 memberships. By comparison, at the same point one year earlier, ASCLS showed 8,639 memberships, which stayed the same through the 2015 association year end (July 30). This is great news and is showing growth in total membership. Those 9,000+ memberships are held by 8,906 individuals. There are some members who hold state memberships in multiple states, which pushes the memberships up over the number of members. Moving forward, we will be focusing on the number of members (not memberships) as our key performance indicator. Of the 8,906 current members, 1,913 are renewed through 2017, which means they’ve joined recently or have already renewed their memberships.

Renewal season is in full swing. We have added a step at the front end of the process encouraging early renewal via broadcast email and an integrated social media ad campaign targeting just our renewing members. I estimate we were able to secure about 600 early renewals, which will represent a savings as we work through the steps of the renewal process.

The first printed and mailed membership renewal packets have arrived in the mailboxes of our members. The newly designed renewal package features the new logo and a redesigned renewal invoice that is cleaner and easier to read. Another new addition is a letter from our President noting the value of membership.
Business Plan - Housing Former CACMLE Education Programs with ASCLS

Introduction

Earlier this year, I was contacted by Christy Honigman, the chief staff executive at CACMLE. ASCLS and CACMLE have a long relationship that predates Christy and me in our current positions.

Over the course of the last few months, it became clear that CACMLE was struggling financially and has gone through a number of strategic discussions that included the selling off of educational assets to fund their ongoing operations. When negotiations to sell those assets failed, their board decided to dissolve the corporation at the end of July.

On Tuesday July 19th, I was contacted by Christy with the news of their dissolution and the suggestion that ASCLS would be a logical landing place for their still performing educational programs. I subsequently talked with Christie Greuser, who manages these programs for CACMLE and personally owns some of the assets through her partnership called IDC.

I had been in discussion with Christy about these programs over the last few months because they fill a gap in the ASCLS portfolio of services.

The programs themselves would take several years to build from scratch. This opportunity provides ASCLS with the capacity to leap ahead in the development of our educational programs with manageable risk and investment.

Educational Programs

The following programs are included in the transfer.

Microbiology Webinar Program: Dr. Elmer Koneman created the microbiology teleconference series 28 years ago. It was the first and continues to be the most successful and longest-running program of its kind in the country. An average of 125 clinical, research and reference labs participate monthly in the video/audio version of the webinar series – this translates into 500 - 800 microbiologists attending the live webinar. The name of the program now is “Grand Rounds in Clinical Microbiology and Infectious Disease Webinar Series.”

2016 Microbiology Webinars and Faculty

- Alice S. Weissfeld, PhD, D(ABMM): Antibiotic Stewardship: Has It Helped Lower Antimicrobial Resistance?
- Christopher D. Doern, PhD, D(ABMM): Optimizing Blood Cultures: What we know, what we don’t, and how we can do better.
- Romney M. Humphries, PhD, D(ABMM): 2016 Updates and Recommendations from the CLSI for Antimicrobial Susceptibility Testing and Reporting
- Susan E. Sharp, PhD, D(ABMM): I Feel the Need...the Need for Speed - The Clinical Impact of
- Yvette S. McCarter, PhD, D(ABMM): Rapid Molecular Detection Methods in Microbiology Testing
- Susan Novak-Weekley, PhD, D(ABMM): Practical Approaches to Lean in the Clinical Microbiology Laboratory
• James J. Dunn, PhD, D(ABMM): Combining Lean, Automation, and MALDI-TOF MS in Microbiology to Deliver Faster Answers at Less Cost, and Better Quality
• Gary Procop, MD, MS: Challenging Case Studies in Microbiology and Infectious Disease Pathology
• Paul Schreckenberger, PhD, D(ABMM): Laboratory Detection of Carbapenemase Producing Organisms (a.k.a. CRE): What Every Laboratory Should Be Doing.
• Susan E. Sharp, PhD, D(ABMM), Yvette S. McCarter, PhD, D(ABMM), and Robert Fader, PhD, D(ABMM): “Ask the Experts”

The current format is a combination of live and virtual event with the ability to download the lectures as a file after the fact. This is relatively costly, time intensive to manage, and limits the possibility of extending the product through new packaging and pricing. Delivering this program on a new, online educational platform should provide an opportunity to grow revenue and users.

There are consistently sponsors willing to underwrite these events. Nine of the 11 webinars in 2016 were underwritten.

![Webinar Gross Revenue Chart](chart.png)

**Self-Study Courses:** The CACMLE self-study program includes over 200 courses in chemistry, hematology, microbiology, blood banking, molecular diagnostics, phlebotomy, immunology and much more. Courses can be taken online, using any internet-connected computer, smartphone, or tablet. The courses are currently presented through a cloud-based learning management system (LMS) provider. The current courses sold will run out of time on the CACMLE LMS in January 2017. Any agreement to accept these programs will require ASCLS to maintain the current infrastructure until then for an approximate cost of $1,400.
Question Banks and Image Atlases: CACMLE does not own these products. They are owned by Christie Greuser and Elmer Koneman, who are the principle partners in IDC. They currently license the content to CACMLE for a royalty payment percentage of sales. In my discussions IDC is very interested in negotiating a deal for ASCLS to sell those products. Gross revenue for these programs are not available, but are generating profits.

Platforms/Systems/Resources Required

In order to take on these programs, ASCLS would need to add a new technology platform. Our current vendor for our member management system and ecommerce solutions (Naylor Solutions who provides us with Timberlake) also has an online learning suite. This cloud-based solution integrates with our existing Timberlake system through a single sign on (SSO) integration.

Path is an enterprise learning management system with authoring tools to take a variety of assets (video, audio, print) and pull them together into an online course. The tool includes testing and surveys.

While the level of integration is not optimal, the company is building a more robust program interface that could allow broader and deeper integration later with other websites like CE Organizer.

There is a onetime setup fee. Depending on the level of training needed this setup fee is between $3,500 and $5,000. There may be additional fees if the number of simultaneous users or the bandwidth exceed some generous limits. There is also a yearly maintenance fee of $2,000 and a monthly fee of $495.
Financial

Current gross revenue on all of these programs is conservatively $240,000. While I believe there is upside potential to this revenue number, for the purposes of this discussion, we should look at conservative revenue projections.

<table>
<thead>
<tr>
<th>Expense Projections</th>
<th>First Year</th>
<th>Ongoing (Annual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup Fee/Maintenance</td>
<td>$5,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>LMS Monthly Fees</td>
<td>$5,940</td>
<td>$5,940</td>
</tr>
<tr>
<td>Carry Over Costs for CACMLE</td>
<td>$1,400</td>
<td>$0</td>
</tr>
<tr>
<td>Webcast Provider</td>
<td>$6,000</td>
<td>$6,000</td>
</tr>
<tr>
<td>Royalties/Consulting/Honoraria</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total Costs</strong></td>
<td><strong>$38,340</strong></td>
</tr>
</tbody>
</table>

Net revenue using this model exceed $200,000 in the first year and more than $210,000 in subsequent years. These projections are based on conservative estimates of revenue and generous estimates of costs. These estimates do not include any growth in sales through optimization of pricing, packaging and promotion, which should eventually occur.

Challenges/Risks

This plan is not without risk or challenges, though the estimate is that are low risk or manageable to challenge. The following should be considered.

1. CACMLE’s reporting of these revenue number may be incorrect. This is unlikely as these number are congruent with the reporting on their federal tax form.
2. Demand for these products may be drifting lower or the CACME reputation may not be as strong as it seems. The feedback I’ve received from multiple members suggests this is not true.
3. Existing skills for online course development do not exist on staff. I have confidence that staff and volunteers have the passion to adopt and the capacity to learn how to use these tools.
4. Staff time is not accounted for in this model. If the revenue is as projected, we would likely need to add another staff member or contractor. The duties of this person or people are not designated at this time. It may involve a welcome realignment of duties among existing staff.

Strategic Alignment and Opportunities

Investments of attention, time and financial resources should be aligned with the pre-defined strategic direction of the organization. Education is currently one of the strategic pillars designated by the board of directors. One can imagine a number of ways a new LMS platform would facilitate achievement of the elements of that educational pillar.

There is considerable growth potential of these programs through enhanced promotion, pricing, and packaging to optimize revenue.

Finally, and perhaps of greatest importance, utilization of this new learning platform for other initiatives with only marginal additional direct costs will open up a world of possibilities. Committees could consider hybrid educational activities that combine synchronous online, asynchronous online and live
events. Without a platform, we would need to cobble together a hodgepodge of tools that would require a high level of manual intervention.

Recommendation and Request for Action

I recommend we pursue this business opportunity and ask the Board of Director authorize implementation and investment consistent with this plan.
Since my last report to the Board, the following has been accomplished:

**New items:**

- **ASCLS & the Association of Public Health Laboratories (APHL) are offering three webinar topics this Fall at a new discounted price of $99.** For more information, visit [www.ascls.org/webinars](http://www.ascls.org/webinars). Did you miss past webinars? Individual ASCLS members can purchase archived webinars as a self-study for only $25 per webinar. Or ASCLS members can purchase archived versions of each webinar as a site and have unlimited access up to 12 months after the live event. Great way to provide laboratory CE for all! ASCLS and APHL partner to bring you this webinar series.

**Update on Projects**

- **ASCLS CE** – [www.asclsce.org](http://www.asclsce.org) – We continue to add new courses to ASCLS CE. This website is a new website that offers P.A.C.E.-approved continuing education courses from a variety of continuing education providers. It affords laboratory professionals the convenience to shop for all their CE courses in one location. It also allows for immediate access to all purchased courses. ASCLS members receive discounts on courses not only by ASCLS but also some of the other CE providers. ASCLS members also have their credits from courses purchased at ASCLS CE transferred to CE Organizer and subsequently to the BOC.

- **Industry Sponsored Webcasts** – In conjunction with Dane Garvin and Global Education Group, ASCLS continues to offer three webcasts FREE:
  - Multicare Health System: Quality Urine Samples and Clinical, Process and Fiscal Outcomes
    - Speaker: Jeanette Harris MS, MSM, BS, MT(ASCP), CIC
    - Sponsor: Becton Dickinson
  - The role of HPV in cervical cancer and vaccination implications
    - Speaker: Dr. Mark Stoler
    - Sponsor: Roche Diagnostics
  - Cervical Cancer & HPV Testing: How We Got Here
    - Speakers: Erin McCarthy, BS, CT(ASCP), IAC & Michele Smith, MS, SCT(ASCP)
    - Sponsor: Roche Diagnostics

- **Medical Laboratory Professionals Week** – Once again, the theme for the 2016 celebration was *Laboratory Professionals Get Results*. ASCLS provided promotional materials and products at the MLPW webpage. Thanks to all for promoting the profession during this important week.
  - ASCLS celebrated MLPW with a social media #Lab4Life 30 Day Challenge for the month of April. We invited laboratorians to 30 days of sharing about daily life as a laboratory professional. The purpose of this challenge was to share with family and friends what it means to be a part of this profession. We received a great deal of response to each theme throughout the month.
  - MLPW store sales were down compared to last year. Gross sales for 2016 was $9960.91 (2014-$5900, 2015-$11,000). Top selling items include the poster pack, the Erlenmeyer Flask mug and the Lab Beaker mug. We continued to offer products with the MLPW 2016 logo and the #Lab4Life logo.
  - Mark you calendar for MLPW 2017 - dates are April 23-29. Visit [www.ascls.org/MLPW](http://www.ascls.org/MLPW) for information.
• **ASCLS Custom/Signature Items** – ASCLS continues to partner with the ADVANCE Healthcare Shop for an online custom store where members can purchase ASCLS NEW logo items and/or lab themed items. Also offering items with the new ASCLS logo and the #Lab4Life hashtag. Go to [http://shop.advanceweb.com/CC/MEMBERASCLS.aspx](http://shop.advanceweb.com/CC/MEMBERASCLS.aspx) to view & order.

• **Beckman Coulter Student Travel Grant** – coordinated efforts between Beckman Coulter, ASCLS, selection committee, applicants and grant recipients; view this year’s recipients at [www.ascls.org/AnnualMeeting](http://www.ascls.org/AnnualMeeting).

• **Annual Meeting Abstract Review** – coordinated the professional, graduate student and undergraduate student abstract review process. For undergraduate abstracts, we had 18 submissions with 11 being accepted for poster presentation. For the graduate student and professional abstracts, we had 36 submissions with 23 accepted for poster presentation and 5 accepted for oral presentation. Also helped to coordinate the reviewer training that preceded the review process.

• **Member Renewal Thank You** - ASCLS offered PF1, PF2 & FYP members renewed by 9/1/2015 a “thank you” gift of up to 6 free online quizzes to assist with their CE requirements. ASCLS CE materials and ADVANCE Learning Scope articles were offered.
  - Of 3647 eligible members, 33 members used the coupon code (2016-LAB4LIFE) for a 1% response rate (2015 – 7.7%; 2014 – 5.9% response; 2013-5.4% response; 2012 – 4.5% response; 2011 – 4.5% response; 2010 – 3% response).
  - A similar offer was also made available for FYP members who passed the Board of Certification exam.
  - This offer will be repeated in 2016-17 for PF1, PF2 & FYP members if renewed by 9/1/2016. Renewed members will be emailed with information after September 30th.

• **Certification Maintenance Membership** – ASCLS partnered with MediaLab, Inc. to assist members with their recertification CE requirements.
  - When members renew, or join, they are able to select a Certification Maintenance Member (CMM) and get 12 hours of P.A.C.E.® approved online continuing education for only $45 for a one year subscription that includes designated discipline hours required for the BOC’s CMP; the fee is in addition to national and state dues.
  - An upgrade to a Certification Maintenance Member Plus (CMMP) is also available to access unlimited hours of online courses with the ability to select courses for $85 plus national and state dues for a one year subscription.
  - For the 2015-16 year, 284 members ordered – 187 CMM and 97 CMMP (2014-15 year 243 ordered – 173 CMM and 70 CMMP; 2013-14 year 269 ordered – 179 CMM and 90 CMMP; 2012-13 year, 408 ordered – 262 CMM and 146 CMMP; 2011-12 year, 452 ordered – 297 CMM and 146 CMMP; 2010-11, 327 members ordered - 222 CMM and 105 CMMP)
  - As of March 2016, this offer is no longer being extended to nonmembers. This change is due to the launch of ASCLS CE. ASCLS members can purchase this package directly via ASCLS CE.
  - The offer is being repeated in 2016-17; information is available at [www.ascls.org/CMM](http://www.ascls.org/CMM).

Call for Abstracts - Clinical Laboratory Educators’ Conference (CLEC) 2017
The 33rd annual CLEC will take place February 23-25 in Boston, MA. Abstracts for poster presentations and/or technology demonstrations are being accepted online at [http://www.ascls.org/CLEC](http://www.ascls.org/CLEC). The deadline for submission of proposals is October 3, 2016.

Call for Proposals – 2017 ASCLS Annual Meeting

1861 International Drive, Suite 200, McLean, VA 22102
571.748.3770 phone; 571.354.7570 fax
Submit your idea for an educational session at the 2017 Annual Meeting by completing the online proposal form. Deadline for proposals is August 12, 2016. Visit www.ascls.org/annualmeeting for more information. The 2017 Annual Meeting will be held July 30 - August 4 in San Diego.
Staff Liaison to:
- Membership Committee; Board Orientation, P.A.C.E.® Committee, New Ideas Factory Task Force, NPNMF, and Student Forum

Ongoing activities
- Coordinate Self Studies and P.A.C.E. applications
- Regularly attend conference calls for the above named committees.
- Process state membership
- Work with Kaitlin Prindle from Neosystems with membership related topics and information
- Contacted lapsed members holding leadership positions for 2015-2016
- Work with Karrie Hovis to bring new CE opportunities to ASCLS members in collaboration with our membership partners

Membership Packages

### Basic Package Info

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Educator</th>
<th>Manager</th>
<th>PF1</th>
<th>STU</th>
<th>Total</th>
<th>Package Non-renewals</th>
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<td>61</td>
<td>2</td>
<td>191</td>
<td>1219</td>
<td>1410</td>
<td>16</td>
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<tr>
<td>2015-16</td>
<td>83</td>
<td>74</td>
<td>9</td>
<td>405</td>
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<td>1874</td>
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<tr>
<td>2016-17</td>
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<td>26</td>
<td>4</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* Currently have several outstanding invoices, complete numbers are not available.

### Package Free Meeting Registration Data

<table>
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<th>Total Free Registrations</th>
<th>Total Used</th>
<th>Used for CLEC</th>
<th>Used for AM</th>
</tr>
</thead>
<tbody>
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<td>91</td>
<td>66</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>2015-16</td>
<td>110</td>
<td>53</td>
<td>24</td>
<td>76</td>
</tr>
</tbody>
</table>

### CE Organizer
- More improvements to CE Organizer have been suggested and will occur in phases.
  - Administrative side will be overhauled to make searching and entering data easier
  - Redesign will include functionality for non-ASCLS users to use CE Organizer
  - Front end will be redesigned to be more user friendly by end users

### Other Membership Activities
Worked on new membership software implementation (Timberlake), go live was April 2016. http://members.ascls.org/
  - Issues with signing into CE Organizer occurred when we changed membership software do to the duplications of CE Organizer records our old software was creating. Many members experience difficulties during this process
Worked on new membership community software implementation (Higher Logic), go live was April 2016. http://connect.ascls.org/home.
Reviewed and modified Membership Package requirements and incentives for 2016-17 with the help of Jim Flanigan.
  - Membership Packages will be processed differently in the new system
2016-17 Renewal mailings have begun to be sent out.
  - First mailing went out in early June.
  - Second mailing will be hitting mailboxes prior to Annual Meeting.
  - Third Mailing will be sent after 8/1/16.
  - Due to a software glitch, we still are unable to add donations to the online renewal, but there is an online link to donate separately
  - Annual meeting attendees were given the option to renew when registering for the AM.
Worked with Casey’s head to develop a new membership brochure with the new logo. Brochures will be available at the annual meeting.

P.A.C.E® related activities
- Working with MediaLab, CACMLE, CE Unlimited and Karrie in CE Partnership called www.asclsce.org
- Enter monthly Learning Scope and FOCUS quizzes in online systems
- Worked with Karen Goodwin to prepare 2016 P.A.C.E® invoices, that were sent to all Annual Providers in Nov 2016. Very few payments are still outstanding
- Worked with Casey’s Head to create 2016 P.A.C.E® sticker
- Reviewed Quarterly Activity Reports as received for each Quarter
- Processed 2016 CLEC P.A.C.E®
- Worked with Karrie Hovis and LaRue of Dane Garvin on webcasts for BD and Roche

NPNMF and Students
- Worked closely with members of the NPNMF to launch the virtual 5K
  - www.labweekrun.org

See the specific committee reports for other specific committee updates.
REGION I

AMERICAN SOCIETY FOR CLINICAL LABORATORY SCIENCE

Central New England  Connecticut  Maine  New York  Vermont

Report to: ASCLS Board of Directors
Report of: Director, Region I
Submitted for: ASCLS Annual Board of Director’s Meeting
Submitted by: Maddie Josephs, Director
Date: June 26, 2016

ACTIVITIES OF REGION I DIRECTOR:

- Corresponded with Region I Council
- Participated in Interim Board of Directors Meeting and Legislative Symposium
- Served as General Chairperson for the CNE Annual Convention, held from April 26-28, 2016
- Worked on CNE Website upgrade
- Submitted article for ASCLS Today (March 2016 and May 2016)
- Participated in Executive Committee Conference Calls
- Communicated with Leadership Development chairs in CNE and NY
- Communicated (ongoing) with CT membership to facilitate nominations and elections
- Met with some VT members and communicated electronically with VT membership to facilitate a merger with CNE. (ongoing-financial concerns being addressed)
- Attended NY State Spring Board meeting
Attended NY State Spring Meeting at St. John’s University in Queens, NY. Presented an ASCLS update

Attended hearings at RI State House and testified before House and Senate Committees to Re-instate RI Professional License for Medical Laboratory Scientists. Wrote several letters to legislature in support.

Appointed Region I Membership, Leadership Development and PAC Board Members (2016-2017)

Serving as CLEC Co-Chair for 2017 in Boston. Communicated with Program Committee to review proposals.

CONSTITUENT SOCIETY SUMMARY REPORTS

Central New England- Brandon Healy, President

Activities

Filled the two open director positions, our secretary and treasurer are both on for their second terms, and our new student president seems very eager to begin her role

Appointed FYP member for 2016 ASCLS AM in Philadelphia

Taskforce was created and is keeping a close watch on the progress of the Rhode Island Licensure bill, which has been resubmitted

Kyle Braga and Theresa Castellone took over the updating of the bylaws and have updated them to meet our current rule of order

Theresa Castellone was awarded ASCLS-CNE Member of the Year

Convene a task force to review current leadership development activities within ASCLS: CNE and recommend potential mechanisms for improvement

Budget has been updated and is ready for 2017

Concerns

A bill has been reintroduced to the Rhode Island Legislature, to reinstate the licensure for Medical Laboratory professionals.

A bill is in committee of the Massachusetts Legislature, to create a license for Medical Laboratory Professionals. This bill seems to have died in committee. We
will work with the bill’s author to try to edit and reintroduce a new bill to Massachusetts Congress

**Request for Action**
None at this time

**New York-Tess Smith, President**

**Activities**

- Attended Region I meeting and board meeting in November 2015
- Assisted Membership Chair with Distributing welcome packets
- Answered questions that were sent through the new websites “contact us” page
- Attended National Meeting in Atlanta, GA
- Distributed bench noted Fall 2015 edition
- 14 ASCLS-NY members participated in Quinn Madeline Charity Walk/Run
- Met with student members at Stony Brook University for Meet and Greet
- Purchased two ASCLS-NY table runners and
- Submitted names for Keys to the Future
- Submitted name for Life Time Achievement Award
- Attended 1199 meeting to discuss ASCLS-NY support of licensure
- Raised money at state meeting for PAC through sale of items donated by student members
- Held Spring State Seminar at St. John’s University on June 10th, 2016
- Assist with updating website as needed
- Continue to recruit and retain members
- Propose committee to revise Handbook
- Explore options for 2017 State Seminar

**Concerns**

None at this time
Request for Action

None at this time

Maine- Carrie Wentworth

- No report

Connecticut-

- Working to identify slate of officers

Vermont-

- No report
To: ASCLS Board of Directors  
From: Director- Region II  
RE: 2016 Annual Board of Director Meeting  
Prepared By: Nadine Fydryszewski, Region II Director  
Date: June 30, 2016

Activities of the Region Director (March – June 2016):

- Communicated regularly with the Region II Council and responded to ASCLS requests for information and/or electronic votes
- Moderated Region II Conference Call Meetings: March 29, May 17, June 28
- Solicited for volunteers to serve in Region II Leadership positions for 2016-2017.
- Drafted 2016-2017 Region II Budget in consultation with the Region II Treasurer
- March 9 - participated in ASCLS- NJ Board Meeting
- March 11 - participated in ASCLS Finance Committee Meeting, Alexandria, VA
- March 12-13 – ASCLS Interim Board Meeting & Planning Day, Alexandria, VA
- March 14-15- attended Legislative Symposium, Alexandria VA & Washington, DC
- March 21 – communicated information to Region II about the ASCLS Lab Week Run
- April 5 – participated in Policy & Procedure Committee meeting (conference call) provided feedback written and on social media policy; drafted written policy for dues/inactive state issues.
- April 14 - attended ASCLS-NJ Annual Spring Seminar and Expo
- April 22 – participated in Policy & Procedure Committee meeting (conference call) provided feedback oral and written on dues/inactive state issues.
- April 27 - participated in NP/NM conference call and agreed to be a judge for the Travel Grant
- May 2 - participated in Policy & Procedure Committee meeting (conference call) provided feedback oral and written on social media policy
- May 5 - participated in ASCLS Board of Director meeting (conference call)
• June - compiled draft of 2016-2017 Region II Leadership Council Roster
• June 29 – participated in NP/NM conference call meeting.

STATE REPORTS:

Delaware – Mary Ann McLane, President
Goals: Provide P.A.C.E.-approved continuing education events for lab professionals in tri-state area; Create and/or participate in “Provide the Face” opportunities and publicize these; Increase society membership by 10%; Communicate with members (and non-members) through ASCLS-DE listserv, Facebook, website at least once every week and through seasonal newsletters; Increase involvement and activities for southern DE.
Activities to date: Participation in the monthly Region II conference calls; Board meetings 3/4/16, 4/7/16; Seventeen (17) “from the ASCLS-DE President” notices sent out on the following: “Save the date” for dinner meeting schedules, Con ed opportunities, webcasts, Employment position alerts, Announcements of family illnesses, deaths within ASCLS-DE and nationally, ASCLS committee service opportunities, Opportunities to participate in University of Delaware research, Annual meeting travel grant for New Professionals, ASCLS-PA annual student BOC review session; Spring dinner meeting, April 26 in collaboration with the Histotechnology Society of Delaware: Mary Ann McLane “Preeclampsia, eclampsia and other hypertensive disorders of pregnancy”; Submitted nominations for Keys to the Future; Kathy Gibney organized the signing of a governor’s proclamation for MLPW, and a state senate resolution, through the efforts of Bethany Hall-Long, DE state senator. Kathy and Mary Ann McLane, plus representatives from the Delaware Public Health Lab, attended the April 20th event in Legislative Hall in Dover. Copies of the proclamation were delivered to the MLT program in Delaware Technical Community College in Georgetown, to the DPHL, Christiana Care Medical Center and to the University of Delaware; Provided a $25 gift card for a MLPW treat for the MLT faculty and staff at Delaware Technical Community College; Participated in the #Lab4Life Challenge during April. The spirit was willing but the feet and schedule were weak for participating in the LabWeekRun; Mary Ann McLane coordinated the first-ever joint booth at the 4th USA Science & Engineering Festival in Washington DC, April 14-17, with AACC and ASCP joining ASCLS in a single booth to provide the face of OUR way of doing science to an estimated 600 participants of all ages. Thirteen (13) volunteers (mostly from Region II) helped over the 4 days. Alexa Pierce-Matlack, Jessica Breslin and Mary Ann McLane participated in a blood screening event for about 100 participants at Bethel AME Church in Wilmington, May 29. Raelene Maser and Mary Ann McLane provided chem/UA/heme review at the June 4th ASCLS-PA BOC review session to about 60 students. Sponsoring a contest connected with renewal of ASCLS membership, with the prize being a free registration for one of our 2016-17 dinner meetings. Gave an extra chance for anyone switching from “student” to “FYP”. Winner to be announced in the fall. Continuing to investigate Project C.U.R.E., a hospital-supply worldwide charity, for our possible role in helping to sort and evaluating lab instrumentation which gets donated. Acknowledging Elissa Passiment’s service as she retired on June 8.
Upcoming Activities: Monthly board meetings; Providing service June 23 and July 8 at the Food Bank of Delaware for their Summer Nutrition program; Summer Sunset Cruise, Bowers Beach DE, June 24 and July 29, benefiting the Food Bank of DE; Attending the ASCLS annual meeting.
Maryland – Stacey Robinson, President

**Goals:** Provide 3 PACE-approved CE events for professionals and students in MD; Reinstate the tax exempt status for ASCLS-MD by obtaining a new tax ID under the current name. (Maryland has not had tax exempt status since 1981); Communicate with ASCLS-MD membership at least quarterly through an e-newsletter; Stabilize, and if possible, increase ASCLS-MD membership; Increase active involvement among the membership including leadership positions; Continue to collaborate with other organizations in the state, such as AMT, and also neighboring ASCLS constituent societies.

**Activities to date:** On May 30th we held our final Board meeting prior to the Annual Meeting in Philadelphia. President, secretary, treasurer, and one of our board members were in attendance. A 2nd board member sent a response to all of the agenda items prior to the meeting. Delegates were selected, we will have President, President-Elect proxy, plus our two additional delegate positions filled. The President, Past-President/Secretary, and Treasurer will remain in their positions for next year. Diane Davis and Christina Camillo will remain as Board Members and Eric Hirtle has agreed to serve as our student member. We have begun planning on a CE Event in Arnold, MD at Anne Arundel Community College this September. Diane Davis has offered to speak about a point-of-care related research project.

New Jersey – Lou Ann Visotcky, President Report prepared in collaboration with Cynthia Dixey, Past President

**Goals:** Increase membership by 10% (~15 new members) and students by 10%, increase retention rates by 5% among students becoming FYP; maintain a qualified and informed medical laboratory science workforce by providing continuing education and legislation updates; provide CE opportunities; provide members with current legislative information affecting the profession; Increase public awareness of the medical laboratory science profession

**Activities to date:** Two members attended the 2016 Legislative Day in Washington DC: Lucia Wang and Mary Kay O’Connor. Mailed out post cards for the Spring Seminar. The ASCLS-NJ 2016 House of Delegates Meeting and the Spring Seminar and Expo, Back to the Future of the Laboratory, was held at the Hotel Somerset-Bridgewater in Somerset, New Jersey on Thursday, April 14, 2016. Christopher Rinn, Assistant Commissioner of the Division of Public Health, Infrastructure, Laboratories, and Emergency Preparedness, to presented the Governor’s Proclamation for Medical Laboratory Professionals’ Week. There were 155 registrants, 2 keynote sessions, morning and closing, 12 sessions with 13 speakers, and 19 vendors. Awards (To be recognized in the upcoming issue of The Analyzer) Student Scholarships: 2- $1000 MLS Scholarships, 2- $500 MLT Scholarships, No Graduate Student Scholarship. 2- Key to the Future Awards Omicron Sigma 2-Educators of the Year and 1-Laboratorian of the Year T-shirt design contest winner. Raised $934 for the Children’s Miracle Network through student organized tricky tray. Three members of ASCLS-NJ attended the 4th USA Science & Engineering Festival in Washington DC on Saturday, April 16, 2016: Lucia Wang, Sally Cortez, and Cynthia Dixey MLS and MLT students attended The Today Show in NYC on Thursday, April 28th supporting the profession with signs and t-shirts. Survey set to ASCLS-NJ 2016 Spring Seminar and Expo registrants through Survey Monkey. Confirmed date for Fall 2016 House of Delegates and Seminar: Thursday, October 13, 2016 at Rutgers-SHRP on the Scotch Plains campus. This event will include dinner and 2-1 hour lectures. Ortho Clinical Diagnostics has verbally agreed to provide speakers. Theme, topics, and speakers have not yet been confirmed. Confirmed date for the ASCLS-NJ Spring Seminar and Expo: April 20, 2017. This will be the same venue as 2016, but the name will be changed to the Crowne Plaza Somerset-Bridgewater.

**Planned and Ongoing Activities:** Board Meetings are scheduled for the first Wednesday of every month. The locations have not been established yet by President-Elect Carolina Vilchez. The Leadership Meeting will take place on June 25, 2016 from 9:30 AM- 1:00 PM at the
residence of Debbie Josko. The 2016-2017 Strategic Plan and Schedule of Events will be discussed. There will be no June board meeting. The spring/summer edition of The Analyzer will be released in June 2016 and will include the Leadership Meeting. We are in the process of finalizing the delegates who will be attending the 2016 ASCLS Annual Meeting in Philadelphia. Continue with student fundraisers such as the Yankee Candle Holiday Fundraiser. ASCLS-NJ Members are scheduled at Rutgers-SHRP on 6/22/16 and tentatively scheduled at Kean to introduce MLS and MLT students to ASCLS and the profession during the start of their programs instead of waiting until the Fall Student Forum in October. Looking for members to serve on the following committees: Leadership Development Chair and members, Marketing and Public Relations Committee Chair, Social Networking Committee

Pennsylvania – Jean Buchenhorst, President

Goals for year: Re-establish one two more Regional chapters- Erie, Pittsburgh, NE PA; Publish 4 issues of the PA Newsletter; Revise Bylaws and SOPs; Host Quarterly Board Meetings; Increase Membership through Recruitment of New Members and Retention of Lapsed Members

Activities to Date: The 2016 Annual Spring Meeting and Exhibits was held April 12-13, 2016 in Harrisburg, PA, the Meeting was well attended; Lack of vendors (only five), did have member table (signed up four new members); Philadelphia Science Fair Booth successful—many visitors; Student Review session a success—60 attendees! Many positive comments; ASCLS-PA Education Scientific Assembly meeting held at Reading Area Community College, increased number of attendees (call in number provided); -T shirt sale ongoing—will have table next to host liaison at Annual meeting; PA chapter discussed a Doodle list to sign up volunteers at host liaison table; Fall, winter and spring newsletters published, working on summer edition; Elections were held, Jean Buchenhorst will again be President, Ann Spjut President elect, Mike Osborn Past-president, Travis Bicher Secretary, Marianne Downes Board of Directors; Awards – Four Key to the Future awards were given, five Keener Memorial Service Awards, one Corporate Recognition award, one Undergraduate Scholarship and one Estolle Gross Award

Virginia – Natalie Case, President

Goals: Establish new leadership; resolve transfer of financial documents and open accounts at a new bank, explore strategies to revitalize membership and activities.

Activities to date: Annual meeting was held on June 3, 2016 - 2 vendors (Sebia and Ortho), 42 attendees between the meeting and student quiz bowl, 12 students for student quiz bowl; VA purchased mugs with our ASCLS-VA design to sell as fundraiser, mugs were sold at annual meeting, mugs will also be sold online through our website soon; VA has 3 delegates going to the national meeting so far; All Board positions and committee positions are vacant - our state student representative resigned in the early spring, our state treasurer and secretary are moving out of the state and therefore resigning at the end of the summer.

West Virginia – Pamela Meadows, President

Goals: Conduct at least quarterly Board of Director meetings (telephone conference); Create a “Provide the Face” project for the Annual Meeting in Charleston and get some publicity for Laboratory Professionals; Increase membership by 50% by June 2015; Continue to review the use of the Facebook page and its value; Establish an online quarterly newsletter to be sent to members; Recruit more clinical professionals and FYNP into the society dominated by educators; Establish online methods for registration and payment for next year’s annual meeting.

Activities to date: WVSCLS elections have been conducted and all officer positions filled, with exception of Pres-Elect.
Planning is underway to contact hospitals and program directors to promote institutional packages for membership. Potential new professional and student representatives are in the process of being identified. Planning is currently underway for annual joint fall meeting/conference with WVCLMA. Speakers have been identified and scheduling is in preliminary stages. WVSCLS president is in discussion with WV Office of Lab Services (WVOLS) concerning inconsistencies and need for revision of state licensure guidelines. WVOLS is working with their lawyer regarding legislative review. A committee will be formed to review current licensure and identify areas for revision. Spring WV BOD conference call was held on May 26, 2016.

**Planned and Ongoing Activities:** The 19th Annual WVSCLS/WVCLMA Joint Meeting is scheduled for October 13-14, 2016.

**Capital Area – Carol Rentas, President**

The Capital Area Society has formed a reactivation committee which has been working on the activities listed below. We expect to move forward at a more accelerated rate now that we have additional prospective members working on the various areas of operation and concern. Initial Governance Structure: President: Carol Rentas (carentas@gwu.edu), President Elect: Marcia Firmani (firmanim@gwu.edu), Treasurer: Nurcan Basar: (nurcan@gwu.edu), Secretary: Cliff Cymrot: (cliffcymrot@gwu.edu), Society Advisor: Leon Headley (leonhead8@gmail.com). Capital Area Recruitment - We are gathering initial group members (5 - 10) in the next few weeks and will send an initial member roster (to include names and contact information) to National office and Region II office to add to regional mailing list. Initial Tasks: Bylaws - we have obtained a relatively current example of a state and should have the initial draft completed for review by July 1st. SOP – we have also obtained an excellent example of a state society SOP which were are using to draft our SOP; also to be completed by July 1st. Tax documents - we are locating the previous tax documentation. Funding – we are working on determining any previous funds available. Membership – we have been informally recruiting through word-of-mouth and will soon send out invitations via previous Capital Area rosters. Dues – we have informally discussed a pricing structure in which, during the initial reactivation of the society, there would be no fee for new members to encourage new membership and build our rosters. Society Community - an ASCLS community was set up to continue the reactivation efforts between scheduled meetings. Society Website - a Capital Area Society website is being developed to be launched directly after reactivation. Meetings - Ad Hoc meetings: the president and president elect have been meeting informally over the last months to review documents and move the reactivation forward expeditiously. Society Leadership meeting: was held with the full group on June 14th. Society meeting schedule: the first meeting of the full group will be in July. Although the society has not been yet reinstated, there has been some interest from local MLTs and MLS and this meeting will serve to update these prospective society members on the progress of reactivation. No specific concerns during the reporting period; however, we are certain there will be moving forward and will reach out to the Region II Director and ASCLS Executive Vice President for advice and direction. In addition, we appreciate the continued support from the Board of Directors as we move forward in earnest with a goal of Capital Area society reactivation this summer.

**CONCERNS:**

**MD:** We have a few concerns relating to the membership packages for academic institutions.

- Cost went up significantly.
• Membership expires July 1 annually. If Juniors don't start until Sept, their preferred contact information will not be available before then. Only the university e-mail is available and not a more permanent personal e-mail or address. This is an issue because the whole thing is going in as a block, so this year getting the free registration for the annual meeting is particularly awkward.
• New method = give me a code, tell everyone to go on-line to register and then I get billed. Code expires in two weeks. During school year I can pull this off, but not summer. Students can't be counted on to read email in summer. Going forward, I can get incoming seniors and the faculty in spring before they leave, but probably just won't pay for the juniors to be members.

VA: Each state has a different way of communicating with their constituents. Emailing is an easy way to communicate, however, the state is responsible for maintaining a current email list and using their own purchased list serve or email account. Is it possible for the state to have access to a real time email list serve to make sure that all member information is up to date? Currently VA uses a gmail account for email correspondence, but there are some member email providers that block gmail account emails.

NJ: Working with accountant and Treasurer to see if we are eligible to apply for ST-5.

DE: None different from what we’ve mentioned before (membership, webpage…)

REQUEST FOR ACTION: None
Activities of the Region Director:

- Participated in Region III Council conference calls.
- Participated in 3 Region III triennial meeting planning conference calls.
- Serve as organizer for the region III triennial meeting and chair of the planning committee.
- Participated in Board conference calls as needed.
- Participated in awards committee conference calls, as available.
- Participated in appointments committee conference calls, as available.
- Participated in diversity advisory council conference calls, as available.
- Submitted an ASCLSToday newsletter article about diversification of the healthcare workforce.
- Attended the Mississippi/Louisiana bi-state meeting.
- Had separate calls with Florida to discuss leadership issues.
- Has separate calls with NC leadership regarding state of the NC society.
- Attended the NC board meeting to discuss sustainability in leadership and the organization.

State Reports:

**Alabama**: Tera Webb, President
The Alabama society continues to increase their virtual presence through the website and other social media. Alabama has been instrumental in organizing, planning, and developing the Region III triennial meeting to be hosted in Birmingham, Alabama. The society has also been active in reaching out to institutions to encourage institutional memberships.

*No issues reported; no request for action requested.*

**Florida**: Michael Bishop, President
Florida has delivered a successful spring symposium and has looked into partnering with an organization for funds to support education throughout the state of Florida. Florida is working on leadership development within the state to help with sustainability of leadership within the state.

*No issues reported; no request for action.*
**Georgia:** Lacey Campbell, President
The Georgia society held a very successful spring meeting in Gwinnett, GA and continues to update their state website (http://www.asclsga.org/), is investigating how to best use social media and continues to make major contributions to the re-write and reformatting of their bylaws.

**No issues reported; no request for action.**

**Mississippi:** Sabrina Bryant
The Mississippi leadership held a successful Bi-State Annual Meeting at the Lake Terrace Convention Center in Hattiesburg, MS. Louisiana continues to struggle with low membership numbers, lack of volunteers for leadership positions, and use of recycled leadership.

**Issues:** Low membership numbers, lack of volunteers for leadership positions, and use of recycled leadership remain as problems; issues with volunteers (not following through, volunteers limited to their geographic area, and lack of response to email blasts); financial reserves are dropping so attendance at meetings requiring expensive travel and hotel stays has been limited.

**No request for action.**

**North Carolina:** Eric Stanford, President
ASCLS-NC was not able to deliver their SP spring meeting (Carolinas Clinical Connection) due to lack of resources and participation from Vendors and Speakers. A few members from North Carolina contacted me in the spring about viability of the society moving forward. This prompted an emergency board meeting and I attended that board meeting (with Barbara Snyderman) to support the society moving forward. From that emergency meeting a new slate of leadership was identified and they are ready to move the society forward.

**No issues reported; no request for action requested.**

**South Carolina:** Fred Hornick, President
The South Carolina society has been inactive for the year. I had a conversation with Fred about this and will be working with him on identifying leadership in the future.

**Tennessee:** John Bandura, President
Tennessee had a successful spring meeting and has been trying to get more members involved with moving that society forward.

**Concerns:** Issues per state are listed above

**Requests for Action:** None
Activities of the Regional Director since March to August 2016

- Communicated promptly to State Presidents all ASCLS matters and requests for action or participation
- Continue to resolve issues and respond to questions from state presidents, committee chairs and taskforce members
- Participated and commented on ASCLS issues and question circularized to Board of Directors via email
- Participated in March 11-13, 2016 ASCLS Interim Board of Director’s Meeting in Washington, DC.
- Participated in March 14-15, 2016 Legislative Symposium in Washington, DC
- Submitted Regional nominees for Omicron Sigma award.
- Communicated with State Presidents to submit Omicron Sigma award nominations to ASCLS Awards committee.
- Communicated with State Presidents to submit award nominations to ASCLS Awards committee by deadline, i.e. Keys to Future, Lifetime Achievement Award, etc.
- Prepared and submitted ASCLS Today article
- Attended ASCLS-Michigan Annual Spring Convention at Michigan State University, Kellogg Center, East Lansing, MI March 29- April 1, 2016.
- Attended April 29, 2016- ASCLS-MI Board of Directors meeting, served as Bylaws chair and Parliamentarian. Provided ASCLS Update at Board meeting.
- Attended ASCLS Membership meeting, April 30, 2016. Served as Parliamentarian and provided ASCLS Update.
- Presented information about the establishment of the Region IV Leadership Academy and provided application forms at Michigan’s Membership table.
- Presented hematology lecture “Leukemia Case Studies,” March 30, 2016
- Attended the ASCLS-OH 2016 Annual Meeting, the Collaborative Laboratory Conference in Columbus, OH, April 13-15, 2016
- Attended ASCLS-OH Board of Director’s meeting and presented ASCLS Update to board, April 13, 2016, Columbus, OH.
- Presented “Getting the Lead Out- Flint’s Dilemma” April 14, 2016
- Attended ASCLS-OH Membership meeting, April 14, 2016. Presented ASCLS Update to membership.
• Presented information about the establishment of the Region IV Leadership Academy and provided application forms at Ohio’s Membership table.
• Participated in ASCLS Spring BOD Conference Call
• Will attend 2016 ASCLS Annual meeting in Philadelphia, PA July 30 – August 5, 2016
• Have mentored students and new professionals about the society and addressed questions and issues when presented.

Committee Assignments:
• Served as Board liaison for Promotion of the Professions Committee and participated in monthly teleconferences
• Served on Long Range Planning Committee for ASCLS.
• Serving on Finance Committee reviewing finance reports submitted to committee

Region IV Leadership Academy
• Conducted Region IV Leadership Academy meetings Teleconferences
• Developed Leadership Academy applications that were distributed at ASCLS-MI and ASCLS-OH. Packets submitted to Presidents of Kentucky Society and ASCLS-IN for distribution to membership.
• Appointed Lynne Williams, Region IV Leadership Academy Chair
• Working to finalize Leadership Academy curriculum

ASCLS-MI Activities:
• Developed Strategic Plan/Goals for year:
  o Membership Recruitment
    • Membership Booth (Spring Meeting)
    • Welcome Letters
    • Keep contact with programs to recruit students
    • Invite guests to BOD meetings, all events
  o Membership Retention
    • Stay on top of lapsed member lists
    • Use social media
    • Continue planning unique CEU/social events
      • Plan at least one per district during the year
    • Brainstorm how to convert Students to FYP’s and FYP’s to PFI/PFII
  o Promotion of the profession
    • Do at least 3 visits during the year; can be to colleges, high schools, career fairs, etc.
  o Advocacy for the Profession
    • Attend Michigan Legislative Symposium and National Leg. Day
• Discussed (with Michigan BOD) plan for Membership Recruitment/Retention and contacting lapsed members as requested by national:
  Use lapsed membership list provided by national and reach out to those members to see if we can get them to renew. Start by distributing list amongst BOD members and contact those we know personally and communicate results to membership chair. After that, begin contacting lapsed members individually via email. We also explored the idea of a social media campaign.

• Preparing to hold 2016 Election for ASCLS-MI Board positions
• Getting ready for Legislative Symposium; sending 7 representatives from Michigan
• Spring Meeting is March 30-April 1, 2016; planning committee is making all final arrangements and registration has opened
• Held successful spring meeting at Kellogg Center in East Lansing, MI. Included general membership and Board of Directors meetings, Student Silent Auction, 65 educational sessions, 25 vendors and awards ceremony
• Preparing for national meeting; Michigan is proud to be sending 10 delegates
• Planning committee for 2017 spring meeting has been recruited and begun communicating

Requests for Action: None at this time

ASCLS-OH - Melanie Giusti, President
Summary of Activities:
• Attended Legislative Symposium in March (Washington, DC)
• Attended 2016 Ohio Collaborative Laboratory Conference in April (Columbus, OH)
• Attending 2016 ASCLS Annual Meeting (Philadelphia, PA)

Board Meeting:
• The ASCLS-Ohio Board of Directors met on April 13, 2016.
• Updated board members as to the status of financial affairs post-replacement of Treasurer. Discussed missing funds and efforts to recover funds.
• Committee updates were provided including scholarship and annual meeting.
• Open positions for the 2016-2017 board were discussed.

Annual Meeting
• Member Business Meeting was held on April 15, 2016, at which new board Members were elected.
• Raised over $700 for Juvenile Diabetes Research Fund via fundraising efforts.

Goals and Priorities:
• Primary focus will be on membership growth, retention, recruitment and involvement through enhanced communication (newsletter, website, emails,
social media, etc.). Increase board communication via more frequent meeting and/or conference calls.
• Pursue offering CEU for members with social activities, such as Brew & CEU.
• Work with National Office on consequences of previous treasurer's actions.

**Key Accomplishments and “Works In Progress”:**

• Membership Development and Retention – An ongoing goal of ASCLS-Ohio is to develop and retain members. Website has been revised to be more attractive and user-friendly for members.
• Committee members – Actively recruiting members to serve on committees and become more involved in the society. One goal is to help develop leadership skills through serving on committees, in the hopes of retaining members and increase potential leaders for the society.
• Legislative Symposium: sent 7 members to this year’s symposium, including five students and two new professionals. Provided some financial support for these attendees.

**Recommendations:** None
**Items for Discussion:** None.
**Request for Action:** None.

**ASCLS-IN - Nicholas Brehl, President**

• ASCLS-IN Bylaws Committee
  o The bylaws committee has sent the updated by-laws to general membership for comment. No comments have been received. There will be a vote on by-laws at upcoming meeting.

• ASCLS-IN State Meeting Committee
  o We’ve hired a new event planner for our annual meeting. We have reserved the IUPUI Campus Center for Thursday March, 30 2017 as the venue. We already have a full list of committed speakers. There will be a networking event/job fair the night before the annual meeting at Sun King Brewery. Save The Date postcards will be mailed in the next few weeks. The website is already fully functional.
  o CLMA-IN is not officially collaborating with us in 2017 partially due to low membership and participation in their organization.

• ASCLS-IN Networking Event
  o Our networking event was once again a successful endeavor for Indiana employers and students. We had a similar attendance as last year which we are content with. However, we aspire to attract more students and managers next year by having the event associated with the Annual Meeting.

• ASCLS-IN Scholarship Committee
  o The Scholarship Committee has selected the four recipients for our scholarships.
Due to financial hardships, the scholarship committee has decided to only award 2 scholarships in future years.

- Changes in the Board
  - Jessica Grasso and Lauren Lalioff are sharing the position of Student Forum Chair. There has been no negative impact from sharing this position. New chairs will be selected in the Fall of 2016 when new students arrive.

Request for action: None

Kentucky Society of Clinical Laboratory Science (KSCLS) - Jane Eubanks

KSCLS Activity:

KSCLS held its Spring Board meeting on April 9, 2016 in Richmond, Ky. The spring board meeting consisted of routine reports, updates regarding the 2016 KSCLS annual meeting and a brief discussion regarding the 2016 annual meeting. The fall meeting was discussed regarding date, speakers, vendor contributions and location. It will be at IWU campus in October during the Fall Keeneland Meet.

The Spring General Membership meeting was held during the Kentucky Laboratory Professionals Day. The general membership meeting consisted of approving the 2016-20167 budget, installation of new board members, presentation of state awards, routine reports, and selection of delegates.

Areas of Concern:
None.

Request for action:
None.
Regional Director Activities since March 2015

- Participated in Long Term Planning meeting conference calls.
- Completing committee charges as assigned.
- Participated in PACE conference calls.
- Reviewed materials provided by Leadership Academy.
- Attended the ASCLS Interim Board Meeting.
- Attended the ASCLS Legislative Symposium
- Participated in the DCLS Oversight Meeting at CLEC, and additional Conference Calls
- Participated in Code of Ethics Task Force Conference calls.
- Region V Activities:
  - Attended ASCLS-SD Meeting, presented educational session.
  - Held Region V President’s Council meeting May 2016
  - Submitted article for State newsletters as requested.
  - Participated in all Region V Leadership Academy planning meetings.
  - Participated in Region V Symposium conference calls.
  - Completed formal audit of Treasury; all treasurer forms and balance sheet updated with secretary treasurer based on recommendations from audit committee
  - Updated Region V SOP, approved by the Presidents Council.
  - Maintain New Region V Website (website averages approximately 200 hits per week, with up to 115 different individuals accessing the information)
  - Assisted the Region V Leadership Academy with their web blog, publishing page and trouble shooting
  - Completing contract negotiation for 2017 Region V meeting, to be held in Sioux Falls SD October 2017.
  - Region V Membership Highlights: ASCLS-WI posted the highest membership for all states as of April 2016; ASCLS-SD has had the highest increase in the states membership the past two consecutive years 2015, 2016 resulting in an increase in national delegates.

ASCLS-MN: Jeff Radle, President
Activities
The ASCLS-MN Constituent Society had its Winter Board meeting on February 20, 2016.
- Update was given on the progress of the Clinical Laboratory Collaborative meeting planning – meeting will be held on April 25th – 27th at the Earle Brown Heritage Center in Brooklyn Park, MN; vendor exhibits will be open on April 26th & 27th; program grid has been finalized. Tuesday, April 26th will be Student Day; a silent auction will held once again with all proceeds going towards the ASCLS-MN Scholarship Fund. This year’s charity partner will be Community Emergencies Assistance Programs – this non-profit agency’s mission is to help families, in all life stages, gain stability and maximize their ability to live independently and
with dignity. We are looking to name the ASCLS-MN co-chair for the 2017 Clinical Laboratory Collaborative meeting in Duluth on May 3-5, 2017.

- Seven members from Minnesota will be attending the 2016 Legislative Symposium.
- Will be looking for nominations for next year’s open board positions – elections will be held at membership meeting on April 27th at the Clinical Laboratory Collaborative.
- Membership Committee reviewed membership numbers which currently stands at 410; Minnesota currently has 158 student members – board discussed the need to convert these members to First Year Professionals; one area of focus will be publicizing the fact that ASCLS will provide one year of membership upon passing BOC certification exam.
- New ASCLS logo was shared with the board.
- Discussed creating a tool kit for new Area Directors; looking to schedule some time at CLC meeting in April for newly elected Area Directors to get together to kit off the year.
- Area Directors and Student Forum Chair reviewed activities from the fall and discussed plans for the spring.
- Reviewed the updated Region V website – discussed the possibility of using the same program to update ASCLS-MN website.

**CONCERNS:** None

**REQUESTS FOR ACTION:** None

Respectfully Submitted: Jeff Radle; ASCLS-MN President

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**ASCLS-ND: Nicole Lemieux, President**

**Activities:**
- North Dakota held their Spring Board Meeting in person in Bismarck, ND May 13th and held their Business meeting that evening open to all members. Bylaw changes were voted on by members and passed. New board members were also voted on.
- The ND Spring Meeting was held May 13-15 in Bismarck, ND. Over 200 attended. The State Agriculture Commissioner was a keynote speaker.
- At the Spring meeting, student scholarships were awarded to 4 North Dakota students, two members were awarded Keys to the Future, eight members were awarded state Omicron Sigma awards, and members were celebrated by membership awards from 5 to 40 years.
- ASCLS ND sponsored 6 awards at the ND State Science and Engineering Fair in April.
- Sharon Reistad and Amanda Schenk represented North Dakota at the Legislative Symposium.
- Brooke Solberg, Shannon Jongeward, and Mary Coleman are the 2017 Spring Meeting Chairs. The meeting will be held next April in Grand Forks, ND. The committee has already began planning.
- Five delegates have been elected to attend the Annual Meeting in Philadelphia.

**CONCERNS:** None

**REQUESTS FOR ACTION:** None
Respectfully Submitted: Stacie Lansink, ASCLS-SD President

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ASCLS-SD: Stacie Lansink, President
Activities:
The ASCLS-SD Constituent Society has had three official Board of Directors conference calls since the last board report.

- Spring one day meeting was held in Deadwood, SD and new officers were elected.
- Jennifer Keimig will chair the two day spring meeting in Mitchell, SD in 2017. Some discussion was held about attendance at the spring meeting and the goal is with moving the fall two day meeting to the spring two day meeting is that there will be more attendance and better turn out to vote for new officers.
- GAC/PAC- Pam Kieffer has distributed some information from the Region V GAC and PAC Shirley Heber and Lori Murray. Region V received 2nd place for the money that we have raised, SD has raised about $700
- Membership- Jeff Kistler, membership chair has been working to keep the membership updated and will has been working to contact lapse members. ASCLS-SD has about 180 members currently.
- Student/New Professional Committee- Kay Rasmussen has revised the Travel Grant to determine what fundraising will go toward scholarships and the travel grant funds.
- Leadership Development- Brendon Sato, reported that the Region V Leadership Academy had their retreat and things went well. The committee is currently reviewing applicants for the coming year. Still looking to replace Carmelle Miller’s vacancy on the Leadership Academy committee.
- Promotion of the Profession – Brett Sherrill reported that a Facebook page is ready and will be sending out invitations to the board shortly.
- Publications- Stacie Lansink currently works on the newsletter and Lezlee Koch currently updates the website.
- Renee Rydell, PACE coordinator for SD has requested the board address updating the PACE forms so that they are more user friendly. The board has approved the updates.
- Kay Rasmussen, President Elect, has resigned her board position as she will be leaving the state in a few weeks. The board is actively looking into her replacement. Brendon Sato has agreed to move up into the President Elect position and the board will look to fill the President Elect-Elect position.
- Brendon Sato, is currently reviewing options for the state meeting to use an online registration to possibly have more participants at the state meetings.

- CONCERNS: None
- REQUESTS FOR ACTION: None

Respectfully Submitted: Stacie Lansink; ASCLS-SD President

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Activities:
The ASCLS-WI Constituent Society had its 3rd and 4th Board meetings on February 13th, 2016 and April 14th, 2016, respectively.

- Our spring meeting was held April 13-14 in LaCrosse, WI. The meeting was a great success with 409 attendees and a successful student bowl and poster session.
- Our new state President was installed at our business meeting on April 14th, 2016. We also have a full ballot for our other open positions.
- We will have a delegation of 7 members for the National meeting in Philadelphia. These members were also selected at our April 14th business meeting.
- Our 2016-2017 Leadership roster has been submitted to the National office.

CONCERNS: None.
REQUESTS FOR ACTION: None.

Respectfully Submitted: Mallory Janquart, ASCLS-WI President
Activities of the Region Director

- Sent Region VI New Member Welcome Email to November 15 Join Dates on January 12, 2016
- Sent Region VI Council Overview of their Membership Numbers as of 12/07/2015 and current state membership rosters on January 12, 2016
- Mailed Letters of Congratulations to Regional Omicron Sigma Recipients in March
- Attended and presented at the ASCLS-IA Annual Meeting in Cedar Rapids, IA on April 6-8, 2016
- Emailed & Posted to Facebook the Region VI Newsletter (Region VI Rundown) – March/April Edition on April 16, 2016
- Attended the ASCLS-IL Annual Meeting in Naperville, IL on April 20-22, 2016
- Attended the KSCLS Annual Meeting in Manhattan, KS on April 25-26, 2016
- Held Region VI Summer Council Meeting via Conference Call on July 18, 2016
- Assisted and provided guidance to Interim Bylaws Chair Barbara Brown with outstanding national bylaw changes
- Responded to State President and Council Members Questions and Assistance as Needed

Constituent State Society Summary Reports

Illinois (ASCLS-IL): Sheila Gibbons, President

Activities: ASCLS-IL held their Annual Meeting in Naperville, IL on April 20-22 in collaboration with CLMA Chicago Chapter. During the meeting, ASCLS-IL awarded one $750 scholarship in memory of Ellen McGill to student Sarah Chritz to attend the Annual Meeting in Philadelphia. Active members of ASCLS-IL were recognized for their service, the three Key of the Future winners were gifted membership along with one Professional 1 membership was raffled off. In addition, ASCLS-IL sold out of their allotted PAC pins during the annual meeting. Currently, state membership has seen an increase of 50 members and hopes to retain this gain through the next renewal cycle!

Concerns: No Concerns

Request for Actions: No Requests for Action

Iowa (ASCLS-IA): Janice Frerichs, President

Activities: ASCLS-IA held their Annual Meeting in Cedar Rapids, IA on April 6-8 in collaboration with CLMA Iowa Chapter. During the meeting, multiple membership recruitment activities were held including a “Get to Know Your ASCLS-IA Board of Directors” Trivia/Scavenger Hunt and a membership booth during exhibits. Emphasis on connecting with lapsed members and recruitment activities were held and ASCLS-IA saw an increase of 49 members over last year! Several career recruitment activities were held throughout the year – Cedar Valley Science Symposium at Wartburg College, Open Minds at Coe College in Cedar Rapids, and the Learning Connection in conjunction with Kirkwood Community College and the Carver College of Medicine at the University of Iowa.

Concerns: President-Elect-Elect position is still open. The President Elect-Elect position was added to the ASCLS-IA bylaws at the 2016 Annual Meeting. The purpose of this position is to decrease the rate of vacancy for the President position by allowing for more mentorship through a longer team on the ASCLS-IA Board of Directors.

Request for Actions: No Requests for Action
Kansas (KSCLS): Beckie Hetrick, President

**Activities:** KSCLS held their Annual Meeting in Manhattan, KS on April 26-27 in collaboration with the Wheatlands CLMA Chapter. Special this year was the invitation and recognition of all past Presidents of KSCLS during the Awards Luncheon, 13 past Presidents of KSCLS were able to attend the luncheon and be thanked for their dedication to the society. KSCLS has been working hard to plan the upcoming Region VI Rho Sigma dinner during the National Meeting in Philadelphia.

**Concerns:** As in all professions, there are a lot of people retiring. Several longtime ASCLS/KSCLS members who have been very active are retiring this year. I think it is very important to figure out a way to keep them active at a reasonable member cost.

**Request for Actions:** No Report

Missouri (ASCLS-MO): John Koenig, President

**Activities:** ASCLS-MO held their Annual Meeting in Chesterfield, MO on April 5-7 in collaboration with CLMA St. Louis Chapter. Along with having a successful annual meeting, the board is already planning the 2017 Annual Meeting to be held April 6-8 in the Lake of the Ozarks. Membership numbers are slightly increased and a full delegation will be sent to the national meeting in Philadelphia.

ASCLS-MO would also like to commend Elissa Passiment for her years of dedicated Leadership to ASCLS and the Laboratory Profession and wish her well in her retirement. Welcome back to the membership, Elissa.

**Concerns:** No Concerns

**Request for Actions:** No Requests for Action

Nebraska (ASCLS-NE): Brad Hays, President

**Activities:** ASCLS-NE held their Annual Meeting in LaVista, NE on April 27-29 in collaboration with Great Plains CLMA Chapter. Nebraska has been working to contact lapsed members and encourage more involvement especially in leadership roles. Membership numbers have stayed steady and student members are strong.

**Concerns:** No Concerns

**Request for Actions:** No Requests for Action
Activities of Region Director:
- Communicated with Region VII Council
- Conducted Region VII Council conference calls
- Gave reports at TX and LA spring meetings
- Submitted article for ASCLS Today
- Communicated with President and President Elect as appropriate
- Participated in Long Range Planning teleconference
- Voted on motions as needed
- Attended the Legislative Symposium in March
- Communicated with Region VII representatives on ASCLS committees
- Participated in Leadership Development Teleconference Calls
- Participated in Board Conference Calls

STATE REPORTS:

Arkansas Society for Clinical Laboratory Science: Stacy Walz, President

State Board Meeting:
- April 15, 2016 at state meeting
- Past-President Claude Rector has been nominated for Region VII Director
- Delegation planned for 2016 Annual Meeting

Spring Meeting:
- 2016 ASCLS/CLMA-Arkansas Joint Educational Conference & Student Quiz Bowl
  - April 14-15, 2016- Baptist Health College- Little Rock, AR
- Nine student quiz bowl teams participated – ASU Beebe team winners
- Five CEUs offered; nearly 70 professionals and students attended

Goals for 2015-2016:
- Increase Arkansas Membership:
Letters were sent to lapsed members highlighting the plans for our state organization and encouraging them to renew.
Board members have increased face-to-face recruitment across the state to share the benefits of ASCLS membership.
Membership increased from 2015 to 2016, by about 20%.
Bylaws under review and tax status
  - Bylaws haven’t been updated since the 1990’s; we will use the national template and modify for our state – still working on this
  - The necessary paperwork and fees were accepted by the IRS; non-profit status reinstated in May 2016
Continued collaboration with CLMA
  - Joint responsibilities in planning fall and spring conferences with mutually interesting topics/activities

**Louisiana State Society for Clinical Laboratory Science: Michele Werner, President.**
- LSCLS participated in the bi-state Spring meeting with Mississippi hosting in Hattiesburg, Ms.
- Spring Board Meeting was held April 11, 2016 in Hattiesburg, LA
- Four LSCLS members represented Louisiana at the Legislative Symposium in Washington, D.C., this included one new professional
- Louisiana will have 7 delegates at the ASCLS Annual Meeting in Philadelphia
- One LSCLS member was selected for the upcoming Leadership Academy
- A committee is presently working on updating LSCLS bylaws and SOP’s to the ASCLS standard

**Oklahoma Society for Clinical Laboratory Science: Sallie Ruskoski, President**
- There was board meeting in April to discuss the One Voice 2016 Joint Meeting
  The latest ASCLS-OK Board Meeting was held in Stroud, OK on June 24, 2016.
- The board met for the last meeting of the 2016-2016 year.
- Nate Harden, board member, will inquire about taking over the website from past-president Mitzie Miller.
- Because of the lack of funds in the ASCLS-OK account, Miles Tompkins, president-elect motioned that the MLS and MLT scholarships be combined, a 1st and 2nd place award given out, and the award amount will be based on the current budget; it was approved.
Miles Thompkins, president-elect will be attending the ASCLS Annual Meeting and Karen Griffin will be Oklahoma’s one delegate.

Latricia Horne, the incoming membership chair will be emailing expired members to encourage them to rejoin and informing them of the new ASCLS group memberships.

One Voice Joint Meeting 2017 will be held at St. Francis Hospital, Tulsa, OK on April 21, 2017. Nate Harden, board member, will chair the committee.

New Mexico State Society for Clinical Laboratory Science: Mary Doshi, President

Planning for the fall ASCLS/Four Corners Health Sciences Symposium is underway and will take place September 30 and October 1, 2016.

Texas Association for Clinical Laboratory Sciences: Rodney E. Rohde, President

Rohde interviewed by multiple sources for ongoing Zika virus outbreak, February 2016
  o Rohde, R.E. Bobcat Blog invited commentary. February 3, 2016. Don’t Look Now – #Zika is in Texas!
> April 6 - 9th, 2016: TACLS Annual Meeting was an Outstanding & Profitable meeting in San Antonio- $20,684.46 estimated profit
  > o Over 200 attendees with many students
  > o Ten applicant scholarships- 6 MLS and 4 MLT; 4 mailed and 6 uploaded: 2 students awarded a $500 scholarship each
  > o Renewed Poster Competition with recognition; 6 Student Bowl teams
  > o Successful Awards ceremony & ASCLS Delegates chosen for Philadelphia
  > o Business meeting: April 9
    > ▪ 30+ in attendance
    > ▪ Approved several motions – Legal counsel financial support of registry bill
    > ▪ “New Professional /Student Track” & Lab Olympics were a big success
      > • Small budget approved to continue
      > • Thanks to Jazmen Myers & Binh Pham for organization with others
    > ▪ TACLS Leadership Academy has been ongoing this year and well-received
      > • Utilizing Texas State webinar tool that allows recordings
    > ▪ Swore in 1 Board member – Jasmin Davis
    > ▪ TACLS membership ~535 as of May 31st; Focus on renewals
    > ▪ Active PACE year
    > ▪ Ongoing efforts to continue helping host cities
      > o TACLS 2017 will be in Dallas/FW area March 29-April 1 (Christie Thompson & John Wentz, Co-Chairs
      > o TACLS 2018 will be in El Paso, Lori Torres, Chair
    > ▪ Scheduled summer study session & Texas CLEC for September 10th
    > ▪ Discussion about introducing only a Registry bill during 2017 session with hopes of making Licensure bill more acceptable later

> Published multiple articles related to profession > from January through April 16th, 2016
  > o Rohde, R.E. Two Laboratory Tests you must Demand – Advice from MRSA Survivors and a Scientist. InfectionControl.tips
    http://infectioncontrol.tips/2016/01/11/2labtests-mrsa/
  > o Rohde, R.E. Zika Cases Confirmed in North America: Time to Panic? InfectionControl.tips
    http://infectioncontrol.tips/2016/01/14/zika-cases-confirmed-in-north-america-time-to-panic/


o Rohde, R.E. Colour-Coding to Prevent Hospital Infections. InfectionControl.tips http://infectioncontrol.tips/2016/02/12/colour-coding-to-prevent-hospital-infections/

o Rohde, R.E. Infection Prevention: Housekeepers Are Your SSI Foot Soldiers

> MLPW: Christie Thompson gave testimony for legislature committee on “Infectious Disease Readiness” w/ written testimony by Rohde; licensure issue support
  o Rohde received Proclamation for MLPW from Governor Abbott’s office

> Rohde published multiple articles in local, state, national and international forums for MLPW recognition during April 2016 (invited & mentored PA New Professional S. Noblit as co-writer)
  o Rohde, R.E. Medical Laboratory Professionals Save Lives Every day, but do you know who we are? Editorial, April 20, 2016. http://infectioncontrol.tips/2016/04/20/medical-laboratory-professionals/
Items of Concern:
Texas
- Lack of retention of student members.
- Decline of overall membership numbers.
- Difficulty finding members to fill leadership positions that have the membership and meeting attendance requirements (*will need President Elect, Secretary & two Board members in 2017*)

Request for Action: None
Activities of Regional Director:
- Participating on Region VIII IMSS Planning Committee monthly conference calls
- Participating on task force developing new position descriptions for Region VIII IMSS meeting
- Attended ASCLS Montana state meeting in April 2016
- Presented at ASCLS Montana State Meeting April 2016
- Attended ASCLS Montana Board meeting in April 2016
- Attended ASCLS Colorado State Meeting April 2016
- Attended ASCLS Wyoming Board Meeting April 2016
- Participated in monthly conference calls ASCLS Patient Safety Committee meetings.
- Participated in E&R conference calls

Activities of the Regional Council:
- Region VIII Council Conference Call April 2016
- Task force updating Region VIII IMSS job descriptions.
- Region VIII Leadership Academy continued education

Constituent Society Summary Reports:

ASCLS-Colorado Cathy McNary - President

Activities & Events:
- Members of ASCLS-CO led by Liz LeFors, CO Student Forum Rep, visited with the students in the MLS programs in the Fall and Winter promoting membership in ASCLS. A Student Meet and Greet in Denver was a success in the Spring, 2016. As of 5/30/16, ASCLS-CO has 61 student members.
- Liz Lefors assists Jenney Mead on the ASCLS-CO web site postings. The ASCLS-CO web site is active with event, Job postings, Newsletters, and news from the state, region and national office.
- An ASCLS-CO Facebook page is in use for communication with the state membership. An ASCLS-CO Student Forum Facebook Page has also been created and in use. Also, communication through the state member list-serve keeps the members up to date.
- The Clinical Laboratory Collaborative Conference, April 7-8, 2016, Northglenn, CO was another success with 271 attendees, 36 student posters, and 38 exhibitors. This is a collaborative event with ASCLS-WY, CACMLE, CLMA Centennial Chapter, and ASCLS-CO. There was a new POCT tract on Friday, 10 manager/ leader sessions in 2 days. All disciplines were represented in the CEU presentations. An ASCLS Membership board and promotions was also present at CLCC.
- ASCLS-CO General Assembly was held on Wednesday, April 6th, in Northglenn, CO. 20 members attended with special guest, Joni Gilstrap, Region VIII Director.
- Spring/ Summer Social events included or will include a restaurant happy hour in the Spring, a behind the scenes Microbrewery tour with CEU in June, a night at the Rockies Baseball in August, 2016, and bowling before the Spring CLCC, April, 2016, just for fun.
- Nominations were submitted for many national Awards. State members were recognized for their volunteer efforts with the Omicron Sigma, State President’s Awards, and the state MOY award.
• Southern District and CACMLE Fall Seminar held on October 29th. Central District Evening Fall Seminar held on
Nov 17th. Western Slope Winter Seminar was held January 22nd. Northern District Evening Spring Seminar was
held on May 17th, 2016.
• ASCLS-CO Winter Board GoToMeeting Call was held Saturday, January 30th, 9:30 to 11:00am. It was great to
share documents, see each person talking and the options of using computer, phone, tablet and smart phones.
Texting also added to the communication. Lastly, the audio recording helped the secretary with minutes taking.
• 3-person ASCLS-CO delegation attended the Legislative Symposium in DC, March 14-15, 2016. Cathy McNary,
Connie Ohlson and Marj Brown. They were joined by 1 AMT Colorado member.
• Continue to work on getting all leaders signed up for Drop Box and store documents in Drop Box. Will be
seeking help from Angie, Stephanie and Tracy for this process. Procedures will need to be written for our group
for identifying persons that should have access, which files we will upload and document editing.

• ASCLS-CO participated in the Career Fair and organized/ implemented the Biomedical Lab Science (BLS) Competitions at the HOSA-CO Leadership Conference for high school students interested in healthcare careers on March 4, 2016, Colorado Springs. More than 800 students and their instructors attended this conference and Career Fair! ASCLS-CO has been a contributing partner of HOSA-CO since 2011.
• Ian Wallace obtained a Governor’s proclamation for MLPW, April 24-30, 2016! State members also participated
in the Lab Week Virtual Run!
• The Colorado Clinical Laboratorian, ASCLS-CO, newsletters published in February, and June, 2016. Annette
Gaskill is Editor-in-Chief.
• Region VIII leaders are actively engaged in planning this year’s Intermountain States Seminar, continuing
education and vendor expo for medical lab professionals, September 29-Oct 1, 2016, in Jackson, WY. Cathy
McNary is the General Chair of this year’s event. Check out the website for up to date information,
• Rachel Dechant of Colorado has been accepted into the national Leadership Academy for
2016-17. Congratulations, Rachel!
• 2016-17 Planning/ Budget/ Retreat is planned for Aug 13-14, 2016.

Areas of Concern: None at this time.
Requests for Action: None at this time.

ASCLS-Idaho Diana Thompson – President

Activities & Events:
• BOD meeting March 26, 2016 face -to- face along with conference call held in
Twin Falls, ID at SLMV Hospital. We also had a Legislative Symposium presentation
by Debbie Shell.
• BOD meeting face to face April 21st, 2016 at The Grove Hotel, Boise, ID.
• General Business Meeting April 23rd, 2016 at The Grove Hotel, Boise, ID.
• BOD meeting June 11, 2016 at The Snake River Grill in Hagerman, ID. This was a
face -to- face meeting. We also had a Mini-Leadership Academy presentation by
Holly Weinberg and Susan Morris.

Accomplishments:
• ASCLS-ID had a very successful Annual Spring Meeting at The Grove Hotel, Boise, ID.
• ASCLS-ID sent one delegate, Debbie Shell to the Legislative Symposium, March 14-
15, 2016.
• Two Region VIII Leadership Academy students this year, Diane Stumpf and Melva Pagan-Alvarez.

Goals:
• Work on the getting the new Membership Packet to a digital format for easier distribution.
• Job descriptions for Chair and Board positions on ASCLS-ID web site.

Concerns: None
Requests for Action: None at this time

ASCLS-Montana – Amy Steinmetz - President
Activities of State Society:
- BOD meeting April 2016 face-to-face meeting along with conference call held in Great Falls, MT
- General Business Meeting April 2016

Accomplishments:
- ASCLS-MT had its Annual Spring Meeting in Great Falls.
- ASCLS-MT had two delegates to the Legislative Symposium March 16-17, 2016.

Goals:
- Move the SOP and Position descriptions into the ASCLS-MT dropbox.
- Create an ASCLS-MT Facebook page.

Concerns: None
Requests for Action: None at this time

ASCLS-Utah – Omar Munoz – President-Interim

No report.

Areas of Concern: No active leadership in Utah.
Requests for Action: None at this time.

ASCLS-Wyoming – Penny Rundberg - President

Activities of State Society:
- Participation in Planning Committee for IMSS 2015.
- Held summer membership barbeque to rekindle members and encourage new membership involvement.
- Constituents attended IMSS October 2015.
- Wyoming Society and Board planning Fall meeting and educational opportunity was planned for November, but was rescheduled for February 2016.
- CLCC Planning Committee Meetings May 19, (contract signed June 12) September 29, October 21, November 24, 2015. There was also lots of work associated with CLCC that was accomplished through emails.
- Board Meeting and education provided February 9, 2016.
- Reached out to new MLS program director to involve students in the society early in their career.
- Members selected to attend Legislative Symposium in Washington D.C.
- New webmaster for Wyoming ASCLS selected.

Accomplishments:
- Participation on planning committees for IMSS and CLCC.
- The use of Go-To-Meeting during CLCC to include members in the Business Meeting who couldn't attend CLCC.
- Started a dialogue with the new MLS program director to involve students in the society.
- New webmaster selected.
- Omicron Sigma Award nominees sent to national, February 2016.
- Board report sent to Region VIII, February 2016.

Goals:
- Participate in planning of IMSS and CLCC
- Use of Go-To-Meeting, to include more constituents in business meetings.
- Encourage applicants for Legislative Symposium.
- Student involvement-mentoring new students in Wyoming.
- Encouraging participation at the Spring Meeting.
- Encourage applicants for Region VIII Leadership Academy.
Concerns:  None
Requests for Action:  None at this time
Activities of Region IX Director:

- Serving as Board liaison on the Product Development Committee for ASCLS
- Serving as Board liaison for Scientific Assemblies
- Participated in teleconferences for the Product Development Committee App Steering subcommittee.
- Participated in teleconferences for the Product Development Committee.
- Responded to requests from ASCLS Board of Directors
- Filled position on national PAC
- Corresponded regularly with Region IX Board
- Attended CLSA Spring Board Meeting on April 12, 2016
- Attended CLSA spring conference
- Submitted Article to ASCLS Today in May, 2015

State Reports:

ASCLS-WA
Eight society members will attend the ASCLS annual meeting. Held spring meeting in April with online meeting access for distant participants. Encouraged statewide participation in new membership category for institutions. Working on updates of by-laws and articles of incorporation as recommended in IRS audit report. Provided article for summer LabO publication. Presented a hands-on program for high school students regarding medical laboratory science. Presented all day hands-on health care summer event for middle school students on university campus. Created and presented provider performed microscopy workshop for 35 physician assistant students on university campus. Created and presented 3.5 hr P.A.C.E. session at Spring Seminar in Olympia in April. Submitted student case study to ASCLS-CLI for possible publication. Guided 12 post-baccalaureate students in creating and presenting two MLS CE Days in Yakima and Tri-Cities. Thirty-five attended the ASCLS-WA P.A.C.E. sponsored event.
CLSA
CLSA has a new Facebook group as well as website. We hope that this will keep our members better connected. CLSA had a very successful state conference in April, with a record number of attendees. We were able to raise over $1,300 for the American Red Cross and $668 for PAC. As of now we will have 4 delegates for this year’s national convention. One of our members has been accepted to the 2016-2017 Leadership Academy.

ASCLS-OR
Published first edition of Centrifuge newsletter for this year. Established Facebook presence with new Webmaster, Ryan Howey. Reestablished website for ASCLS-OR with new domain, ASCLS-Oregon. Selected recipients for Betsy Baptist Scholarship. Moved President-Elect into President position with resignation of Cara Calvo. Discussed possible candidates for open P-E and Secretary positions. Discussed potential Student Representatives and availability due to practicum sites. Used Google Groups with Survey Monkey to gather input from active members. Sent out postcards to lapsed members to encourage reregistration and participation. Moved Centrifuge newsletter Associate Editor Jackie Rice to Executive Editor position. Moved Centrifuge Executive Editor Patty DeTurk to Associate Editor position with her acceptance of the Presidency. Summer goals: recruit and elect PE, Secretary, and New Professional; publish second edition of newsletter; continue planning NWMLS to be held in October in Portland.

Concerns/Comments

CLSA:
CLSA needs to revise SOPs and/or Bylaws to clarify who is eligible for various delegate positions and to determine how funds will be allocated for future national conference attendees.

Requests for Action: NONE
Activities of the Student Forum Chair and Officers since February 2016:

- Been in constant communication with the Vice Chair, Secretary, Board Liaison, and Regional Representatives
- Created a list of student representation for the regions and the states as state presidents and region directors give me the information, only missing representative from one region.
- Held Conference Call #6 February 4, 2016
- Held Conference Call #7 March 21, 2016
- Held Conference Call #8 April 18, 2016
- Held Conference Call #9 May 16, 2016
- Held Conference Call #10 June 14, 2016
- Held Conference Call #11 June 29, 2016
- Jazmen Myers submitted an article for ASCLS Today (February issue)
- Elizabeth LeFors submitted an article for ASCLS Today (April issue)
- Vathani Logendran submitted an article for ASCLS Today (June issue)
- Participated in Board of Directors Conference Calls and E-mail motions
- Successfully planned, executed, and finished the Yankee Candle Fundraiser. We raised $1,012.00 and all funds have been sent to the ASCLS Office. Funds used to sponsor Student Forum travel grants to the Legislative Symposium and Annual Meeting.
- Officers post to the ASCLS Student Forum Facebook page on a weekly basis
- Discussed, wrote, and distributed ASCLS Student Forum E-newsletters in February and May to stay in contact, share information, and highlight student leaders and accomplishments.
- Edited the Student Forum Manual and was reviewed at interim board meeting 2016.
- Reviewed Student Forum Manual suggestions given at interim board meeting, revised, edited, and sent tentative final draft to Policy and Procedures committee via EVP, Jim Flannigan, June 2016.
- Discussed, planned, and finalized Student Forum sessions and activities for the Annual Meeting
- Sponsored two Legislative Symposium travel grants for $400 each. Grantees were Michelle Nguyen and Tyra Fairchild.
- Sponsored a Regular Student Annual Meeting travel grant for $800. Grantees are Lauren Engel and Savannah Drake.
- Sponsored a Regular Student Annual Meeting travel grant for $400. Grantee is William Johnathan Windsor.
- Appointed Region Representative I, Kelcey Harper, as the Diversity Advocacy Council Student Forum Liaison.
- Announced and held Student Forum t-shirt competition. The chosen design was printed on t-shirts with the new Annual Meeting logo. Ordered a total of 200 at a cost of $2,014.00. T-shirts were sent to Stephanie Noblit in Philadelphia and are to be sold at the annual meeting.
- Planned and announced the 2nd annual Student Forum Mixer to take place at Smokin’ Betty’s in Philadelphia, Pennsylvania on Monday, August 1st at 8pm following the Student and First Timer’s reception.
• Shipping remaining ASCLS themed glassware to Stephanie Noblit from D.C. office to be sold at the annual meeting.

**REGION I**  
*Kelcey Harper*

- Attended Board of Directors/Convention Planning Committee meetings for ASCLS-CNE in March/April
- Attended ASCLS-CNE Annual Convention in April
- Presented at ASCLS-CNE Annual Convention in April to 30+ students about the benefits of ASCLS membership and the role of the Student Forum.
- Elected new Student President, Vice President, Treasurer, Secretary for ASCLS-CNE (names & contact information currently with ASCLS-CNE President, Brandon Healey)
- Moderated a session at the ASCLS-CNE Annual Meeting
- Future plans: Reach out to newly elected SF Board members for CNE to begin the transition process
  - New York, no representative and/or no response.
  - Vermont, no representative and/or no response.
  - Maine, no representative and/or no response.
  - Connecticut, no representative and/or no response.

  Concerns: Lack of student representatives from Region I, besides myself (CNE)  
  Request for Action: None

**REGION II**  
*Rebecca Matthews*

- No new activity and/or no response
  - Virginia, Rebecca Matthews: No response.
  - W. Virginia: No representative and/or no response.
  - Maryland: No representative and/or no response.
  - Delaware, Natalie Respond with Marissa Abidi, and Bryn Golesworthy: No representative and/or no response.
  - Pennsylvania: No representative and/or no response.
  - New Jersey: No representative and/or no response.

  Concerns: None  
  Request for Action: None

**REGION III**  
*Jason Frazier*

No new activity and/or no response
  - Alabama, Jason Frazier: No response
  - Puerto Rico: No representative and/or no response.
  - Tennessee: No representative and/or no response.
  - Mississippi: No representative and/or no response.
- South Carolina: No representative and/or no response.
- North Carolina: No representative and/or no response.
- Florida: No representative and/or no response.
- Georgia: No representative and/or no response.

Concerns: None
Request for Action: None

REGION IV  
*Alicia Kuzia*

- No activity and/or no response.

REGION V  
*Nicole Buza*

- Attend Legislative Symposium in March 2016
- Attended the ASCLS Region V board meeting via conference call in February and May
- Collected and edited articles for the May Student Forum Newsletter
- Attended the ASCLS National Student Forum meeting via conference call in February, April, May and June
- Contacted student forum chairs for each of the states in the region on a regular basis – informed them of events occurring in the Student Forum at the national level, made sure they were aware of due dates for board reports
- Contribute to the national Facebook page

  - Wisconsin, Nicole Buza: Attended state BOD meeting in February (conference call) and April at the state convention, in LaCrosse. Sent an informative email to the students in the state and included the newsletter in May. Sent an email containing scholarship opportunities. Attended State Convention – gave a presentation at the student meeting and presided over the elections. Elected a new Student Forum Chair (Ali Nussbaum) and Vice Chair (Keaunis Grant). Gave new elected student forum members a brief orientation on their roles. Attended the Legislative Symposium in March 2016 and maintained the Facebook page.
  - Minnesota, Amy Blumke: We elected a new Student Forum Chair during for the state of Minnesota during our convention. His name is Matthew Yang.
  - South Dakota, Tyler Makor: We elected a new Student Forum Chair during for the state of South Dakota during our convention. Her name is Ashley Clarke.
  - North Dakota, Jessica Rosin: We elected a new Student Forum Chair during for the state of North Dakota during our convention. His name is Muhammad Riji. He is an MLS student from Fargo, ND. We also gave out (4) $500 scholarships to ND students at our state meeting.
REGION VI
Scott Waddell

- No activity and/or no response

REGION VII
Beth Hughes

- Since the last board meeting, Region VII has had their state meetings in each state. Louisiana has elected new student forum officers for the upcoming year. Region VII has also been helping the National Student Forum with planning the upcoming national meeting in Philadelphia.
  
  - Arkansas, Felicia Walker: No response
  - Louisiana, Anna Cavalier: New Student Forum Officers have been elected for this new year: Chair, Andrew; Vice Chair, Jade Ardoin; Secretary, Sydni Greigoire
  - New Mexico, Bianca Varela: No response
  - Oklahoma: No representative and/or no response.
  - Texas, Binh Pham: New Student Forum Officers have been elected for this new year: Chair, Taylor Meyer; Vice Chair, Carla Subias; Board Members, Eric Bruton, David Kluver, Thai Le

Concerns: None
Requests for action: None

REGION VIII
Abby Siebert

- No activity and/or no response

REGION IX
Alex Steiner

- No activity and/or no response
  
  - Washington, Alex Steiner: No activity and/or no response
  - Oregon, Lorianne Smith: No activity and/or no response
  - Alaska, Lauren Yell: No activity and/or no response

Concerns: None
Requests for action: None

REGION X
No representative

- No activity

ASCLS Student Forum:

Concerns: None
Activities of the Region Director:
  ➢ Responded to requests for information and electronic votes from ASCLS
  ➢ Attended ASCLS-HI May annual membership tele-meeting.
  ➢ Participated in numerous Student Forum tele-meetings.
  ➢ Participated in numerous Board of Directors Appointments Committee tele-meetings.
  ➢ Participated in numerous ASCLS PAC tele-meetings.
  ➢ Attended the 2016 BOD Planning Day and Interim Meeting in Alexandria, VA.

State Reports:

ASCLS-AND: Susan Radley, President
Board met via teleconference several times.

CONCERNS: Struggling to find members to serve on the Board of Directors and committees.

Request for Action: None

ASCLS-HI: Kristen Croom, President
Board met February 9, 2015 and April 15, 201 with additional business conducted via email.

Activities:
  • The 2016 Hawaii Clinical Laboratory Conference was co-hosted by ASCLS-Hawaii and the Aloha Chapter of CLMA.
    o Strong turnout with over 200 people and 40 vendors.
    o The ASCLS-HI board offered a partial registration reimbursement at the conference for members. This meant that the members needed to come to our exhibit table to collect their money. This gave the board members and opportunity to have a face to face conversation with about 50 members. Lapsed members were extended the opportunity to renew during the meeting and receive the reimbursement with two taking advantage of the offer. We received positive feedback and will consider doing this next year.
    o Elissa Passiment was sponsored by ASCLS-Hawaii and gave two great presentations at the conference. She was able to attend our business meeting and gave those attending insight into what ASCLS is accomplishing at the national level. The Board hosted a dinner for Elissa, husband Joe, and our Region X director.
    o Amanda Reiner represented ASCLS-Hawaii at the Legislative Symposium. During the business meeting she presented an enthusiastic synopsis of the event. She was impressed with the amount of information provided at the symposium. She felt that one day is not sufficient to cover the topics thoroughly to provide a good background for the visit to the hill.
  • We scheduled the second annual game night during MLPW. Attendance was abysmal. Upon analysis, we realized that last year the 2015 Hawaii Clinical Laboratory Conference was right before MLPW allowing us to recruit participants during the conference. We are considering doing another game night outside of MLPW.
• We have our second ASCLS Road Show scheduled in mid-July at Tripler Army Medical Center. We are providing two back to back sessions to this laboratory. We hope to be able to expand to additional laboratories next year.
• We hosted our 2nd annual Science of Beer Event at Gordon Biersch on 06/23/16. We learned from our mistakes last year and offered more food and continuing education credits. Next year we are planning on a science of Coffee, Wine and Chocolate events to broaden our horizons.
• A cemetery tour is being planned to learn about diseases and medicines used in the past.
• We have elected our board for next year. The incoming president and president-elect will both attend the national meeting in Philadelphia. This will give all of us the opportunity to recharge and plan for events next year.
• I spoke to the MLS class at the University of Hawaii about the importance of professional organizations. I hope to make this an annual event for this class. We are hoping to do the same for the University of Hawaii MLT program.

CONCERNS: None

Request for action: None

ASCLS-CA: Josh Pulido, President
Board of Director Meetings were held in April, and June.

Activities:
• Planning is underway for a Spring Regional Meeting in Rancho Mirage, CA in March 2017.

CONCERNS: The California society is at risk for the lack of volunteers for key board positions.

Elections were held in April and no position was contested.

Request for Action: None
Activities of the NPNMF Chair since February 2016:

- Led January Conference Call
- Led February Conference Call
- Led March Conference Call
- Led April Conference Call
- Planning June Conference Call
- Planning Orientation Meeting for Annual Meeting
- Wrote an article for NPNMF Spring Newsletter
- Edited NPNMF Winter, Spring, and Summer Newsletter
- Assisted in Planning the Lab Week Run; sponsored by NPNMF
  - Fundraising event
- Participated in the Lab Week Run
- Awarded Travel Grant for National Meeting
- Wrote 2 articles for Summer NPNMF Newsletter
- Will be attending the National Meeting in Philadelphia

Activities of the NPNMF Vice-Chair Since February 2016: Karen Larson

- Attended all monthly NPNMF Conference Calls
- Led the small group responsible for creating this year’s NPNMF member survey. Finalized survey changes and prepared survey for distribution.
- Co-wrote the May ASCLS Today NPNMF article with our 2015 Annual Meeting Keynote Speaker, Jennifer Kahnweiler. The topic was about leading conference calls more effectively with introverts in mind.
- Planned the first annual MLPW Virtual Run with others
- Volunteered on Host Committee for CLEC in Minneapolis, February 25 - 27
- Attended Legislative Symposium, March 13 & 14
- Attended MN Clinical Laboratory Collaborative, April 25-27
- Honored with the Omicron Sigma National Award
- Honored as one of the Voices Under 40 award recipients
- National Phlebotomy Scientific Assembly Chair
  - Preparing my two phlebotomy speaking sessions for the 2016 National Meeting
  - Posted discussion topics on ASCLS Community Page
o Wrote the Phlebotomy SA article about exceptional customer service in phlebotomy for the May edition of ASCLS Today

• Region V Tri-State Leadership Academy Committee Member
  o Coaching participants as they develop their group project
  o Speaker at May retreat, gave a session on Strategic Planning and Action Planning

• ASCLS-Minnesota Metro Area Junior Director
  o Organized a local Twin Cities Lab Week 5K Run/Walk to complement the Lab Week Virtual Run, recruited Beckman Coulter as a sponsor to provide food and coffee for runners
  o Served as an interviewer at the ASCLS-MN Student Forum Interview Night, also brought many handouts with interviewing tips for attendees
  o Organized March CE event worth 2 P.A.C.E. credits, recruited speaker and had about 20 people attend
  o Attended the ASCLS-MN Legislative Day

Region I: Stephen Latuso

• Central New England: No Representative
• Connecticut: No Representative
• Maine: No Representative
• New York: No Representative
• Vermont: No Representative

Concerns:
Requests:

Region II Evan Katradis

• Delaware: Alexa Pierce
• Maryland: Evan Katradis
• New Jersey: Rebecca Nemeh
• Pennsylvania: Ryan Stetz
• Virginia: No Representative
• West Virginia: Amber Chambers

Concerns:
Requests:

Region III: Ally Thompson

• Alabama: Tabitha Goodwin
  o No Response
• Florida: No Representative
• Georgia: Ally Thompson
  o Ally Storla organized continuing education event in conjunction with ASCLS GA Fall Board Meeting at Orpheus Brewery and One Midtown Kitchen
  o Working on an ASCLS Georgia Legislative Day which will involve a CEU opportunity at the CDC and social events tentative for March 2017
Reaching out to all Georgia MLS/MLT Programs by preparing a PowerPoint Presentation and Visiting new classes in August to introduce ourselves, share information, and answer a brief Q/A session from new students entering the profession

- Used Facebook/Email and many State Presidents/New Professional Members in Region III to help spread the word about Lab Week Run 2016

- **Mississippi:** No Representative
- **North Carolina:** Stephanie Nesmith
  - No Response
- **South Carolina:** No Representative
- **Tennessee:** No Representative

Concerns: More follow up required to determine who current 2016-2017 New Professional Member Representatives Are throughout the Region, many webpages still in the process of being updated

Requests:

**Region IV** Mandi Jones
- **Indiana:** Daniella McCurdy
- **Kentucky:** No Representative
- **Michigan:** Mandi Jones
- **Ohio:** Kateland Koch

Concerns:
Requests:

**Region V** Tiffany Montalvo
- **Minnesota:** Jenna Pruitt
- **North Dakota:** Jozey Keith
- **South Dakota:** Tiffany Montalvo
- **Wisconsin:** Cassie Zblewski

Concerns:
Requests:

**Region VI** Stephanie Godfrey and Katie Franck
- **Illinois:** Leigh Manzonelli and Jynelle Moyer
- **Iowa:** Katie Franck
- **Kansas:** Erica Rosa
- **Missouri:** Monica Stumpf
- **Nebraska:** Kevin Nicholson

Concerns:
Requests:

**Region VII** James Gardner and Cherifka Robertson
Arkansas: Cherika Robertson and Katherine Horn
  o No Response
Louisiana: James Gardner
  o LSCLS and ASCLS-MS had a very productive Spring Meeting this past April.
  o LSCLS had a fit bit raffle which raised over $300 towards any student or new
    professional to attend the Annual Meeting.
  o Work is still being done creating a recruitment plan that can be used by everyone.
New Mexico: No Representative
Oklahoma: Brittney Jordan
  o No Response
Texas: Brooks Kennedy
  o No Response

Requests:

Region VIII Ian Wallace
Idaho: Hollie Hatch
  o We’re preparing to say good-bye to one of the instructors of the MLS program at Idaho
    State University. Kathryn Norton and I are arranging for a send-off banquet. She will be
    starting a brand new MLS program in northern Idaho. Very exciting.
  o I continue to reach out to the current MLS students and encourage their participation
    with ASCLS on local, regional and national level. It looks like Abby Siebert may become
    the Region VIII Student Representative.
  o We held a legislative meet & greet at the main hospital lab in Boise that included a tour
    of the lab. ASCLS Idaho is pushing for licensure and this was a very important event for
    the cause.
  o Current MLS students are in the initial phase of their research presentations. They will
    present at ISU Research Days and also at the ASCLS Idaho Spring Convention.
  o The biggest news is that Idaho will have a second MLS program! Sonja Nehr-Kanet left
    Idaho State University to establish a new program at North Idaho College in Coeur
    d'Alene, ID.
    o Aiming to improve the rate of new professionals entering the MLS field in
      Eastern Washington, Northern Idaho & Western Montana.
  o We had our annual Spring Convention in Boise, ID at the Grove Hotel.
    o The theme was the "Amazing Convention"
    o Keynote speaker talked about IQCP - very informative.
    o Student presentations from Idaho State University were a highlight.
  o First year professionals seem to have scattered throughout the state & greater region -
    taking on various positions.
    o A small group of us met up at the convention and had lunch.
Colorado: Alice Roberts
  o Teamed up with CACMLE to bring in speakers for an evening CE event on November
    17th.
Managerial/Supervisory panel: “Ready for Lab Management? Tips for Becoming a Laboratory Leader”
- We had about 20 participants attend

Student Forum and New Professional
- Visiting MLS/MLT Schools in Colorado
  - Promoting ASCLS and the Profession
- Fundraiser
  - Microbial soap petri dishes

Pueblo Fall Seminar on October 29th, 2016
- Organized by ASCLS-CO and CACMLE

Colorado Winter Seminar in Grand Junction, CO on January 22nd, 2016
- Organized by ASCLS-CO and CACMLE

Social Media
- Increased presence on Facebook

Health Occupations Students of America- Colorado (HOSA-CO) Conference being held on March 4th, 2016
- We have three representatives from ASCLS-CO heading to Washington D.C. for the Legislative Symposium in March
- Held a Student/New Professional Meet and Greet in Aurora, CO at BJ’s Restaurant and Brewpub on April 1st, 2016 which was very well attended by students and new professionals alike.
- Bowling Fundraiser Event to take place in Northglenn, CO on April 6th, 2016
  - Fundraising committee formation requested to ASCLS-CO BOD
- Held our state meeting, CLCC 2016 in Denver, CO on April 7th-8th
  - This year we have a POC “Track” and a Management/Leadership “Track” for all attendees
  - Had over 270 attendees, 40 exhibitors, 30 educational sessions, and a 35 student poster display.

Medical Laboratory Professionals Week
- Proclamation from the State of Colorado
- Signed and Sealed by Governor John Hickenlooper
- Many individuals from Colorado participated in the Lab Week Run

New Belgium Brewing CE Event “The Science of Suds” scheduled for June 26th in Fort Collins, CO

Sending 7 individuals to the Annual meeting in Philadelphia, PA

ASCLS 2016-2017 Planning/Budget Meeting/Leadership Retreat scheduled for August 13-14th, 2016 in Fort Collins, CO.

ASCLS-CO Member Appreciation Day at the Colorado Rockies tentatively scheduled for August

Intermountain State Seminar (IMSS) scheduled for September 29th-October 1st.

**Concerns:**
• We need more individuals in leadership positions
• Member retention

• Montana: Ashley Schlosser
  o Montana State Meeting held in Great Falls, Montana.
    ▪ We had great speakers and a great networking event on Friday of the meeting. I was able to speak to several students about the importance of ASCLS.
    ▪ I also volunteered to speak to the local high school students about being a MLS and feel like it was a great opportunity to visit with students before they go to college and give them a heads up about the great career opportunities that we have for future MLS.

• Wyoming: BreeAnn Cossitt
  • Sent two individuals to represent the state of Wyoming at the Legislative Symposium in March.
  • Many Wyoming members attended CLCC in Denver April 7th and 8th. Spring meeting was held April 7th where we discussed ways to reach out to students attending the UW Laboratory science program now affiliated with Casper College.
  • Planning of IMSS is in full swing:
    o We are working on a Friday night social
    o “Save the Date” flyers
    o Programs
    o Sponsorship for speakers
    o Updating the website and Facebook page
    o Managing finances.
  • WPHL Laboratory Preparedness Conference was held in Casper May 17th and 18th.
  • We are planning to hold a recruitment social in either July or August, working to iron out the details.

• Utah: No Representative

Concerns:
Requests:

Region IX Heather Davey
• Alaska: No Report
• Oregon: No Report
• Washington: Jamie Choe
  o No Report

Concerns:
Requests:

Region X Noel Clay
• Arizona/Nevada: No Representative
• California: No Representative
• Hawaii: Noel Clay

Concerns:
Requests:

**ASCLS NPNMF Officers:**

Concerns:

1. On behalf of the NPNMF Officers, we are concerned that some region/state communication coordinators are not aware of their responsibilities as a representative. We would appreciate it if the Regional Directors and State Presidents would inform them of their duties and encourage their region/states representatives to be more active and participate in the Forum.

2. On behalf of the NPNMF we are concerned that having two (2) Board Liaisons led to uncertainty of the liaison role on the part of the FYP Director. We feel that our appointing only the FYP Director (NPNM Director) as the NPNMF Board Liaison and appointing someone as the Forum advisor who is well educated about the Board will satisfy the Forum. We also be able to would appreciate the opportunity recommend who our advisor is after the three (3) year term is up for each Forum advisor. This advisor will advise the Forum and the FYP Director (NPNM Director)

Requests for Action:

1.
Report to: ASCLS Board of Directors
Report of: ASCLS Appointments Committee
Submitted for: 2016 Annual Board Meeting
Prepared by: Suzanne Campbell, ASCLS President-Elect
Date: July 15, 2016

Appointments Committee Members:
Suzanne Campbell, Joni Gilstrap, Sally Pestana, Janelle Chiasera
Ad Hoc Members: Susie Zanto, Elizabeth Ezeb, Jazmen Myers

Activities to Date:
1. The committee met by monthly conference call and exchanged e-mails. Committee members split up the committees and contacted chairs to determine level of activity of their committee members and whether they should be reappointed, if eligible.
2. President-elect Suzanne Campbell modified previously created survey monkey tool for members to fill out if interested in serving on committees or as special representatives. Deadline for response was December 22, 2015.
3. Determined number of openings for all committees.
4. Chairs and vice-chairs were contacted to determine interest in reappointment and/or recommendations for replacements.
5. Email request for Student and New Professional committee members sent 2/22/2016 by Andrea Hickey.
6. Identified members willing to serve as committee chair, vice-chair, members and ASCLS representatives to other affiliated organizations.

Concerns: None

Requests for Action:
- I move that the ASCLS Board of Directors approve the appointments of the members listed in the attached document to the various ASCLS Committees.
- I move that the ASCLS Board of Directors approve the appointments of the members listed in the attached document as Chairs and Vice Chairs of the various ASCLS Committees.
The Policy and Procedures Committee included Roslyn McQueen, Nadine Fydryszewski, Cindy Johnson, Karen Chandler and Jim Flanigan

The committee met via conference call several times and communicated via email as necessary. The following items were addressed:

- The Student Forum Manual was reviewed and referred back for some corrections.
- The Committee spent a great deal of time discussing problems with the dues section in the SOP’s and identified several changes which are needed. The final wording for these changes is not ready to be submitted but comments will be forwarded to the next year’s committee.
- The Committee discussed the Social Media Policy draft submitted for review and revised the document. The revised document is submitted to the board with a request that the board approve the new document.
- The Committee responded to questions from the GAC Committee regarding the GAC section in the SOP’s.

Concerns: None

Request for action: The committee requests that the board approve the attached Social Media Policy.
AMERICAN SOCIETY FOR CLINICAL LABORATORY SCIENCE

Social Media Policy

Purpose and Scope
This policy applies to any and all social media efforts conducted on behalf of American Society for Clinical Laboratory Science (ASCLS), including sites maintained by constituent Societies, ASCLS Regions, ASCLS Committees and Forums.

Social media shapes public opinions about the Society and the laboratory profession as a whole. There is value engaging in online communities to exchange information, express opinions, and communicate with a global audience.

Definition
Social media is the use of web-based and mobile technologies to turn communication into interactive dialogue.

ASCLS Branded Sites
- ASCLS official social media sites are maintained by the Social Media Team.
- ASCLS regional, state, and local societies, and ASCLS Committees, Forums, Regions and State societies are encouraged to link to the appropriate ASCLS national sites and notify the ASCLS Social Media Team of their sites so ASCLS can link to them from the national organization’s sites.
- Members who manage ASCLS Committee, Forum, Regional and/or State society sites should review ASCLS policies prior to posting ASCLS-related information on their websites. These sites are not maintained by the Social Media Team.

Content Policies
- Any comments containing inaccuracies will be corrected (if possible, or removed as a last resort) so as not to damage the reputation of the American Society for Clinical Laboratory Science. Typos and grammatical errors will not be modified.
- Any posting deemed to be objectionable by the team members, or which contains ill-mannered, lewd, or vulgar comments containing profanity will be removed from the site. Repeat offenders will be blocked from participating in ASCLS social media sites.
- Patient stories and videos will only be posted after proper consent had been obtained or the content is properly anonymized. All post failing to meet these criteria will be removed immediately.
- Solicitations will be removed. Repeated solicitations from a particular user will result in that user being blocked from that ASCLS social media page.
- Questions from members and other professionals, or customer service issues and complaints will be responded to in a timely manner. This may require working with appropriate contacts within the organization.
- All press inquiries will be forwarded to ASCLS Staff for official responses.
- If an issue cannot be resolved through daily moderation practices, the moderator will elevate the issue so that ASCLS senior leadership and/or staff can act on any
potential issues.

ASCLS Social Media Team Composition

- The ASCLS Social Media Team is comprised of the Team Moderator(s) and a minimum of seven ASCLS members. At least two of the seven members will serve as Team Leads.
- The Team Moderators are members of the ASCLS professional staff.
- The Team Members are selected by the current ASCLS President from ASCLS member volunteers who have experience in posting to social media sites, and have knowledge and experience in ASCLS operations and principles, as they will be representing the Society in their postings.
- The Team Leads are chosen by the Team Members from among its membership.
Long Range Planning Committee Members:

Suzanne Campbell, Pat Tille, Karen Chandler
Ad Hoc Members: Susie Zanto - past president; Janelle Chiasera-DAC liaison

Activities to Date:

1. The committee met by conference call on a monthly.
2. The focus of the long range planning day will be to utilize a strategic mapping process instead of strategic planning.
3. A group activity has been identified by president-elect Campbell.
4. James (Jim) Flanigan, new EVP, will be given time for introduction and question/answer.
5. The Sarbanes-Oxley presentation will be moved to a Board of Directors orientation session.
6. Committee charges for 2016-2017 have been revised and will be provided to the committee chairs.

Concerns: None
Requests for Action: None
The AMSC has not had any meetings since the Spring Report. The committee has been in constant email communication with the meetings management staff in order to finalize the program and events related to the Annual Meeting. The preliminary program was mailed in March.

Committee members have written articles promoting the AMI and Annual Meeting for ASCLS Today.

There were a number of members who had difficulty getting hotel rooms. The ASCLS office worked with the hotel to secure additional overflow rooms.

Registration numbers are on track and are similar to last year’s numbers.

The Host Society Representative has been hard at work, collaborating with the New Ideas Factory, on fun things to do while in Philadelphia. The Host Society table will be open, at the Registration Desk area, starting at noon on Saturday, July 30th. Attendees will be able to find the following information and events at the table:

1. Brochures and sight-seeing information
2. Information to sign up on Dine-Around Dinners for Saturday, Sunday and Wednesday
3. Information to sign up for Pub Crawl activities on Monday night
4. Information to sign up for historical walking tours

The deadline to submit ideas for the ASCLS Annual Meeting in 2017 is August 11, 2016. The AMSC will be meeting in September in San Diego, CA to evaluate the new format of the Annual Meeting and to begin planning the next Annual Meeting.

Thank you to the entire AMSC committee as well as the APRC and SA Chairs for their assistance in making this a successful Annual Meeting yet again!

Request for Action: None

Concerns: None
American Society for Clinical Laboratory Science

Report of: Abstract and Proposal Review Committee (APRC)
Report to: ASCLS Board of Directors
Submitted for: ASCLS Interim BOD Meeting
Prepared by: Deborah Josko, Chair
Date: June 17, 2016

APRC Activity:

I. Regarding Charge #3 [Provide a mandatory training session (most likely by conference call) for abstract reviewers detailing the abstract review process and tips for critiquing abstracts.]

- Dr. Mary Ann McLane, Consulting Editor Coordinator of Clinical Laboratory Science conducted a training session for APRC members on April 18, 2016.
- Participants were given blind abstracts prior to the session to evaluate whether “good” or “bad” and to categorize whether qualitative or quantitative research, clinical case or management/education case.
- Quantitative vs. Qualitative abstracts were discussed in great detail.
- By the end of the session APRC members had a better understanding of the difference between the two.
- FOCUS articles by Butina, Campbell and Miller 2015 regarding Qualitative Research were distributed during the conference call.
- This process was important to 1) standardize the abstract review process. All rating sheets were updated based on committee feedback; 2) to evaluate research abstracts based on the appropriate category – either Qualitative or Quantitative Research. Abstract rating sheets were revised to reflect the difference.
- This ensures all members are on the same page when grading and evaluating abstracts.
- Participants received CE credit for this exercise.

II. Abstract guidelines were revised based on committee feedback and will go into effect for the 2017 Call for Abstracts.

III. Abstracts submitted for poster and oral presentations for the national meeting in Philadelphia were distributed to APRC member by the Vice-Chair. The summary rating sheet was due on May 16, 2016. Participants were notified the end of May on Monday, May 30, 2016 if their abstract was accepted.

Areas of Concern:

- An action item was presented to the ASCLS Board of Directors at the last meeting to approve changing the term of office for the Chair and Vice Chair of the Abstract and Proposal Review Committee to two year terms.
  - This request was denied however if a committee member or members wish to extend their term they were instructed to reach out to the ASCLS President-Elect prior to the national meeting.

Request for action: None

Respectfully submitted,

Deborah Josko, PhD
APRC Chair
American Society for Clinical Laboratory Science

Report to: ASCLS Board of Directors
Report of: ASCLS Awards Committee
Submitted for: ASCLS Annual Meeting
Prepared by: Stephanie Mihane, Chair
Date: July 8, 2016

ASCLS Awards Committee Activities:

- Held monthly teleconferences from August 2015 to July 2016, with committee members from Massachusetts to Hawaii.
- Updated Awards Guidelines for 2016 on the ascls.org website.
- Finished the “Behind the Scenes” Guide for Award Committee members and distributed through email and Dropbox.
- Six articles were posted to ASCLS Today by committee members describing several of the awards and to encourage applications. Email blasts were sent out to leaders as reminders of approaching deadlines for submission.
- Discussed request for additional award category by Dennis Ernst
- Several major changes to Awards Committee processes were introduced this year;
  - Addition of “Voices under 40” Awards – 12 nominees were selected by the Promotion of the Profession Committee and will be announced and presented with certificates at the Members Awards Ceremony.
  - Constituent Society Members of the Year will be presented their plaques at the Region Caucuses this year instead of the Members Awards Ceremony. This decision was based on the limited time frame for the ceremony and the addition of the “Voices under 40” Awardees.
  - All certificates are being printed by the ASCLS Office with a new logo and certificate paper, AMTF and E&R recipients will still be presented the ivory certificates with their respective logos.
  - Mid-year transition to a new ASCLS Office Executive Vice President Staff Liaison required transition of Dropbox files to ASCLS office, along with an orientation to the committee processes.
  - Increased collaboration between E & R Fund Liaison and AMTF Liaison to document Award notification and RSVP process. This information will be incorporated into the “Behind the Scenes” (BTS) Handbook.
Decision to have President –Elect present ALL Member Ceremony awards but Kleiner (special request from E & R Scholarship sponsor) and Cardinal UR Essential.

Addition of July Awards Committee teleconference to provide assignments and responsibilities for the committee members who will be in attendance at the ceremonies.

Request for Action: I move that the ASCLS Board of Directors increase the number of members on the Awards Committee from the current 6 members to 9 members, 3 appointed each year.

Be it noted: The increasing time commitment required of volunteer committee members, a lack of formalized committee mentorship, and the need for detailed policies and procedures on how to coordinate Awards Committee responsibilities with the ASCLS Office, Annual Meeting Steering Committee and Meeting Management team is asking too much for the current six members.

Items of Concern: The time allotted for the Members Awards Ceremony is too limited as we continue to add award categories and scholarships to the program. Although this year, to save time, the Constituent Society Member of the Year Awards will be presented at the Regional Caucuses, and the ASCLS President-Elect will present awards instead of the Committee Chairs, but this may not be acceptable to the general membership who look forward to recognition at the Members Ceremony.

- The Awards Committee Chair wishes to recognize the following for their assistance this past year:
  - Ed Neren and Neren Possible Services for securing support and sponsorship: Diagnostica Stago for the printing of the Awards Program and Bio-Rad for the award certificates and plaques
  - Leticia SanDiego for her work as the liaison to the printer
  - Gilma Roncancio-Weemer for her work on coordinating the winner’s spreadsheet, organizing the certificates and plaques, and putting together the Industry and Members Award Ceremonies program and script.
  - Scott Aikey, Industry Ceremony Emcee
  - Barbara Brown, Members Ceremony Emcee
  - Award Committee members for their commitment to assuring a successful year:
    - Catherine Schaffner, Vice-Chair
    - Gilma Roncancio-Weemer
    - Marcella Yee
    - Lisa Hochstein
    - Shannon Kern
    - Farogh Nazari, Industry Rep
    - Ana Isabel Jacino, Student Rep
    - Lacey Campbell, New Professional Rep
    - Louann Lawrence, E&R Fund Rep
    - Janelle M Chiasera, Board Liaison
    - Elissa Passiment and Jim Flanigan, Staff
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In March, I was asked by President Snyderman to assume the Chairmanship of the Bylaws Committee. I contacted the committee members, informing them of my appointment and asking them to bring me up to speed on the progress toward their charges.

On reviewing the master list of states’ Bylaws’ compliance, I assigned each of the committee members, including myself, to contact the Bylaws chairs and/or Presidents of states whose documents are not up-to-date and on file in the National office.

There are still some states’ Bylaws not updated and in the office but All of the leadership of those states have been contacted and with a vote on 2 ASCLS Bylaws changes coming up in Aug. I feel all have a heads-up to work on their bylaws.

I hope I have helped get the Bylaws Committee back on track. There is still a lot of work to be done, but with the guidance of a new Chair and the team work of this committee, it will get done.

Concerns: None

Request for Action: None
CEPI duties include:
1) Monitor and assess the trends in levels of practice and education of practitioners at all levels.
2) Develop and deliver annual mentoring and professional development activities in conjunction with the Clinical Laboratory Educators’ Conference.
3) Assess current trends in educational programs and their effects on career choices in clinical laboratory science. This is to include the updating, development, and implementation of appropriate career recruitment materials and strategies for use with precollege and undergraduate students, as well as graduate students. The Student Forum should be used as a resource as appropriate.
4) Periodically review and recommend revision of the body of knowledge of all practice levels.

The CEPI met the following dates via teleconference:
October 16, 2015
November 13, 2015
December 21, 2015
February 9, 2016
Email update – April 2016
July, 2016 TBD

Each committee member volunteered to be involved in an activity this year based on the above charges:
Joan Polancic, Cathy Robinson & Cathy Shaffner – ELC
Kathy Doig & Cindy Handley – Recruitment materials
Becky See – CEPI representative to the March 2016 Legislative Symposium (unfortunately her current job will prevent her from attending so Sue Stalewski, ESA Chair, will attend and report to the ESA)

Committee Activities:
The two activities the committee worked on for the 2015-16 year are revision of the Entry Level Curriculum (ELC) and development of updated recruitment materials.

Entry Level Curriculum
Since the ELC revision is a major undertaking and a wide range of expertise was needed, a subcommittee was appointed. Joan and Kyle Riding served as co-chairs of the ELC. Members include:
Blood Bank and Immunology
Linda Smith, PhD, MLS(ASCP)CM BB
Professor, UT Health Science Center, Department of Clinical Laboratory Sciences
San Antonio, TX

Susan Higgins, MS, MT(ASCP)SC
Director, Indian Hills Community College MLT Program
Ottumwa, IA

Chemistry and Renal/Urinalysis
Joan Polancic, MSEd, MLS(ASCP)CM; committee co-chair
Director, Denver Health School of Medical Laboratory Science
Denver, CO

Michelle Briski, MEd, MT(ASCP)
Director, Saint Paul College MLT Program
St. Paul, MN

Hematology/Coagulation and General/Administration/Education
Cathy Shaffner, MLS(ASCP)CM SH
Director, The University of Toledo MT Program
Toledo, OH

Kathleen Finnegan
University of NY Stony Brook

Kyle Riding, PhD, MLS(ASCP)CM; committee co-chair
Instructor, Keiser University MLT Program
Orlando, FL

Microbiology and Molecular Diagnostics
Marcia Firmani, PhD, MSPH, MT(ASCP)
Director, Biomedical Sciences Division and Medical Laboratory Sciences, The George
Washington University
Washington, DC

Lynn Poth, MS, MT(ASCP)
Plebotomy Program Director; Medical Laboratory Technician Program Instructor
Saint Paul College—A Community & Technical College

Phlebotomy
Cathy Robinson, MS, MLS(ASCP)CM
Adjunct Professor, Louisiana State University, MLT/MLS/ Phlebotomy Programs
Alexandria, LA

Rebecca Silva, MS, MT(ASCP)
Department Chair/Associate Professor, Medical Laboratory Technology Program
New England Institute of Technology
East Greenwich, RI
The first ELC was published in 2002 and was created by educators and practitioners using the *Body of Knowledge* (BOK) published by ASCLS. The ELC has learning objectives identified at the 3 taxonomic levels in each major discipline area. The current ELC Committee was charged with two main goals:

- Use the recently updated ASCLS Body of Knowledge (BOK) and their discipline expertise in entry level practice to update the curriculum by removing dated topics and adding new items.
- Ensure differentiation of the MLT and MLS curriculum based on the level of education required for each.

The revised ELC draft documents were reviewed at CLEC. In addition, the documents were available to educators who are not able to attend CLEC with comments accepted through March 11th. The ELC Committee then prepared another draft made available in early May, for review by the ASCLS membership and Scientific Assembly members. Comments were due by June 1st. The final documents will be referred to the BOD and HOD for approval.

**Recruitment materials**

Since ASCLS career recruitment brochure and CD have not been updated in several years, the committee brainstormed about recruitment needs and developed a survey for educators to provide input as to the type of materials to be developed. The survey was distributed via the ASCLS ESA Member Community & CLSEDUC listserv in late October/early November 2015.

191 responses were received. Based on the response, (>71% stated the need) a new printed pamphlet and a downloadable video are proposed to be developed. Many educators stated that the video needs to be brief enough to be used on social media, to target 17-21 year olds, and include a diverse array of professionals. CEPI will sent a request for action to the interim BOD meeting for approval on the two items.

Kathy Doig (Michigan State University) led the filming and development of the video and pamphlet with the assistance of the University of Michigan Clinical Pathology Laboratory. The items will be reviewed by the committee and ASCLS staff and hopefully be available this fall. In consultation with ASCLS Liaison, Karrie Hovis, there will be a series of video testimonials that will be available via ASCLS YouTube channel, and one recruitment video that will be downloadable from the ASCLS website for recruitment efforts. The accompanying recruitment pamphlet will be able to be purchased by Program Directors, Laboratories, and other Educational Personnel as needed through the ASCLS website.

**CLEC 2017 proposal**

CEPI submitted a proposal for an educational session at CLEC 2017 to address clinical site rotations since this is an ongoing issue for MLT and MLS programs. The committee is waiting to see if this was accepted or not.

**Request for Action:** To approve the revised Entry Level Curriculum documents and send to the House of Delegates for adoption.

**Note:** See documents at ASCLS website.
REPORT TO: ASCLS Board of Directors
REPORT OF: Clinical Laboratory Science journal
SUBMITTED: ASCLS annual meeting
PREPARED BY: Susan J. Leclair, Editor-in-chief
DATE: July 1, 2015

The current Editorial Board is:

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<tr>
<th>Role</th>
<th>Name</th>
<th>Term</th>
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<tr>
<td>Editor in Chief</td>
<td>Susan Leclair</td>
<td>2013-2016</td>
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<tr>
<td>Research/Reports</td>
<td>Maribeth Flaws</td>
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<td>Focus/Continuing Education</td>
<td>Kristen Landis Piwowar</td>
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<td>Perry Scanlan</td>
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<td>Elizabeth Leibach</td>
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<td>Consulting Editors Coordinator</td>
<td>Mary Ann McLane</td>
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**2012 - 2016 Manuscript Flow**
Through July 1, 2016

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**Presentations:**

We offered a session at the CLE in Cincinnati and we will be giving a presentation for the 2016 ASCLS meeting. We have submitted a presentation for the 2017 CLEC.
Activities:

After a year of electronic publication, the editors have begun a review of all policies, procedures and author directions/guidelines. First drafts of these reviews will be evaluated during the annual meeting with a target date of January 2017 for final publication.

Research Editor MariBeth Flawes has indicated that she is not willing to be nominated for a second term. A potential nominee has been selected and will serve in a mentor/protégé role for the 2017 year.

Nominees for the "Clinical Laboratory Science" awards were finalized and forwarded to the ASCLS Awards Committee.

Developed, implemented, and assessed a reviewer training program.

Worked with authors of submitted manuscripts and abstracts to improve submissions.

Solicited candidates for appointment as Consulting Editors Coordinator

Motion:

To appoint Deborah Josko as Coordinator of the Consulting Editors for the term 2017 – 2020.
Summary of Activities since February 2016.

1. Conference call meetings were held on April 25, 2016 and June 27, 2016. An in-person meeting is scheduled for July 31, 2016 at the 2016 Annual Meeting.

2. Updated/completed documents are being compiled for the DCLS Toolkit on the ASCLS website. These include:
   a. List of universities in the US who have, are in the approval process, or have plans for a DCLS program.
   b. Course Bank: a catalog of online courses appropriate for students in DCLS programs and available online to students from other institutions.
   c. Doctor of Clinical Laboratory Science Professional Responsibilities document recently developed
   d. Updated Reference List on topics related to the DCLS (to be completed in July)
   e. Updated Models of Course Faculty and Resources Sharing for DCLS programs (to be completed in July)

3. Since the Board approved the Committee’s request to appoint a Task Force to update the ASCLS Position Paper: Advanced Practice: Doctorate in Clinical Laboratory Science (last approved in August 2013), two members of the Committee were appointed by President Snyderman to serve on this Task Force.

4. The following projects are in progress:
   a. DCLS Body of Knowledge document
   b. Financial support mechanisms for DCLS students
   c. DCLS certification mechanisms
   d. Model content and structure of DCLS clinical residency
   e. Mechanisms for ASCLS support of DCLS development
   f. Strategic Plan update for 2016-2017
   g. Recommendation of individuals to fill two committee vacancies for members whose terms have been completed

5. A Request for Action was drafted for the DCLS Oversight Committee to be an independent, permanent committee reporting directly to the BOD, including the justification and proposed revisions in the DCLS Oversight Committee Composition and Responsibilities (see below).
Concerns: None at this time

Request for Action:
The committee proposes that the ASCLS Board of Directors restructure and reposition the DCLS Oversight Committee as an independent, permanent committee reporting to the ASCLS Board of Directors. The following is a justification for this request and proposed changes in DCLS Oversight Committee Composition and Responsibilities.

Justification:

From a developmental perspective, the DCLS Oversight Committee began as an ad hoc task force, transitioned into three different temporary BOD Committees, and was finally placed organizationally as a permanent Committee reporting to the Education Scientific Assembly (ESA). When presented multiple options for permanent organizational placement, the serving BOD chose the ESA option, without input and prioritization from the serving Oversight Committee, because the activities of the Oversight Committee at the time were focused almost exclusively on DCLS program structure, standards, competencies, and curriculum development.

However, the Oversight Committee had from the beginning, been charged to address certification/licensure, market analysis, professional description, certification/licensure, and practitioner support/reimbursement as well as program and curriculum development. As these broader position elements become more focused, the unique and complex nature of DCLS practice also became more focused. Whereas the MLS background is prerequisite, DCLS practice has emerged as distinct and higher order from MLS combining technical, clinical, and research competencies.

To implement strategies for on-going needs assessment, market research, program and curriculum standardization, certification, graduate support, and practitioner reimbursement, the Oversight Committee must be visible both within and outside the organization to provide leadership necessary to develop the acknowledged flagship degree and practitioner of the profession. Therefore, the serving Oversight Committee proposes to restructure and reposition the Committee as an independent, permanent committee reporting to the BOD to promote not only these near-term objectives, but also to position the Committee to transition into the structure required for promotion of translational research crucial to sustaining and forwarding the Profession in the evolving and highly complex healthcare environment.
**DCLS Oversight Committee**  
**A Sub-Committee of the Education Scientific Assembly**

Original guidelines approved by the ASCLS BOD 2009  
Revisions Approved by ASCLS BOD: March 16, 2014  
Revisions Proposed by the DCLS Oversight Committee 6/27/16

Reports to: **ASCLS Education Scientific Assembly** - **ASCLS Board of Directors**

**Purpose:** Provide leadership, support, and advocacy for the development, implementation, and on-going quality of DCLS programs, practice, and professional issues.

**Term of Office:** Members serve for a three (3) year term. Individuals may serve for two (2) terms, and may not serve again unless they have been off the Committee for a minimum of one year.

**Composition of Committee:** The Committee is comprised of nine twelve (9/12) healthcare professionals: seven eight (7/8) ASCLS members who will have voting privileges, and twofour (2/4) non-voting consulting members. The composition of the committee will be:

8 **ASCLS Members - voting:**
- **Four Five (4/5) CLS Educators**  
  - Preferably educators who have a DCLS program or are actively working on approval of a DCLS program at their institution
- **One to two (1/2) Laboratory Administrators/Managers or Quality Managers**
- **One to two (1/2) MLSs who are currently practicing as a DCLS or performing some of the roles of a DCLS in current employment environment/practice, or currently enrolled as a student in a DCLS program.**

4 **Consulting Members – non-voting:**
- **One (1) Hospital or Industry-related Quality Administrator**
- **One (1) Pathologist who supports the DCLS concept as a career path**
- **One Two (1/2) non-pathologist physicians, or other advanced practice healthcare professionals who are members of interprofessional healthcare/patient management teams (i.e. Nurse Practitioner (DNP), PharmD, DCN, etc.)**

**Committee and Officers:** Annually, the standing DCLS committee will recommend to the **Board of Directors** potential members to fill committee vacancies. The officers of this committee are the Chair and Vice-Chair. The Chair and Vice-Chair will be selected by the DCLS Committee from the MLS professionals serving on the committee. Each will serve a one (1) year term, with the option to serve an additional year.

**Committee Observers:** Stakeholders in DCLS development, implementation, and on-going quality should attend Committee functions and offer guidance concerning DCLS programs, practice, and professional
issues but will not have a vote in Committee determinations. The observers should represent universities offering or planning to offer DCLS programs, DCLS candidates, potential DCLS program applicants, DCLS employers, both existing and potential, industry partners, and anyone interested in furthering the concept of the DCLS. Interested stakeholders should forward contact information to the DCLS Committee Chair to be added to the email list to receive notification of meetings.

Committee Responsibilities:

- Assist in establishing a means for DCLS Programs to share resources including courses and faculty.
- Provide input and expertise for the development of educational and professional standards (professional responsibilities, Body of Knowledge, curriculum and practice models, etc).
- Maintain ongoing communication with NAACLS applicable accreditation and certification boards regarding DCLS Standards and facilitate the consistent interpretation of these standards globally.
- Collaborate with healthcare professionals who support the concept of the DCLS to address issues regarding DCLS programs and employers.
- Facilitate and maintain standardization and certification of the DCLS through support for task analysis, and continuing evaluation of formal educational and applied clinical competencies, and identification of and collaboration with appropriate federally-approved certification boards.
- Seek resources for financial assistance for DCLS students through scholarships, residency stipend models, or other means from professional, private, and public sectors.
- Collaborate intra- and inter-professionally to market DCLS practitioners throughout the healthcare industry and to the public.

Committee Meetings:
The Committee meetings will shall meet:

- There shall be at least two meetings annually, one during the annual ASCLS meeting and one during the annual Clinical Laboratory Educators’ Conference (CLEC) which will include an open forum for attendance by interested parties.
- Additional meetings may take place be conducted by conference call as determined necessary by the Chair.
- Include a committee meeting at the annual Clinical Laboratory Educators’ Conference (CLEC)
- Include a committee meeting during the annual ASCLS meeting— which will include an open forum for all interested members.
1. Kay Southern authorized an increase to the Dan Southern Scholarship from $1500 to $2000, to be offered in the 2015-16 scholarship cycle.

2. Notified the AMTF Scholarship Selection Committee about the funding authorized for the 2015-16 cycle: Southern $2000, Rodak $1500, Kanuth $1500, Dolbey graduate $3000, Dolbey MLS $1500, Dolbey MLT $1000x2. (NOTE: Trustees voted to provide an additional $1000 Dolbey MLT scholarship this year to a student whose ranking was higher than two MLS scholarship awardees.) No scholarship or grant awardees can attend the awards ceremony.

3. Kleiner awardees were notified, and Madhuchhanda Choudhary (winner), Lynne Williams (honorable mention) will attend the 2016 Awards Ceremony in Philadelphia. Still waiting for the second honorable mention to reply.

4. Ms. Judy Kleiner, donor for the Kleiner Award, will attend both the ASCLS Awards Ceremony on 8/3/16 to present the Kleiner Award, and the AMTF dinner that evening, as guests of E&R. Hotel for one night and dinner costs are covered.

5. Grifols Diagnostics $1000 donation toward the Rodak scholarship was received on June 7. This is the first fruits of the vendor contact effort made at the 2015 LabExpo. Bill Pierce and J.R. Constance are organizing the contact effort for the 2016 annual meeting.

6. Trustees approved the design for an E&R banner for display at the 2016 Silent Auction, and it is being printed by Aztec Printers in Wilmington DE ($75). Three-inch buttons saying “Ask Me about E&R” for the Trustees to wear have been made, plus brochures about E&R to hand out as folks pick up their auction number, all to enhance the connection in attendees’ minds between the auction and E&R. Lisa Bakken and her SA team are revising the Silent Auction flyer to send out to all state presidents and to all meeting attendees.

7. George Fritsma volunteered to be the E&R rep for the ESA’s abstract review process for student posters at the annual meeting.

8. Lisa Bakken has been appointed to complete the term begun by Bunny Rodak, and will coordinate the Silent Auction this year. Mike Sutch (Ortho) will join as the Industry representative and Rita Heuertz will fill the position open as George Fritsma completes his second term.

9. Trustees approved the second extension of Tim Randolph’s 2011 Member Grant following documentation of the unforeseen difficulties in getting human subjects. Report is due July 1, 2017.

10. Two Member grants were approved by the Trustees for funding approval ($5000 each). There were no Spradling (graduate student) grant proposals submitted this year. Mr. Spradling approved using the $3000 to sponsor the attendance of students to the 2017 Legislative Symposium. The funds will be divided evenly among all student attendees and require written reports. We will advertise this through ASCLS and have recipients nominated by their ASCLS Region Directors.

11. Grant reports were processed by the Trustees:
   a. Spradling grant report from Temitope Adeyeni from 2015 was accepted by the Trustees.
   b. Report from 2014 member grant awarded to Emily Hill was not forthcoming as of June 15. Follow up letters to her and to Teresa Nadder resulted in an apology and two reports. There was, however, a discrepancy between the amount listed as awarded ($5000) and the amount listed in the grant approval letter ($4980), with $31.07 returned to E&R. Requested Jim Flanigan to investigate.

12. Notified by ASCLS-GA President Lacey Campbell that there was no nomination for the Gilbert Award this year.
13. George Fritsma has provided information and encouragement to Precision BioLogic to consider endowing a scholarship memorializing a recently deceased spouse of a company employee. Even after George is off the committee, he will most likely pursue this!

2. Next meetings = conference call 7-14-16; face-to-face 8-1-16.

Concerns: None

Requests for Action: None
Activities since the ASCLS Interim 2016 BOD Report:

- Held GAC conference call meetings April 18, 2016, May 16, 2016, and June 20, 2016
- GAC face-to-face meeting March 13, 2016
- Presented ASCLS GAC information at ASCLS-Michigan Legislative Day September 30, 2015
- Attended ASCLS GAC Meeting/Laboratory Legislative Symposium March 13-15, 2016
- Attended ASCLS-Michigan Annual Meeting March 29-April 1, 2016
- Attended ASCLS-MI BOD meeting March 30, 2016 and June 4, 2016

Legislative Update:

- Public Health Issues currently at congressional level: Zika Virus, Opioid epidemic, 21st Century Cures legislation, and push to get Mental Health legislation completed.
- Workforce Issue: ASCLS is building a coalition of organizations to address the workforce issue and requesting a GAO study to collect data on laboratory workforce shortage.

Regulatory Update:

- PAMA rule published with following: (a) implementation of new fee schedule delayed; (b) applicable labs are those identified by National Provider Identifier (which may still eliminate most hospital labs), (c) no information yet on the type of data and format of data to be reported. ASCLS will work with Congress to make modifications in some of the provisions to keep dollars from leaving the lab.
- Recent changes in CLIA personnel regulations that will allow BSN nurses to do high complexity laboratory testing. ASCLS has sent data to CMS-CLIA about the lack of preparation of nurses to perform laboratory testing. Working with ASCLS members to also respond to new VA rules which would allow nurses to be laboratory directors.

GAC Committee Assignments

- ASCLS Today: Article from GAC on Biosecurity and Biosafety has been submitted and will be published with next publication.
- E-newsletter – Patrick Cooney – ASCLS Legislative Consultant - will develop an e-blast on current legislative issues.
• *Regulatory Alert* – Drafted and sent a regulatory alert to all ASCLS members on June 24 to summarize the final PAMA regulations.

**Regional Updates:**
- **Region I:** Rhode Island House Bill 7447 for reinstatement of licensure for laboratory personnel was referred to the House Health, Education and Welfare Committee for a hearing on Wednesday, March 16. The bill is getting a lot of publicity, and the new director of the State Department of Health supports the bill. A Massachusetts proposed licensure bill is being consulted on by an unknown laboratory organization other than ASCLS.
- **Region III:** In Tennessee, a bill (HB1800/SB2382) has been proposed that would allow those with no lab background to be laboratory directors in hospitals with fewer than 30 beds. It is felt that the bill’s language is contrary to CLIA regulations. COLA has been informed and has concerns about its legality.
- **Region VI:** A licensing effort for genetic counselors in Iowa has been reported.
- **Region VIII:** ASCLS-Idaho requested that the Idaho House Health and Welfare Committee hold their licensure bill in Committee while the organization meets with additional healthcare organizations around the state, as well as gathers more data about the quality of testing in Idaho. The bill will be re-submitted next January.
- **Region IX:** Alaska is in a fiscal crisis and therefore there is no additional movement on a licensure bill.
- **Region X:** The Theranos debacle has been the focus in CA.
- **Student and New Professional Liaison:** T Fruehling held conference calls for GAC students and new professionals on billing/coding and on how a bill becomes a law.

**Requests for Action:** None

**Concern/Request:** We are asking ASCLS members to visit with their US Congressional leaders when they are in their home districts during the July and August recess. Patrick Cooney will develop an informational sheet that will include key committee members from both the House of Representatives and the Senate that we would like our ASCLS members to meet with.
Report to: ASCLS Board of Directors
Report of: Judicial Committee
Prepared by: Scott Aikey, Chair
Date: June 29, 2016

There has been no activity required of the Judicial Committee this year to date.

Request for Action: None

Concerns: None
ASCLS Membership Committee Activities:

- ASCLS Membership Committee members have met by conference call on the first Monday and Saturday of each month beginning August, 2015.
- Committee member attendance has been consistent at about 65%. One student rep has been absent from all calls. Region III rep was replaced in January and has attended one call.
- **ASCLS Voices Under 40**: Several calls for nominations and reminders were sent to ASCLS members. An SOP was finalized detailing the Voices process; nomination form, judging forms, notification forms, template letters to applicants and employers, template for spotlights, etc. Fifteen nominations were received by the deadline of May 1; nominees were rated by seven committee members. Notifications were sent to all nominees by June 5th; letters sent to employers by June 18th, honoree names submitted to Awards committee by June 2. Recognition will take place at the ASCLS Member Awards ceremony on August 3. The committee has reviewed the Voices process and recommended changes for the next year.
- Member Rewards promotion was tweaked this year and there was very little participation.
- ASCLS Group Membership Package information: Group packages have increased with a consistent interest among educational programs and a building interest among laboratory groups.
- A template for monthly communications to our members was developed and monthly updates have been sent out regularly beginning in August, 2015. These updates were posted on the Membership Matters group as well as on the Membership Committee page and in the Join section. Committee members were also charged with sending the communications directly to those they represent.
- ROI information for membership: beginning in January, each monthly update includes a bullet point detailing one member-only benefit. Examples include networking opportunities, leadership academy offerings at state, regional and national levels, and CMP membership offerings.
- New Professional representative, Lauren Maurer, served as our Facebook editor and posted updates from the committee as well as promotions such as the **ASCLS Voices Under 40** on a weekly basis.
- Lacey Campbell and Brandy Greenhill headed up the You Tube Video Contest again this year. The winning entry was submitted by Emily Young, South Dakota State University
- Lezlee Koch, South Dakota and Diane Stumpf, Idaho designed several graphic flyers to share with members. The committee promoted designing flyers for holidays throughout the year and agreed that having a graphic designer position on the committee would be very beneficial.
- Maddie Josephs submitted an article to ASCLS Today for the May edition

**Concern:** none

**Request for Action:** none

**Board Liaison:** Maddie Josephs
DATE: 7/13/2016
REPORT TO: ASCLS Board of Directors
REPORT BY: William Hunt, Nominations Committee Chair
RE: Report for the Annual Board of Directors Meeting, July 2016

Goals for the Year
1. Present the ASCLS members a full slate of qualified candidates.

Activities Completed Since Interim Board Meeting:
1. Candidate photos and bios were submitted to Cheryl Caskey for inclusion in the April ASCLS Today.
2. The Nominations Committee Chair sent a “Thank You” to the candidates running for offices/committees. The “Thank You” e-mail included the candidate presentation times and ASCLS campaign regulations.
3. Members of the Nomination Committee voted for the President Elect Question from a selection of several suggestions. After much discussion The PE Question was decided unanimously by the Committee. The Question was then sent to the President Elect candidate. The candidate is being asked to respond to: "ASCLS and the entire practice field is at a time of great change. New leadership is emerging while long valued leaders are retiring; new technologies continue to drive our profession forward; and we as professionals are being encouraged to transform into a new type of healthcare provider who plays a more consultative role in patient care. What strengths do you possess that will position ASCLS as a strong, relevant professional organization leading our practice field through these exciting, yet challenging, times of change?"

Activities Ongoing:
1. Candidates will be introduced at the Annual Board of Directors Meeting and the Professional Issues Update/Open Forum. Delegates will also have a chance to meet and interview the Candidates at the Meet the Candidates Sessions Monday, August 1st 4-5 PM.
2. The candidate’s photos and bios will be on display by the Registration Desk at the ASCLS National Meeting.
3. During the past year new Candidate Information Forms (CIF) have been developed for each position. Candidates will more easily understand the requirements.
4. Nominations Committee Calendar, Rotation Schedule for ASCLS Election and the Candidate Information Form (CIF) will be updated for review by the 2016-2017 Nominations Committee.

Activities Planned:
1. The 2016-2017 Nominations Committee will meet during the National Meeting to start plans for the coming year on August 4th 7:30-8:30 AM
2. The Nominations Committee will discuss proposing the following changes to the ASCLS SOP for the Board of Director position qualifications and Nominations Committee position qualifications:
   a. Article V Board of Director, B, 2, c
      i. Must have been a Delegate to the National Meeting 3 of the last 5 years.
      **Change to:** Must have attended the House of Delegates at the National Meeting 3 of the last 5 years.
      **Rational:** This language does not exist for PE or Sec-Treasurer and many more experienced members do not serve as Delegates but attend the House of Delegates so newer members may serve as delegates.
   b. Article VII Committees, Nominations Committee A, 1, a,2), 2
      i. Member of a national task force, committee or Board of Directors within the last 5 years and attendance at a minimum of 3 of the last 5 Annual meetings with a preference given to individuals also serving as Delegates.
      **Change to:** Member of a national task force, committee or Board of Directors within the last 5 years and attendance at a minimum of 3 of the last 5 Annual meetings.
**Rational:** The Nominations Committee only checks candidates to see if they meet the minimal qualifications. They do not give a preference.

**Concerns:** None

**Requests for action:** None
Regional Director candidates must have attended at least two regional council meetings in the last five years (Attendance of the Regional Council meeting at the National Meeting counts)
Must have been a Delegate to the National Meeting 3 of the last 5 years.

Should we make a request to change the wording in the SOP's. (Not in bylaws)

1. Make it the same as the PE or Sec-Treasurer deleting the language.
2. Change wording to: Delegate or Alternate 3 of the last 5 years.
3. Change wording to: Attended the House of Delegates at the National Meeting 3 of the last 5 years.

Personally prefer #3. If you are going to be Regional Director you should know how to run a Regional Council Meeting. As we have discussed many experienced members let "less experienced" members serve as delegates at the house so they gain experience. (The "experienced" either serve as Alternates or sit in the gallery.)

Nominations Committee:

a. Professional or emeritus members, who are and have been active members in the Society for ten (10) years or more prior to election. No officer or director, elected or appointed, of this Society is eligible.

b. Member of a national task force, committee or Board of Directors within the last 5 years and attendance at a minimum of 3 of the last 5 Annual meetings with a preference given to individuals also serving as Delegates.

Not sure how we on the Nominations Committee give preferences to individuals also serving as Delegates. If a nominee is qualified we don’t actually vote to take them off the ballot!!

Should we request the following modification to the
SOP’s:

a. Member of a national task force, committee or Board of Directors within the last 5 years and attendance at a minimum of 3 of the last 5 Annual meetings with a preference given to individuals also serving as Delegates.
Report To: ASCLS Board of Directors  
Report Of: ASCLS Political Action Committee Board of Trustees  
Submitted For: ASCLS Annual Board Meeting  
Prepared By: Theresa R. Fruehling, Chair PAC Board of Trustees  
Date: July 1, 2016

PURPOSE:
A voluntary non-profit organization created to provide financial and educational support for the election campaigns of responsible candidates for Congress.

ACTIVITIES:
Committee goals:
- Raise funds for allocation to members of Government who support the betterment of Clinical Laboratory Sciences
- Raise awareness among members of ASCLS about the importance of using their voice
- Help fund Legislative Days and other member activities which voice our professional concerns to our Congressmen and Senators

Activities towards goals:
- Legislative Symposium Activities:
  - Pin color: Rose Quartz
    - Set price: $20.00
  - Announced the PAC “Revolution”
    - The beginning of a new direction for PAC
    - Annual PAC Appreciation dinner: dinner to thank our donors featuring a guest speaker (political figure) discussing the importance of donations, interactions with Congressional members, and using our voice
  - Inaugural dinner to be held Monday night, August 1st
  - Established donation criteria for invitation
    - Annual donation totals for 2016 dinner:
      - $150.00 per individual
      - $300.00 per individual to be recognized as a ‘Gold’ donor
      - Gold donors are encouraged to form “Golden” tables; with the table bringing in the highest donation receiving ‘special attention’ during the dinner and the honor of sitting with the featured speaker
• PAC Standard Operating Procedures (SOP’s):
  o Developed in order to establish helpful guidelines for members of ASCLS:
  o Completed:
    ▪ PAC pin request
    ▪ Donation Verification (National)
    ▪ Could be used for states
    ▪ Regional/ State PAC FAQs
      ▪ Technically not an SOP, but provides information to commonly asked questions

• Additional PAC materials:
  o Example of how to complete the ‘Evans & Katz Voluntary Contribution’ form posted to website
  o Fundraising ideas sent to state and regional representatives

• Compiled donation information:
  o Manually compiled into database 800+ names:
    ▪ Donation information obtained from:
      • 2015 ASCLS National Meeting
      • 2015 ASCLS Fall State meetings
      • 2016 Legislative Symposium
      • 2016 ASCLS Spring State/ Regional meetings
      • Donations via website
    ▪ Database used to determine:
      • State winners for National
      • Identify donors for PAC dinner
      • Regional rankings
      • Average donation per event

• Conference call:
  o Held two separate Nation-wide conference calls in early March for all PAC Chairs, State Presidents, and/or Regional Directors
    ▪ Conducted separate calls with PAC representatives when additional information was requested by said representative
  o Held monthly/ bi-monthly conference calls with National Board of Trustees
    ▪ Conducted separate calls with members of the Board of Trustees if they were unable to make the conference call

CONCERNS:

REQUESTS FOR ACTION:
Activities: February 22, 2016 through July 1, 2016:

Held 4 monthly conference calls, one each in March, April, May and June.

Charge #1: 1. Continue to publicize and distribute current ASCLS developed Patient Safety products and publications. Coordinate with other ASCLS Committees such as Membership Committee, Product Development Committee and the Scientific Assembly, as appropriate.

Publicity documents have been developed and shared at each ASCLS meeting and requests were made of state and regional meetings to do the same.

Charge #2: Design, develop, publish and distribute new patient safety products, as needed.

The Committee developed and administered a survey of the membership to evaluate their needs with respect to patient safety products.

Charge #3: Continue to develop and provide patient safety curriculum for faculty to incorporate into the MLS and MLT curricula, coordinating with NAACLS.

Three members of the committee, Stacy Walz, Karen Golemboski and Cathy Otto are in the second year of the two year study to examine a patient safety curriculum in MLS programs.

Charge #4: Support evidence-based research in patient safety and patient safety policies.
   a. Identify patient safety research projects and potential collaborators and submit grant to funding agencies (or other funding sources).
   b. Work with CDC Laboratory Medicine Best Practices to identify data sources for systematic review and evaluation methods used to conduct review of practice effectiveness.

No request for action or data has been requested from the CDC since the MOU was signed in Fall 2013.

Charge #5: Work with the Promotion of the Profession Committee to prepare clinical laboratory professionals to take responsibility for improving their consumer advocacy as it applies to patient safety issues.

The Committee has developed short case study scenarios to address each of the 6 quality aims (safe, effective, efficient, timely, patient-centered and equitable) to use as part of the Patient Safety It is Up to Me Campaign.
Charge #6: Strengthen media response to patient safety issues and promote the value of the clinical laboratory profession.

The ASCLS Patient Safety Committee completed its first year of its collaboration with COLA and their www.labtestingmatters website. Twelve monthly blogs written by Committee members were published on the labtestingmatters website. We promoted these blogs with ASCLS social media sites: Facebook, LinkedIn and our ASCLS community forums.

This was highly successful, the Committee has plans to continue this in 2016-2017.

Charge #7: Continue to develop and revalidate existing patient safety tools and resources available through ASCLS and publicize their availability in ASCLS Today, mailing lists, the ASCLS website, and social media as appropriate. During the revalidation, identify articles to support included information, and include that information on the Patient Safety page of the ASCLS website.

The Committee has updated some of the Patient Safety Tips Flyers. All documents need to be reviewed and revised if necessary. More information needs to be added to the Patient Safety page of the ASCLS website.

Charge #8: Write at least two articles for ASCLS Today describing the importance of the activities of the Patient Safety Committee, including positive outcomes/accomplishments, and the patient safety materials developed.

A second article was submitted for the June issue of ASCLS Today.

Charge #9: Identify the next steps in the process of incorporating patient safety competencies into clinical laboratory science practice identified by the ASCLS Patient Safety Position Paper.

The Committee is working on identifying further steps to incorporate patient safety competencies into clinical laboratory science education practice through the accreditation process.

Charge #10: Work with the DCLS Committee on developing specific patient safety competencies to be incorporated into the DCLS Competencies document.

Karen Golemboski and Cathy Otto have been attending the DCLS Committee conference calls and sharing information from the Patient Safety Committee. Patient Safety Competencies have been incorporated into the DCLS Competencies document.

Concerns: None

Request for Action: Move that the ASCLS Board of Directors expand the number of 'regular' members of the Patient Safety Committee from 8 to 12 and restructure the committee so that there are two work groups: 'Products and Promotion' and 'Education and Research'.

Rationale is listed on the following pages.

Committee Members:
Cathy Otto, Chair
Karen Golemboski, Vice-chair
Jennifer Dawson
Joni Gilstrap, Board Liaison
Elissa Passiment, Staff Liaison
Susan Morris
Lezlee Koch
Stacy Walz
Lisa Bakken
Pam Meadows
Tera Webb
Heather Chapman
Amanda Horn
Tera Webb
Brianna Miller, Observer
Elizabeth Leibach, CDC Liaison
Jason Frazier
Since the Patient Safety Committee became an official committee in 2010, it has had three foci: Product Development (to include educational products for patients and practitioners), Education (future and current practitioners) and Research. Each year we have focused on 3 to 5 activities listed in the charges. In many cases, the activities that the Committee completed were complex and required input from a majority of the committee members. The hallmark of the success of this committee has been the collaboration that occurs during conference calls when committee members identify issues and brainstorm solutions. On average 6 committee members participate on these calls each month. Expanding the number of committee members to double its current size and then assigning specific charges to two subgroups will ensure that more work is accomplished in a shorter period of time.

The work of this committee is important to ASCLS and most of all to the profession. With the latest publication of *Improving Diagnosis in Health Care* from the National Academies of Science, Engineering, and Medicine (Institute of Medicine (IOM)) improving patient safety is going to be more important. Other healthcare professionals (medicine, pharmacy and nursing in particular) have incorporated patient safety quality aims and healthcare competencies into their practice and curricula for preparing future practitioners. We have yet to incorporate the IOM identified healthcare competencies into preparing future laboratory professionals. Our certification exam does not require candidates to answer questions specific to IOM identified patient safety competencies. More committee members who spend their time on a specific focus will provide a better opportunity to address these opportunities for our profession.

**Current Structure of Patient Safety Committee**

This is what the SOPs indicate are the make-up of the committee:
8 'regular' members, one of which is chair, one of which is vice-chair
2 new professional members
2 student members
1 board liaison
1 staff liaison

This year we also have (not listed in the SOPs) 1 CDC liaison (We have an MOU with them for when they need data for processes, we are one of their primary resources. Since this was signed in Fall 2013, we have not been asked for any data.)

And we also have 1 'Observer'. We often have more, people who have been on the committee in the past or who are interested in our work, but did not receive an appointment to the committee. The use of observers has been a great way to continue to incorporate the expertise of previous committee members and for the development of future committee members.
Proposed Structure of the Patient Safety Committee

Purpose of New Structure: To fulfill the charges given to the Committee, and to advance the profession in providing laboratory services that are safe, effective, efficient, timely, patient-centered and equitable using 21st Century healthcare practitioner competencies.

Request: To expand the number of 'regular' members from 8 to 12.

Proposed Structure:

12 'regular' members, one of which is the chair, one of which is the vice-chair and there are 2 work group leaders (the chair can be the leader of one group and the vice-chair the leader of the other group), one for each of the work groups: "Products and Promotion" and "Education and Research"

The Committee will have 12 'regular' members.
2 new professional members (so that there will be one on each work group).
2 student members (so that there will be one on each work group)
1 board liaison
1 staff liaison

Assigning the Charges to the Workgroups

To demonstrate how this would work using the current ten charges for the Patient Safety Committee, this is how the two workgroups would divide these charges so that each subgroup can focus upon charges that are related to each other.

1. Continue to publicize and distribute current ASCLS developed Patient Safety products and publications. Coordinate with other ASCLS Committees such as Membership Committee, Product Development Committee and the Scientific Assembly, as appropriate. (PRODUCT & PROMOTION)

2. Design, develop, publish and distribute new patient safety products as needed. (PRODUCT & PROMOTION)

3. Strengthen media response to patient safety issues and promote the value of the clinical laboratory profession. (PRODUCT & PROMOTION)

4. Continue to develop and revalidate existing patient safety tools and resources available through ASCLS and publicize their availability in ASCLS Today, mailing lists, the ASCLS website, and social media as appropriate. During the revalidation, identify articles to support included information, and include that information on the Patient Safety page of the ASCLS website. (PRODUCT & PROMOTION)

5. Write at least two articles for ASCLS Today, one preferably in fall describing accomplishments/activities of previous year. (BOTH)
6. Continue to develop and provide patient safety curriculum for faculty to incorporate into the MLS and MLT curricula, coordinating with NAACLS. (EDUCATION & RESEARCH)

7. Support evidence-based research in patient safety and patient safety policies
   a. Identify patient safety research projects and potential collaborators and submit grants to funding agencies (or other funding sources)
   b. Work with CDC Laboratory Medicine Best Practices to identify data sources for systematic review and evaluation methods used to conduct reviews of practice effectiveness (EDUCATION & RESEARCH)

8. Identify the next steps in the process of incorporating patient safety competencies into clinical laboratory science practice identified in the ASCLS Patient Safety Position Paper. (EDUCATION & RESEARCH)

9. Work with the DCLS Committee on developing specific patient safety competencies to be incorporated into the DCLS Competencies document. (EDUCATION & RESEARCH)

10. Work with the Promotion of the Profession Committee to prepare clinical laboratory professionals to take responsibility for improving their consumer advocacy as it applies to patient safety issues. (PRODUCT & PROMOTION)
To:   Board of Directors  
From:  Product Development Committee  
For:   Annual Meeting  
By:   Lynda Britton, Chair  
Date:   June 17, 2016

Following are actions since the Interim Board Meeting:

1.  Conference calls occurred on April 18, 2016 at 12 PM CDT and April 20, 2016 at 7:00 PM CDT to meet most of the members’ schedules.

2.  MediaLab Courses  
   A.  MediaLab Courses in progress:  
      1.   *Lamellar Body Counts: Is This the Future*—almost completed but some small changes needed.  
      2.   *Molecular Testing in Blood Bank*: content has been reviewed; awaiting minor revisions.  
      3.   *Customer Service Skills in Phlebotomy*: Karen Larsen has agreed to produce a course in the fall but a contract has not been signed.  
      4.   *Emerging Pathogens*: Marcia Firmani signed a contract to update her CD and place it into MediaLab coursebuilder format. It is due July 1.  
      5.   Becky Tow has volunteered to produce a phlebotomy course and topics are being discussed.

   B.  We have agreed to add the reviewers’ name(s) to the courses to recognize their contributions.

3.  The App committee met by conference call on 4/18/2016 and discussed sending a survey to the Scientific Assemblies to request the following:  
   1.   Submit your ideas  
       We invite you to submit any leads to prospective snippets/links you would like to share with your professional community by filling out the survey HERE.  
   2.   Become a reviewer  
       As a member of the Scientific Assemblies, you can join other SA members who have volunteered to review the links and draft the snippets. Please register HERE.  

The development license (funded by ESA) has been purchased and first phase of app development is nearing completion.

5. The following products were reviewed and found to be outdated. It was the consensus of the committee that they not be placed in the new store.
   1. Lindsey – Forms—Completed
   2. Samantha – Clinical Chemistry—Completed
   3. Maya – Laboratory Medicine—done
   4. Two reviews are yet to be completed: Urinalysis and Clinical Chemistry in Spanish.

   Concerns: None

   Actions: None
A unique event happened at this year’s 4th USA Science & Engineering Festival in Washington DC, April 15-17, 2016. For the first time, three national laboratory professional organizations, ASCLS, AACC and ASCP, coordinated in providing a single experience for attendees, showing how WE do science. Titled, “Solving Medical Mysteries”, our exhibit had children of all ages doing a “who-dun-it” with rbc’s and antibodies (fake, of course), groans and ooooohs with very real worms in a jar, streaking agar plates, matching photos of gram stains, bacterial isolations and wbc’s with actual stained smears and University of Minnesota realistic painted isolation plates, guessing how color can be turned into a number with a colorimeter, reading a pulse oximeter, and what do those colored lines on a pregnancy test mean?

Handouts were provided from the ASCLS Patient Safety Committee on “Venipuncture safety tips” and “Do I need to fast?” as well as “Who does my lab tests?”

The ASCLS members who volunteered their time over one to three days of the weekend were Mary Ann McLane (DE), Mary Gourley (PA), Carol Rentas (DC), Elaine Pappamihiel (VA), Sally Cortez (NJ), Cynthia Dixey (NJ), Lucia Wang (NJ), Eric Hirtle (NJ), Lucy Pierre (MD), James Adams (MD), Stacey Robinson (MD) and Jean Bauer (MN). ASCP staff were Edna Garcia and Liz Waibel, and AACC-Capital Section volunteers were Ed Wong, Zhen Zhao, Eri Anastas, Kerry Walsh, Apurva Srivastava, William Wu, and Sarah Wheeler. Organizers estimate that over 60,000 students, teachers, military families, government officials and press attended Sneak Peek Friday, while roughly 300,000 people attended over Saturday-Sunday. We encountered toddlers to high schoolers, parents to chaperones, some barely interested to those asking 100+ questions, all in the name of demonstrating how wonderful OUR version of science is!

What a great, absolutely exhausting time we had! It was pretty much non-stop for 9-3 on Friday, 10-6 on Saturday and 10-4 on Sunday. Everyone agreed it was a superb event, and it would be a golden opportunity to participate in the 2018 Festival.

The materials used for the displays, and even the concept itself, can experience a second life in the future. Colleagues who want to hold their own “provide the face” career fair exhibit locally can ask Mary Ann McLane (mclane@udel.edu) for examples of the trifold pictures of bacterial gram stains, agar culture growth patterns, white blood cells on a differential smear, the commercial source for artificial blood and “testing antibodies”, as well as the ASCLS link for the pamphlets offered through the Patient Safety Committee. These supplies remain available for anyone to request, and they will find a new audience whenever the next Science Festival is held.

We are very grateful to all three organizations and the ASCLS Education Scientific Assembly for the funding needed to make a great display. We are so delighted that our colleagues from AACC and ASCP provided the collegial atmosphere in both planning and execution of this joint effort.
The combined ASCLS-AACC-ASCP team on Saturday, with three more added on Sunday:
Summary of Charges and Initiatives 2015-2016

1. Continue to develop and update promotional tools and resources available through ASCLS and publicize their availability in ASCLS Today, mailing lists, the ASCLS website, and social media as appropriate.
2. Collaborate with other clinical laboratory organizations to demonstrate the value of the profession to ourselves, other healthcare professions and to the general public.
3. Promote consumer advocacy among members as a means to demonstrate the value of the clinical laboratory profession to the general public.
4. Coordinate with Executive VP, and schedule articles for online Advance ‘ASCLS Voice' monthly column. Topics were discussed and determined for the upcoming year at the annual meeting.
5. Write two columns for ASCLS Today highlighting the activities of the PPC committee.
6. Work with the Director of Professional Development and Project Management to promote ASCLS materials for MLPW and provide resources for members with MLPW activities.
7. Identify one member to coordinate the Promotion of the Profession Fundraising Competition and coordinate with the Awards Committee on the presentation of awards at the ASCLS Annual Meeting.
8. Assist the Past President (Media Responder) with media responses, as needed
9. Develop a fund raising campaign for an appropriate charitable organization to be held in conjunction with the 2016 annual meeting.
10. Identify any promotional activities being undertaken by other ASCLS committees/forums and collaborate on these endeavors.

Report on PPC Activities since July BOD Report:

1. Charge 1: Jamie will continue to send updates to the ASCLS President for Society News Now and send updates to Karrie to activities from the PPC as well as resources for members.
2. Charge 2: Mary Ann and Ian have done a great job collaborating with AACC and ASCP to organize a joint booth at the USA Science and Engineering Festival April 14th-17th. The event was a great success. See attached report.
3. Charge 3: The 30 day #Lab4Life Challenge was done through the month of April. There was good participation and it was a lot of fun to read the daily posts. Jamie will adapt the poster so it can be done any month to promote awareness of the profession.
4. Charge 4: An article for Glen McDaniel was posted in Advance. Beth has already received the next article on DCLS. She has several articles lined up through September. Charlotte also wrote an article for Advance about high school outreach.

5. Charge 5: Jamie will write one article for ASCLS Provides HOPE and one article discussing the activities of the committee.

6. Charge 6: The call was during lab week but was going well. Sales are more than last year. Several activities were going on. The lab week run was VERY successful, selling out its registration. This will hopefully be an annual event. There were also the #IAMASCLS photo posts and the 30 day challenge. Karrie also mentioned that ASCP has a new marketing director and hopefully will be more united with the other committees in lab week promotion rather than doing their own.

7. Charge 7: Alice has been sending out regular emails reminding state societies to submit for the award. She has also created the hashtag #ASCLS_Cares. She is asking for pictures of fundraising events from submitting organizations that we can post on social media and show others what state societies are doing.

8. Charge 8: Charge 9: Philabundance will be this year’s recipient of the ASCLS Provides HOPE project. We will be hosting a food drive. We are set to go. We have already started to get donations online.

9. Charge 10: The lab week run was a great event we were honored to participate in the planning.

As chair of PPC, I would like to commend each and every member of this committee. Members participate in monthly conference calls, and there is full participation by each member in our numerous activities and projects.

**Concerns:**
None

**RFA:**
None
American Society for Clinical Laboratory Science

Goals for the year 2015-16
1. Submit a proposal for a roundtable session for the 2016 Annual Meeting.
2. Update and develop leadership development tools and resources and update the LDC Manual.
3. Work with constituent societies to appoint leadership development chairs in constituent societies and regions.
4. Establish a communication schedule to communicate regularly with constituent societies and regions.
5. Increase Keys to the Future participation to 100% in constituent societies.
6. Solicit articles featuring new leaders and past Keys to the Future awardees.
7. Work with the Leadership Academy Committee to solicit nominees to attend the next Leadership Academy class.
8. Demonstrate return on investment for membership/activity in ASCLS.

Activities
1. Communications: The monthly conference calls were held on March 8th, April 12th, May 10th, and June 14th. Much of the discussion over this quarter has centered on development of a resource to support the development of state and regional leadership academies and how this might impact the national leadership academy. The Leadership Academy Committee Chair and Vice Chair participated in the May call. We have completed our planned calls for the year and will be having our next meeting in person on August 1st in Philadelphia.
2. Keys to the Future: A total of 73 nominations were received from 34 constituent societies.
3. LDC Manual: An updated draft of the manual has been written. It is still in need of another review by the committee prior to publication.
4. Discussion Board: Monthly Tips were migrated from the old discussion board to the new one in March. Resources that continue to be relevant were migrated as well. The community is up to 37 members though there has not been any activity since March.
5. Roundtable: The session on successfully including students and new professionals in meetings is scheduled for August 3rd at noon.

Requests for Action: I move that the Leadership Development Committee and the Leadership Academy Committee have at least one appointed member in common.

We feel that there is sufficient overlap in our charges that both committees would benefit from enhanced communication. Each year our charges include working with the Leadership Academy Committee to solicit nominees for the Leadership Academy and developing leadership tools and resources. We spent much of this year considering the possibility of compiling resources for State and Regional Leadership Academies. We did not develop this resource because of concerns that we might somehow detract from the national level academy and what we were concerned might be a dwindling applicant pool.

Concerns: None
Summary of Charges and Initiatives for SA Coordinator

1) As more patients access their test results, facilitate ways to empower our members to provide clinical laboratory science expertise to the public, in addition to the Consumer Information web team.

2) Monitor activities of SA sections discussion group/member community. Identify those sections that may require help in strengthening activities and assist them with developing a plan for communicating with and engaging members.

3) Solicit a nominee for the Professional Achievement Award from EACH Scientific Assembly by working with the chairs of each SA and other individuals such as constituent society presidents. Review barriers to the lack of nominees.

4) Work with the Director of Membership to develop a method to welcome each ASCLS member as soon as they sign up for a specific SA section.

5) Ensure that each SA welcomes new ASCLS members to the section.

6) Review the SA Chair Manual with each SA chair.

SA Coordinator and Co-Coordinator Activities

1) Worked with Karrie Hovis regarding the Clinical Laboratory Investigations: Case Studies Editor in Chief position description.

2) Reviewed nominations for the BioRad Professional Achievement Award. There were five applicants with one being awarded to Hematology/Hemostasis, Lab Admin, Microbiology, and Chemistry/Urinalysis.

3) Created a subcommittee to review candidates for the Editor in Chief of Case Studies. There were many applicants. The subcommittee comprised of Ashlee Ketchum, Beth Warning, Kristin Croom and Linda Laatsch. The position was awarded to Teresa Nadder.

4) Updated SA manual to include the Editor in Chief of Case Studies position description. Other updates were included for Education Assembly.

Specific SA Chair Activities

Molecular Scientific Assembly – Kristin Croom

1) Wendy Lumm wrote paper on pharmacogenetics for the ASCLS Today.

2) Wendy Lumm and Dr. Barbara Kraj were able to prove Kyle some input regarding the documents for entry level curriculum.

3) Wendy and Kristin Croom volunteered to be judges at this year's poster presentations at the annual meeting.
Immunology/Immunohematology – Sharon Ziemba

1) Received no updates for Immunology/Immunohematology.

Microbiology/Public Health – Linda Britton

1) I have welcomed each new Microbiology SA member.
   a. As I receive a new member email from the ASCLS member community, I send an immediate response to those individuals welcoming them to our SA with an explanation of my role as Chair.
   b. I also give the new member a basic explanation regarding the Member Community as a whole and about the resources, discussion, and announcement areas.
   c. I have not received notifications of new members since April. Karrie Hovis was unsure if the new platform supports notifications of new members.

2) I have posted a request through the Microbiology/Public Health member community for poster judges. If there are not any responses, I will contact members directly.

Informatics – Andrea Pitkus

1) Member community active regarding US REALM HL7 Implementation guides which emerged in February, as well as mention of the April kick off call for pilots for those wishing to implement

Chemistry/Urinalysis – Shawna Martin and Maja Chloupkova

Vice Chair Masih Shokrani contributed 4 Articles and 1 corresponding Continuing Education Questions published, as senior and corresponding author, under FOCUS in the 2016 spring issue (Volume 29/Number 2) of Clinical Laboratory Science journal

FOCUS: NEW PERSPECTIVES IN DIABETES MELLITUS

Article 1: Introduction, Background and Various Types.
Authors: Michelle Renee Campbell, Masih Shokrani

Article 2: Diagnosis Modalities.
Authors: Michelle Renee Campbell, Masih Shokrani
Clin Lab Sci 2016;29(2):111-113

Article 3: Comparison of HbA1c and Glycated Protein Methodologies.
Authors: Michelle Renee Campbell, Masih Shokrani
Clin Lab Sci 2016;29(2):114-121

Article 4: Diabetes Management and Future Trends.
Authors: Michelle Renee Campbell, Masih Shokrani
CONTINUING EDUCATION QUESTIONS:
Authors: Michelle Renee Campbell, Masih Shokrani
Clin Lab Sci 2016;29(2):127-128

Presentations to be given:

**Oral Presentation:** Novel Approaches in Lipoprotein Testing and the Role of Lp(a)
Day: Tuesday, August 2, 2016  Time: 2:45:00 PM-3:45:00 PM
At the ASCLS Annual meeting in Philadelphia

**Poster Presentation:** Assessment of Relationship between Hemoglobin A1c and Highly Sensitive C-Reactive Protein Levels in Pre-Diabetic Individuals
Aug 2 and 3 at the ASCLS annual meeting in Philadelphia

Hematology/Hemostasis – Elaine Keohane

1. Sent welcome message to 1 new community member.
2. Vice-Chair, Kristin Landis-Piwowar will take over as Chair after the Annual Meeting. The Chair will ask for nominations for a new Vice-Chair in the Hem/Hemostasis community group and at the Scientific Assembly meeting in Philadelphia with a term as Vice-Chair for 2016-2018 and Chair for 2018-2020. A vote will be taken at the Scientific Assembly meeting in Philadelphia.

Phlebotomy – Karen Larson

1) Submitted an ASCLS Today newsletter article in the May edition on behalf of the Phlebotomy SA. It is about customer service tips in phlebotomy.
2) Karen Larsen will be resigning her position as chair at the end of nationals.
3) Karen will post to the community about the open position for the Phlebotomy chair position.

Point of Care – Marj Montanus

1) No activity since last report.
2) Chair Marj Montanus has resigned. She has taken on an additional job position and can no longer devote the time to this position. She will be unable to make it to the national meeting due to job restraints in limiting vacation due to hospital upgrade to Epic.

Laboratory Administration/Consulting/Quality Assurance/Accreditation/Industry – Ed Peterson

1) Updates not provided

Generalist – Connie Laubenthal
1) Due to health problems Connie Labenthal has resigned as chair. She will not be able to attend nationals. The vice chair will run the SA meeting on Tuesday and elect another vice chair for the upcoming year.

**Education- Sue Stalewski**

See separate reports for scientific assembly and subcommittees.

**Concerns:**

1) Members have expressed (via email lists) a dearth of qualified faculty for MLS programs. Is there action that can be supported by the ASCLS ESA? Will add as an agenda item for discussion at the Annual Meeting ESA Committee meeting.

2) The ESA is unable to take action except at the CLEC and Annual Meetings and as an active committee may need a means of gaining member input and approval outside of these events. The ESA is also the benefactor of CLEC profits, however, the amount, plan for use, and distribution of those funds is not clear to ESA members, chair and vice-chair. A preliminary discussion regarding these concerns needs follow up and I will do this before the Annual Meeting.

**Request for Action:**

1) DCLS: I move that the ASCLS Board of Directors restructure and reposition the DCLS Oversight Committee as an independent, permanent committee reporting to the ASCLS Board of Directors. (see attached DCLS subcommittee report for justification)

2) CEPI: I move that the ASCLS Board of Directors approve the revised Entry Level Curriculum documents and send to the House of Delegates for adoption. (see ASCLS web documents related to ELC)
Summary of Activities since February 2016

Vice Chair report:
18 poster abstracts were reviewed. 16 were accepted and the majority were accepted with revisions.
11 posters will be presented at ASCLS for judging.
One case study was submitted and the recipient, Matthew Glover, was awarded first place. He is a student at
Mississippi Baptist Medical Center, School of Medical Laboratory Science, in Jackson, MS.
Four research papers were submitted. The recipient of the award is Michaela Kinnetz. She is a student of Albany
College of Pharmacy and Health Sciences, Department of Health Sciences, Albany, NY.

18 colleagues volunteered to review abstracts with at least two reviewing each entry. Recognition to ESA VC Darius
Wilson for coordinating this effort and the on-site judging at the Annual Meeting.

Subcommittee related:
• Participated in Committee for Professional and Educational Initiatives (CEPI) communications. Complete
CEPI report attached. Major areas of focus include Entry Level Curriculum and career marketing materials.
CEPI has proposed a CLEC 2017 session related to clinical education.
• Participated in monthly DCLS conference calls. Complete DCLS subcommittee report attached
• Participated in Product Development Committee meetings regarding Educational APP development
  o $800 reimbursed to Carol Rentas for monthly app hosting (approved at Fen. 2016 ESA meeting)
  o Discussion regarding ASCLS ESA logo and presence on APP splash page initiated with Karrie Hovis.
    This aspect of the APP project needs to be further developed.

Other:
• I was recruited to serve on advisory board for Allied Health CAS, Liaison International. MLS programs
demonstrate low adoption of centralized application services and Liaison (via Matthew Anderson, Rush
University) is interested in learning more about MLS procedures. This will be an agenda item for the ESA
meeting in Philadelphia and I will also connect with others in ASCLS who have experience with CAS.

• Attended ASCLS Legislative Symposium on behalf of the CEPI committee and as a member of the Wisconsin
Delegation.

• Participated in revisions to SA handbook related to ESA and CEPI
AMERICAN SOCIETY FOR CLINICAL LABORATORY SCIENCE

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3. CEPI: I move that the ASCLS Board of Directors formally recognize the leadership of Joan Polancic (CEPI subcommittee chair) and Kyle Riding (ELC revision co-chair) for their excellent organization and facilitation of the revised Entry Level Curriculum process.

Attachments:
DCLS oversight committee report
CEPI report June 2016
Activities:

- Coordinated a meeting of those P.A.C.E.® Committee members attending the ASCLS Annual Meeting
- Updated committee mailing list
- Lead committee conference call on November 24, 2015 agenda that included the following topics:
  - a review of changes to the manual
  - training on how to review a self-study submission including
    - criteria for approval using the revised form
    - discussion of who should review a discipline and how to assess if a course is up to date including if the references are up to date
    - any links in on-line courses function
    - grammar should be excellent
    - is it relevant to our profession and at the level we would expect
    - how to calculate CEU’s to award
  - CE Collaboration URL name
  - Sticker color for 2016
- Reviewed self-study courses
- Reviewed committee membership for 2016-2017
- Responded to Communications

Future Activities:

Complete forms revision for the P.A.C.E.® manual.

Concerns:

- None

Request for Action:

- None

P.A.C.E.® Program Data:
(Data in this report provided by Andrea Hickey, P.A.C.E.® Coordinator, is through July 1, 2016. Note: P.A.C.E.® operates on the calendar year)

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* Self Study only provider category was discontinued beginning in 2015
Since the report to the Interim Board of Directors meeting in March, the ASCP Board of Certification (BOC) held its Spring meeting on April 15 – 16 Miami, FL.

Reports were presented by the sponsoring societies (ASCLS, ASCP, and AGT), participating societies (AABB, AAPA, ACM, ASC, CLMA, and NSH) and collaborating societies (AACC and ASH). In addition to the exam committee and standing committee reports, the BOG also heard reports from CAAHEP, NAACLS, and CCCLW.

**Examination Updates**

- The Medical Laboratory Assistant (MLA) examination will be available on July 1, 2016.
- With the financial support of the American Society for Apheresis (ASFA), the BOC developed a Qualification in Apheresis. The Qualification in Apheresis (QIA) was available starting in January, 2016.
- The BOC is in negotiations with ISAC (International Society for the Advancement of Cytometry) and ICCS (International Clinical Cytometry Society) to develop, administer, and maintain a new certification in Cytometry.
- The BOC was asked to develop a doctoral level examination in Immunology because the ABMLI (American Board of Medical Laboratory Immunology) doctoral level exam will be phased out beginning in 2016 with certification activities finished by December 2017. ABMLI will continue to offer recertification and certification verification for those already certified. The BOC did not approve doctoral level Immunology exam at the Spring meeting, but directed the Executive Director of the BOC to contact the Dean of the American College of Microbiology [at the American Society for Microbiology] to discuss the possible collaboration.
- On June 17, 2016 the BOC received notification of continued accreditation for 20 certification examinations. The ANSI accreditor commented the “ASCP BOC staff provided a well-organized surveillance application and supporting materials. They responded to all questions prior to the site visit knowledgeably and completely...This is a very large and complex program which is particularly well-managed.”
- The BOC Examination Committees meet annually and, this year, they reviewed the results of MLS and MLT practice analyses. After all the examination committees have met, the BOC staff will collate the committees’ decisions on the practice analysis and provide educators with updates on content when available.

**Management Updates**

- The BOG approved an increase in CMP fees to $95.00 effective July 1, 2016.
- There have been 10,954 certificants in calendar year 2015.
- CMP participation for calendar year 2015 was 21,696 total participants (includes required, reinstatement, and voluntary) up 14% from 2014. The required participation rate is 70%
- As of April, 2016, the BOC awarded 5,921 ASCPi certifications from 76 countries of education.
The BOC Website

The BOG reviewed some of the proposed web pages for the new BOC website. The ASCP has been working on a major revision of its website and the BOC pages are included in that overall site. ASCLS representatives to the BOC expressed a great deal of concern about the inclusion of ASCP membership information on the BOC pages. The Board of Governors voted to direct the BOC Executive Director to work with the ASCP Information Technology department staff to correct all web pages (pre and post login) as soon as feasibly possible by removing membership content from all BOC web pages.

News Briefs

The Editorial Committee, chaired by Scott Aikey, developed and distributed news briefs to BOC partner organizations. These are intended to be shared in newsletters and on social media. Examples include “MT or CLS or MLS - What’s in the name?” and “Licensure versus Certification”.

Governance:

- The Board reviewed the Executive Committee’s recommendation for the BOG governance structure. In the new model the Chair Elect and Past Chair will serve one year terms and the Chair will serve a two year term.
- Linda A. Smith, PhD, MLS(ASCP)CBMBCM was elected to a three year term as an ASCLS representative the ASCP Board of Certification Board of Governors. She will begin her term in the fall of 2016, replacing Susan Morris.
- The following nominations for the Executive Committee were approved:
  - Chair: Kathleen Hansen, MLS(ASCP)CM
  - Chair-Elect: Susan M. Harrington, PhD, D(ABMM),MLS(ASCP)CM
  - Secretary: Scott E. Aikey, MLS(ASCP)CMDLMCM
  - Financial Officer: Sui Zee, MD, FASCP
  - Member-at-Large: Laura Bilodeau, MD, FASCP
  - ASCLS Representative: Susan Beck, PhD, MLS(ASCP)CM
  - AGT Representative: Helen Bixenman, MBA/HCM, CHC, CG(ASCP)CMDLMCM
  - Participating Society Member: Patty Eschliman, MHA, MLS(ASCP)CMDLMCM
  - Immediate Past Chair: Karen A. Brown, MS, MLS(ASCP)CM

On a personal note:

Scott Aikey, Susan Beck, and Kathy Hansen would like to thank Susan Morris for her seven years of service as an ASCLS Representative to the ASCP Board of Certification Board of Governors. Susan’s service began before her term of office when she served on the ASCLS team negotiating the merger between the NCA and the ASCP Board of Registry. Susan’s ability to forge relationships and trust were instrumental in the success of the merger negotiations. Once on the Board, Susan served on the important Nominations Committee and she ensured that ASCLS representatives were present on the BOC Executive Committee. It has been an honor to work with Susan Morris in these important years in the history of certification in the clinical laboratory science profession.
Coordinating Council on the Clinical Laboratory Workforce

To: ASCLS Board of Directors
Re: CCCLW Annual Meeting Board Report
Prepared by: Rick Panning, ASCLS Representative, CCCLW
Date: July 3, 2016

The Coordinating Council on the Clinical Laboratory Workforce continues its mission of being a united voice of clinical laboratory organizations and stakeholders, focusing our collective efforts to:

- Increase the number of qualified clinical laboratory professionals.
- Increase healthcare and public awareness of our value in achieving positive patient outcomes.
- Enhance the image of clinical laboratory professionals.

Opportunities
- Control our profession’s destiny and get a seat at the healthcare “table”
- Impact the care process and public health like only our profession can

Creation of two teams to address new focus:
- Measuring Value Project (Data team): Obtain metrics necessary to provide objective evidence of lab professionals positive impact on patient outcomes
- Collaboration/Communication team: Deliver the story the evidence tells through collaboration and a unified voice within the laboratory profession

Meetings for March-June 2016:
- CCCLW Expert Panel meeting on March 7-8, 2016 (Elissa Passiment representing ASCLS)
- Meeting on June 20, 2016 in Chicago (Jim Flanigan, EVP and Rick Panning, ASCLS Representative)
- Steering Committee:
  - Steering committee calls (Rick Panning as communication workgroup chair) on March 25, April 18 and May 13.

Current Activities/Initiatives

1. Current member organization (CAP, APHL have decided to leave organization).
   - AACC
   - AGT
   - AMT
   - ASC
   - ASCLS
   - ASCP
   - ASHI
   - ASM
   - BOC
   - CLMA
   - NAACLS
   - NSH
   - Ortho
   - VA
2. Financial report
   - Since March 2016
     - Income $12,500 from rants from ASCP and AMT for Expert Panel
     - Expenses of approximately $16,300
     - Balance prior to June meeting = $15,788
     - Decision had been made not to assess 2016 dues as balance would cover costs for remainder of 2016
     - ASCLS will continue to maintain the treasury and allow use of credit card for meeting expenses.

3. Measuring Value Team Project Update – Paul Epner
   Literature Review progress report:
   - Teresa Nadder chairs. Meeting regularly since March, pulled 70 articles for review. Summarized into a grid format. Still problems with definitions of value and various pieces of literature. Most of the articles are review or commentary in nature. May need to expand the literature.
   - Outcomes: Patient, family, clinicians, administration, public health, CMS
   - Goal to complete by the end of Nov. for adequate timing for an expert panel in January.
   - First draft of survey of current measures in practice has been completed. Ready to launch survey in October. ASCLS Admin will be used to circulate the survey.

4. Expert Panel meeting – replaces CCCLW December meeting
   - Expert panel meeting on March 7-8 was a success and provided a good start for the project. Ed Peterson represented ASCLS.
   - Literature review, chaired be Theresa Nader will be published
   - Current measures survey was summarized
   - Paul Epner developing a 2 page executive summary

5. Communication/Collaboration: Executive summary of the change in focus of CCCLW to concentrate on the laboratory profession’s value proposition and associate data team.

6. Website updates
   - Vendor selection: Orange Wave for updating both CCCLW and LabScienceCareers.com
   - Kathy Cilia (AMT), Michele Smith (ASCT), JR Constance (ASCLS) and Jason Yuhas (APHL) serve on the website committee.
   - A preview of the new website was shared on June 20, 2016. [http://preview.editmysite.com/j9edc6.a48a704eb6cd7683c7231f7e382e2a22](http://preview.editmysite.com/j9edc6.a48a704eb6cd7683c7231f7e382e2a22)
   - At June 20 meeting, members split into workgroups to review preview version of website and make recommendations for changes and additions. The output from this process will be provided to the vendor and website committee to make changes.
   - Identified need for editorial board to keep information current
   - Workgroups:
     - Main page: About the organization, why this site, member organizations, contact us
     - FAQs for Administrators, FAQs for Education, News, News/Blog spot
     - Resources – Articles and presentations, Recruiting resources, Awareness campaign, WorkForce data
     - Materials to add:
       - Consolidated executive summary of CCCLW accomplishments
       - New and on-going workforce-related activities
       - Opportunities for organizations to collaborate
       - Key messages, and Position statements
7. **Labsciencecareers.com website**: discussed new structure, content revision, maintenance and ongoing support

8. **Steering committee/leadership**
   - Hilary Blair (ASCP) and Kathy Cilia have volunteered for the next 2 year term on the steering committee. (in addition to current members Steve Zibrat (AACC) and Rick Panning (ASCLS)
   - We are still following up to identify a CCCLW chair. Susan Morris (BOC) has indicated she would serve another term

9. **Summary**
   - September meeting will be a conference call
   - Website: Meeting power point sent out to all. Send list of content changes from each team to Susan by July 1
   - Labsciencecareers.com: Send Word document of old content to all for review. Send recommendations for minimal changes to old content for loading onto LSC as a starting point. Proposal to ASCLS Leadership Academy to design LSC new content

**Requests for Action**: Request to the leadership of the Leadership Academy to take on redesign of Labscience careers website and propose new content as their 2016-2017 project.

**Concerns**: None
About the Health Professions Network (HPN):

The HPN represents 80 member associations and works to promote collaboration and serve the interests of allied health professionals from 200 different health professions as well as educators, regulators, accrediting agencies, and government agencies. Since its founding in 1995, HPN has worked to advance and explore current issues relevant to health professions.

I represented ASCLS at the HPN Board of Directors monthly Conference Call Meetings. I continue to serve as HPN’s Treasurer and Finance Chair.

The HPN continues to work with national stakeholders in the series of Summits being held. The theme of this next Summit was “Communication & Dissemination in Healthcare” which was held April 4-8, 2016, in Atlantic City, NJ. Speakers and presentations included:

I also represented ASCLS at an HPN working meeting in Dallas, TX, May 22-24, 2015, where we focused on following up to complete work planned from the HPN collaborative meeting that was held in Jan in Atlanta to address the gap analysis of the DOL Competency Model crosswalked with the National Health Science Standards. This work group completed filling in the gaps for a planned second generation DOL Competency Model. More to come.

Additional HPN notes:

The HPN continues working to implement a two-pronged consumer awareness campaign: One, to create awareness of the health professions and the career opportunities in these fields; two, to address the more fundamental issues (lack of clinical sites, shortage of faculty, inadequate program funding, issues with credentialing and licensure). The economic downturn, for the short term, has obviated the need for the first goal—awareness of the health professions is already there—so now we must face the second challenge.

The HPN will continue to further develop its relationships with HRSA, DOE, etc., to potentially complement national missions and initiatives.
The HPN is working to strengthen the organization, communicate membership benefits to a larger audience, recruit and engage new members and organizations, develop revenue-generating activities, and enhance relationships with other key health care organizations, to ensure a two-way dialogue between HPN and member organizations. Other goals include:

- Increase public awareness of the health professions
- Recruit students into health care fields
- Serve as an informational resource for policy makers re: health workforce
- Undertake a multifaceted communications plan and PR campaign (making use of Web 2.0 and social media networking)

**HPN Meeting schedule for 2015-16**

Fall – September 30-October 3, 2015    Seattle, Washington
Spring – March 29-31, 2016    Atlantic City, NJ

**Request for Action:**  None

**Rationale:**  N/A
Activities for February 22, 2016 through July 1, 2016:

Submitted: Annual Report 2016 for the Chief Delegates Meeting at the World Congress in Kobe, Japan August 31--September 4, 2016

Posted a request on the ASCLS Membership Community for individuals to apply to serve on an IFBLS Advisory Group for Microbiologists

Submitted abstract for presentation on Patient Safety at the invitation of the Planning Committee for the IFBLS World Congress

Registration for the World Congress is available through July 31, 2016

Concerns: None

Request for Action: None
Introduction:

The concept of interprofessional patient care teams to provide more effective medical care for patients has been promoted for decades.\(^1\)\(^-\)\(^5\) These teams usually consist of the admitting physician, hospitalist physicians, nurses, doctoral pharmacists, health profession therapists, and social workers. Professionals from the clinical laboratory are conspicuously absent from these teams, yet many medical decisions (diagnosis, therapy, discharge, etc.) rely on laboratory test results.\(^6\) With a plethora of clinical laboratory tests and new molecular methodologies being added to the clinical laboratory test menu, clinicians are challenged with keeping abreast of the latest in laboratory services.\(^7\)\(^,\)\(^8\) Technological advancements in laboratory informatics, patients’ ready access to laboratory test results, and personalized/precision medicine place the clinical laboratory in the center of patient-centered care.\(^9\)\(^-\)\(^13\) Thus, medical laboratory professionals can be key members of the interprofessional health care team. Development of certified Medical Laboratory Scientists to assume a role as a member of the interprofessional health care team requires additional education to acquire advanced knowledge and skills.

Background:

In 1999, the Institute of Medicine (IOM) reported that an estimated 44,000 to 98,000 hospitalized Americans die each year from preventable medical errors in a health care system that is fragmented with inadequate systems to protect patients.\(^14\) An evidence-based analysis of more recent data increased the estimate of preventable patient deaths in U.S. hospitals from 210,000 to over 400,000 each year.\(^15\) In addition to this tragic human toll, medical errors waste billions of health care dollars annually.\(^14\) In a follow-up publication in 2001, the IOM specified six aims to improve the delivery of health care so that it is safe, timely, efficient, equitable, patient-centered, and effective based on scientific knowledge.\(^2\) In 2003, the IOM specified five core competencies for health care professionals, namely, the ability to provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, apply quality improvement, and utilize informatics.\(^3\) The IOM further expanded recommendations in 2015 concentrating on the diagnostic process to reduce diagnostic errors.\(^16\) Recommendations included promoting teamwork with health care professionals, patients, and families; better use of information technologies; developing processes to detect and reduce diagnostic errors; and providing more funding for research on the diagnostic process.\(^16\)
The American Society for Clinical Laboratory Science (ASCLS) strongly supports the IOM’s recommendations to improve patient safety.\textsuperscript{17} Although initiatives in clinical laboratory quality improvement, informatics, and evidence-based practice continue to be addressed to improve health care quality and safety, these efforts need to be expanded, coordinated, standardized, and linked to patient outcomes.\textsuperscript{11,18-24} ASCLS particularly supports a new role for clinical laboratory practitioners in interprofessional collaboration, effective health care teams, and patient-centered care.\textsuperscript{17,18,25,26} Inclusion of a clinical laboratory practitioner in the interprofessional health care team would have a positive impact on patient outcomes and safety. It would also result in cost savings to the health care system by providing valuable and reliable clinical-based knowledge regarding laboratory testing that fosters accurate and timely diagnoses and treatment, thus supporting the IOM’s recommendations.\textsuperscript{2}

The Centers for Disease Control and Prevention (CDC), Division of Laboratory Systems convened a professionally facilitated meeting “The 2007 Institute: Managing for Better Health.” This Institute addressed the wide-ranging goal of improving the integration of laboratory medicine within the health care system. Four main goals were identified at this meeting.\textsuperscript{27} One of the goals identified was:

\textit{“to institutionalize new models of clinical consultation provided by laboratory medicine professionals to clinicians to guide their decisions about utilization of laboratory tests or services.”}\textsuperscript{27}

This goal addresses the CDC’s vision of a collaborative, consultative relationship between medical laboratory professionals and clinicians, thus integrating laboratory medicine into patient care.

The advanced practice clinical laboratory practitioner can increase efficiency, facilitate patient management outcomes, and improve timely access to accurate and appropriate laboratory information by participating directly in patient care decisions, monitoring laboratory utilization, and conducting research on the diagnostic process.\textsuperscript{3,16,28} Medical Laboratory Scientists have extensive knowledge regarding laboratory tests and data, and with advanced education can:

- Provide patient-centered, customized consultation services on appropriate test selection and interpretation for the purpose of clinical decision making among the interprofessional health care team and for the patient.
- Monitor laboratory data, test utilization, and diagnostic testing processes in individual patients and populations using informatics and analytics to reduce diagnostic errors, improve efficiency, and reduce costs.
- Conduct research and apply evidence to demonstrate clinical utility of laboratory tests and algorithms and to improve the quality, efficiency, and safety of the overall diagnostic testing process.
- Educate health care providers, patients, their families, and the general public about the indications, best evidence, patient preparation, and interpretation of clinical laboratory testing, including home self-testing.
- Direct laboratory operations to comply with all state and federal laws and regulations, as well as guidelines determined by professional boards of licensure, and certification/accreditation agencies.
- Participate in public and private health policy decision making at all organization and government levels using best evidence.

Pathologists and other health care providers recognize the need for greater clinician access to laboratory consultants for clinical decision support and appropriate utilization of laboratory services.\textsuperscript{7,29} The advanced clinical laboratory practitioner would be in a unique position to improve patient outcomes while developing and strengthening collaborative relationships among laboratory professionals and other health care providers. Improper test selection and patient preparation, and misinterpretation of laboratory tests cost patients in time, treatment, and money, and jeopardize their safety.\textsuperscript{20} The advanced clinical laboratory practitioner would also be instrumental in coordinating utilization of laboratory test data to actionable outcomes that can improve patient care and reduce medical errors.
ASCLS has advocated for the role of advanced practice non-physician laboratory scientists in promoting improved patient outcomes. In July 2004 the ASCLS House of Delegates accepted a model career ladder for the profession. The highest practice level (Advanced Practice Scientist III) requires a doctorate degree with skills in consulting, evaluating laboratory testing outcomes, and evaluating research designs. In July 2009, the ASCLS House of Delegates approved a position paper which expanded the practice levels and educational requirements. In that paper, the highest level of practice (Level VIII) specified a requirement for a doctorally-prepared clinical laboratory practitioner (Doctor of Clinical Laboratory Science or PhD), with practice skills in clinical assessment, evidence-based practice/research, laboratory services clinical consultation, patient counseling, grant-funded research as principal investigator, and test utilization/assessment/protocol development. The following represents the most recent position of ASCLS on the Doctorate in Clinical Laboratory Science.

**POSITION**

ASCLS supports the development and implementation of a professional Doctorate in Clinical Laboratory Science degree in institutions of higher learning. The professional doctorate would not be viewed as an entry level for the profession, but instead will provide an additional level of education to afford advanced career opportunities for Medical Laboratory Scientists. ASCLS recommends that the professional be designated Doctor of Clinical Laboratory Science, and the degree be designated a Doctorate in Clinical Laboratory Science (DCLS).

ASCLS believes that formal education leading to certification as a generalist Medical Laboratory Scientist provides an essential foundation for success in the graduate curriculum and for building the advanced DCLS competencies. Therefore ASCLS believes that the minimum prerequisites for entry into a DCLS Program include 1) completion of a NAACLS-accredited Medical Laboratory Science Program (or equivalent international program), 2) a baccalaureate degree, and 3) generalist Medical Laboratory Scientist certification. For individuals with clinical laboratory experience or relevant advanced degrees who do not have all three prerequisites, ASCLS believes that advanced placement mechanisms could be made available in NAACLS-accredited Medical Laboratory Science programs to enable these individuals to meet these prerequisites and become eligible for entry into a DCLS program.

ASCLS supports the concept of designing a common education model for this professional degree and implementing programs in a collaborative manner where feasible and desirable. Consortia or other collaborative models that rely on distance delivery options, and emphasize the relative strengths of the participating institutions are encouraged.

ASCLS supports the curriculum model developed by the ASCLS DCLS Task Force. This curriculum serves as a guide for program development. It includes the core competencies of basic science, and clinical laboratory science that provide the knowledge, clinical skills and interpersonal skills needed for competency at this advanced level of practice.

ASCLS supports and encourages development of interprofessional health care teams that include the Doctor of Clinical Laboratory Science (DCLS).

ASCLS supports a continuous dialogue with the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) in the process of developing and revising accreditation standards for the Doctorate in Clinical Laboratory Science programs.

ASCLS believes that DCLS practitioners must earn doctoral-level board certification comparable to the certifications held by individuals with whom they will consult such as medical doctors (MDs, DOs), pharmacists (PharmDs), nurses (DNP), etc. Therefore a single board certification specific to the unique scope of practice of the DCLS should be developed. Further, that certification agency should seek approval from the U.S. Department of Health and Human Services for its DCLS certificants to qualify as laboratory directors under the Clinical Laboratory Improvement Amendments (CLIA) of 1988.
ASCLS believes that state licensing boards, ideally with nationwide reciprocity, should be created in all states to regulate the practice of DCLS practitioners and protect the public.

References:


23. Centers for Disease Control and Prevention, Division of Laboratory Systems, Clinical Laboratory Integration into Healthcare Collaborative (CLIHC™). 


Introduction:

The concept of interprofessional patient care teams to provide more effective medical care for patients has been promoted for decades.1-4,15 These teams usually consist of the admitting physician, hospitalist physicians, nurses, doctoral pharmacists, health profession therapists, and social workers. Professionals from the clinical laboratory are conspicuously absent from these teams, yet the majority of many medical decisions (diagnosis, therapy, discharge, etc.) rely on laboratory test results.3-4,6 With a plethora of clinical laboratory tests and new molecular methodologies being added to the clinical laboratory test menu, clinicians are challenged with keeping abreast of the latest in laboratory services.7,8 Technological advancements in laboratory informatics, patients’ ready access to laboratory test results, and personalized/precision medicine place the clinical laboratory in the center of patient-centered care.9-13 Thus, medical laboratory scientist professionals can be a key member of the interprofessional health care team. Development of the certified medical laboratory scientist to assume a role as a member of the interprofessional health care team requires additional education to acquire advanced knowledge and clinical training skills.

Background:

In 1999, the Institute of Medicine (IOM) reported that an estimated 44,000 to 98,000 hospitalized Americans die each year from preventable medical errors in a health care system that is fragmented with inadequate systems to protect patients.8,14 An evidence-based analysis of more recent data increased the estimate of preventable patient deaths in U.S. hospitals from 210,000 to over 400,000 each year.15 In addition to this tragic human toll, medical errors waste billions of health care dollars annually.14 In a follow-up publication in 2001, the IOM specified six aims to improve the delivery of health care so that it is safe, timely, efficient, equitable, patient-centered, and effective based on scientific knowledge.2 In 2003, the IOM specified five core competencies for health care professionals, namely, the ability to provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, apply quality improvement, and utilize informatics.3 The IOM further expanded recommendations in 2015 concentrating on the diagnostic process to reduce diagnostic errors.16 Recommendations included promoting teamwork with health care professionals, patients, and families; better use of information technologies; developing processes to detect and reduce diagnostic errors; and providing more funding for research on the diagnostic process.16
The American Society for Clinical Laboratory Science (ASCLS) strongly supports the IOM’s recommendations to improve patient safety.\(^\text{17}\) Although initiatives in clinical laboratory quality improvement, informatics, and evidence-based practice continue to be addressed to improve health care quality and safety, these efforts need to be expanded, coordinated, standardized, and linked to patient outcomes.\(^\text{11,18-24}\) ASCLS particularly supports a new role for clinical laboratory practitioners in interdisciplinary collaboration, and promotion of effective health care teams, and patient-centered care.\(^\text{17,18,25,26}\) Inclusion of a clinical laboratory practitioner in the interprofessional health care team approach would have a positive impact on patient outcomes and safety. It would also result in cost savings to the health care system by providing valuable and reliable clinical-based knowledge regarding laboratory testing that fosters accurate and timely diagnoses and treatment, thus supporting the IOM’s recommendations.\(^\text{2}\) The addition of medical laboratory professionals further supports the IOM’s report suggesting that improved access to accurate and timely information is a way to prevent errors and improve patient safety.\(^\text{6}\)

The Centers for Disease Control and Prevention (CDC), Division of Laboratory Systems convened a professionally facilitated meeting “The 2007 Institute: Managing for Better Health.” This Institute addressed the wide-ranging goal of improving the integration of laboratory medicine within the health care system. Four main goals were identified at this meeting.\(^\text{27}\) One of the goals identified was:

*to institutionalize new models of clinical consultation provided by the laboratory medicine professionals to clinicians to guide their decisions about utilization of laboratory tests or services.*\(^\text{27}\)

This goal addresses the CDC’s vision of a collaborative, consultative relationship between medical laboratory professionals and clinicians, thus integrating laboratory medicine into patient care. Since the meeting, CDC has modified the initial four goals down to two. However, this goal has been maintained, emphasizing its importance.\(^\text{9}\)

The advanced practice clinical laboratory practitioner may can increase efficiency, facilitate patient management outcomes, and improve timely access to accurate and appropriate laboratory information by participating directly in patient care decisions, monitoring laboratory utilization, and conducting research on the diagnostic process. Medical Laboratory Scientists have extensive knowledge regarding laboratory tests and data, and with advanced training can: assist in appropriate laboratory test selection based on physiological and clinical situations. Working along with the healthcare team, the advanced practice clinical laboratory practitioner can

- participate in rounds, contributing expertise related to test ordering as well as provide day-to-day consultation
- consult with healthcare providers in a variety of healthcare settings about selecting the most appropriate laboratory tests
- customize the testing needs of patients, particularly those in a critical care setting
- provide support to the patient during pre-analytical phase of testing (test preparation)
- assist with interpretation of tests, and provide patient specific analysis of the test results
- explain test results specific to a patient’s medical status in relation to physiological conditions and/or possible interfering substances
- educate patients to perform home/self-testing
- Provide patient-centered, customized consultation services on appropriate test selection and interpretation for the purpose of clinical decision making among the interprofessional health care team and for the patient.
- Monitor laboratory data, test utilization, and diagnostic testing processes in individual patients and populations using informatics and analytics to reduce diagnostic errors, improve efficiency, and reduce costs.
- Conduct research and apply evidence to demonstrate clinical utility of laboratory tests and algorithms and to improve the quality, efficiency, and safety of the overall diagnostic testing process.
- Educate health care providers, patients, their families, and the general public about the indications, best evidence, patient preparation, and interpretation of clinical laboratory testing, including home self-testing.
- Direct laboratory operations to comply with all state and federal laws and regulations, as well as guidelines determined by professional boards of licensure, and certification/accreditation agencies.
- Participate in public and private health policy decision making at all organization and government levels using best evidence.

Pathologists and other health care providers recognize the need for greater clinician access to laboratory consultants for clinical decision support and appropriate utilization of laboratory services. The advanced clinical laboratory practitioner would be in a unique position to improve patient outcomes while developing and strengthening collaborative relationships among laboratory professionals and other health care providers. Improper test selection and patient preparation, and misinterpretation of laboratory tests cost patients in time, treatment, and money, and jeopardize their safety. The advanced clinical laboratory practitioner would also be instrumental in coordinating utilization of laboratory test data to actionable outcomes that can improve patient care and reduce medical errors.

ASCLS has advocated for the role of advanced practice non-physician laboratory scientists in promoting improved patient outcomes. In July 2004 the ASCLS House of Delegates accepted a model career ladder for the profession. The highest practice level (Advanced Practice Scientist III) level represents the professional doctorate degree in clinical laboratory science requires a doctorate degree with skills in consulting, evaluating laboratory testing outcomes, and evaluating research designs. At this level of practice, the medical laboratory scientist is expected to serve in consultant roles, interpret patient assessments to determine clinical status of the patient, and manage patient laboratory data as part of the healthcare team. In July 2009, the ASCLS House of Delegates approved a position paper which expanded the practice levels and educational requirements. In that paper, the highest level of practice (Level VIII) specified a requirement for a doctorally-prepared clinical laboratory practitioner (Doctor of Clinical Laboratory Science or PhD), with practice skills in clinical assessment, evidence-based practice/research, laboratory services clinical consultation, patient counseling, grant-funded research as principal investigator, and test utilization/assessment/protocol development.

The following represents the most recent position of ASCLS on the Doctorate in Clinical Laboratory Science.

POSITION

ASCLS supports the development and implementation of a professional Doctorate of Clinical Laboratory Science degree in institutions of higher learning. The professional doctorate would not be viewed as an entry level for the profession, but instead will provide an additional level of education to afford advanced career opportunities for the Medical Laboratory Scientists. ASCLS recommends that the professional be designated Doctor of Clinical Laboratory Science, and the degree be designated a Doctorate in Clinical Laboratory Science (DCLS).

ASCLS believes that formal education leading to certification as a generalist Medical Laboratory Scientist provides an essential foundation for success in the graduate curriculum and for building the advanced DCLS competencies. Therefore ASCLS believes that the minimum prerequisites for entry into a DCLS Program include 1) completion of a NAACLS-accredited Medical Laboratory Science Program (or equivalent international program), 2) a baccalaureate degree, and 3) generalist Medical Laboratory Scientist certification. For individuals with clinical laboratory experience or relevant advanced degrees who do not have all three prerequisites, ASCLS believes that advanced placement mechanisms could be made available in NAACLS-accredited Medical Laboratory Science programs to enable these individuals to meet these prerequisites and become eligible for entry into a DCLS program.
ASCLS supports the concept of designing a common education model for this professional degree and implementing programs in a collaborative manner where feasible and desirable. Consortia or other collaborative models that rely on distance delivery options, and emphasize the relative strengths of the participating institutions are encouraged.

ASCLS supports the curriculum model developed by the ASCLS DCLS Task Force. This curriculum serves as a guide for program development. It includes the core competencies of basic science, and clinical laboratory science that provide the knowledge, clinical skills, and interpersonal skills needed for competency at this advanced level of practice.

ASCLS supports and encourages development of interprofessional health care teams that include the professional doctorate prepared medical laboratory scientist Doctor of Clinical Laboratory Science (DCLS).

ASCLS supports a continuous dialogue with the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) in the process of developing and revising accreditation standards for the Doctorate in Clinical Laboratory Science level programs.

ASCLS believes that practitioners at the DCLS level should hold active certification and/or licensure. ASCLS supports a continuous dialogue with the Board of Certification (ASCP) in the process of developing a DCLS Certification.

ASCLS believes that DCLS practitioners must earn doctoral-level board certification comparable to the certifications held by individuals with whom they will consult such as medical doctors (MDs, DOs), pharmacists (PharmDs), nurses (DNP), etc. Therefore a single board certification specific to the unique scope of practice of the DCLS should be developed. Further, that certification agency should seek approval from the U.S. Department of Health and Human Services for its DCLS certificants to qualify as laboratory directors under the Clinical Laboratory Improvement Amendments (CLIA) of 1988.

ASCLS believes that state licensing boards, ideally with nationwide reciprocity, should be created in all states to regulate the practice of DCLS practitioners and protect the public.

References:


ENTRY LEVEL CURRICULUM
for
Medical Laboratory Scientist (MLS)
and
Medical Laboratory Technician (MLT)

This document belongs to all practicing medical laboratory professionals. It is our right to define its contents, our responsibility to monitor and update it, and our privilege to use it to promote the profession and build and maintain accredited educational programs.

Medical Laboratory Science Entry Level Curriculum
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I. The first Entry Level Curriculum (ELC) was published in 2002 and created by educators and practitioners using the Body of Knowledge (BOK) published by ASCLS. Entry Level is defined as the knowledge and skills that a new graduate at the MLT or MLS level should possess upon entry into the workforce.

The ELC is designed for several purposes; to
- develop a new program,
- assist the new instructor/professor with course development, and
- update a current program or course.

II. Development Process
A sub-committee of the Education Scientific Assembly (ESA) Committee for Educational Programs and Initiatives (CEPI) was assembled in the fall of 2015 to facilitate the process of updating the ELC. The 2015-16 ELC Committee was charged with two main goals:
- Use the recently updated (2014 version) ASCLS Body of Knowledge (BOK) and personal expertise in entry level practice to update the curriculum by removing dated topics and adding new items.
- Ensure differentiation of the MLT and MLS curriculum based on the level of education required for each.

The ELC committee received comments from MLS and MLT educators who attended CLEC 2016 and continued to solicit comments from educators who could not attend. With these comments, a second version was created and distributed to all ASCLS members for comments. These comments were used to create a third revision. Consulting each other, ELC committee members finalized all documents by applying the
Beck/Moon algorithm introduced at CLEC 2016. The algorithm included three basic questions:

- Is it current practice?
- Is it entry level?
- Is it foundational?

In situations where conflicting comments were received, this algorithm provided the criteria for removing dated information from the documents. Upon completion, the third version was submitted to the ASCLS Board of Directors for adoption at the 2016 House of Delegates.

III. Curriculum Format
The MLS and MLT entry-level curricula are defined as the knowledge and skills expected of a new graduate upon successful completion of a formal educational program. It assumes no work experience other than that required as part of a clinical education affiliated with the program.

The curriculum format is delineated by discipline area within the MLS and MLT levels. Each discipline area is further delineated by major topics which include a sequence and coordination of concepts, principles and theories, and skills.

The curriculum represents a consensus by reviewers of the minimum knowledge and skills required to be successful in an entry level role. The committee developed the final documents with the understanding that all listed technical items may not be available at each educational institution so that in some programs, only cognitive aspects (state, explain, describe) will be taught and at others the psychomotor may also be taught (perform or observe). The committee also expects that some programs will teach beyond what may be included, based upon regional needs of their graduates and availability of resources.

Molecular diagnostics is a new addition to the 2016 version of the ELC. Other changes included moving body fluids from the Chemistry section to create a new Urinalysis and Body Fluids section.
Where there is overlap in some discipline areas, it is cross-referenced to another section within the ELC disciplines. For example, microscopic analysis in Hematology, Urinalysis & Body Fluids, and Microbiology are all cross-referenced to the more detailed microscope section in the General Practice document.

Finally, to assist educators in easily knowing which items were deleted from the previous edition of the ELCs and which items were added, a summary list is included at the end of each discipline section. This information could be useful when revising and updating course material.

IV. **Taxonomic Levels**

The taxonomic levels within the ELC are identified and based upon a simplified version of Bloom’s taxonomic levels as described in *Clinical Laboratory Education*, written by Susan J. Beck, PhD, MLS(ASCP)CM and Vicky A. LeGrys, DA, MT(ASCP) and published in 2014 by ASCLS.

The cognitive domain includes:
- Level 1: recall of basic knowledge and comprehension
- Level 2: application and interpretation of content
- Level 3: critical analysis, decision making, and problem solving, which relates to the evaluation and processing of knowledge

The psychomotor domain includes:
- Level 1: readiness; an awareness of and ready to perform; observes
- Level 2: competence and confidence with performing a task
- Level 3: proficiency and adaptation, ability to alter performance successfully when encountering unexpected or new situations

The affective domain includes:
- Level 1: awareness of an activity or situation
- Level 2: valuing; attachment of worth and beginning to express behaviors demonstrating value of an activity or situation
- Level 3: commitment; ability to justify values
Taxonomic levels were included to assist new instructors and new programs. For a complete list of verbs, visit the NAACLS website which differentiates cognitive, psychomotor and affective (http://www.naacls.org/PDFviewer.asp?mainUrl=/docs/announcement/writing-objectives.pdf).

V. The Future
This document will be updated every 5 years using the revised BOK. The newly established BOK Review Committee will guide the process.

This document belongs to all practicing medical laboratory professionals. It is our right to define its contents, our responsibility to monitor and update it, and our privilege to use it to promote the profession and build and maintain accredited educational programs.

_Joan Polancic, MSEd, MLS(ASCP)CM & Kyle Riding, PhD, MLS(ASCP)CM_
Entry Level Curriculum Committee Co-chairs
Acknowledgements

No project of this magnitude is ever accomplished without the support, advice, and consultative services of many people, including educators, ASCLS members, the ASCLS Board of Directors, and ASCLS Staff. Special thanks to ASCLS staff members Elissa Passiment, Karrie Hovis and Jim Flanigan for their support and assistance.

Medical laboratory professionals from all over the country donated their time, effort, and expertise by serving as reviewers of the document. Thank you to all for your contributions.

Thanks to Marcia Armstrong and Brenda Bouchard, the editors of the 2002 ELC and all contributors. They undertook a major task in developing the curriculum from which this version is based.

Contributors to this *Entry Level Curriculum* were selected from educational programs by the co-chairs of the ELC Committee. The committee was selected to guarantee equal MLT and MLS representation and to produce documents that were job-related as well as academically appropriate.

Committee members put in innumerable hours to update, collate and review comments, and create final documents. A special thanks to all committee members for your time, expertise and efforts.
Entry Level Curriculum Committee

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MLS Entry Level

Health care reform environment
Describe the forces affecting changes in the health care environment Level 1
State changes occurring in laboratories related to health care changes Level 1

Federal regulations, government organizations/agencies and national organizations
Define the functions and impact on laboratory practice of the following: Level 1
Health and Human Services (HHS)—Lab Reimbursement/Fee Schedule
Center for Medicare and Medicaid Services (CMS)
Centers for Disease Control and Prevention (CDC)
Federal Drug Administration (FDA)
Department of Transportation (DOT)
Occupational Safety and Health Administration (OSHA)
Bureau of Biologics (BOB)
Clinical Laboratory Standards Institute (CLSI)
Office of Inspector General (OIG)
Clinical Lab Improvement Amendments (CLIA) regulations and accreditation requirements
International Standards Organization (ISO)

Describe the governmental laws and regulations that affect the laboratory and their impact Level 1
Balanced Budget Act 1997 (BBA)
CLIA ‘88
Health Insurance Portability and Accountability Act (HIPPA)
Federal and state bioterrorism statutes

Recognize the following organizations and agencies and describe their roles in laboratory accreditation Level 1
The Joint Commission(TJC)
College of American Pathologists (CAP)
State Health Departments
Commission on Office Laboratory Accreditation (COLA)
Substance Abuse and Mental Health Service Administration (SAMHSA)
American Association of Blood Banks (AABB)

State the components of and discuss the process for a laboratory accreditation survey to prepare for an inspection

**General Management Theory**

- Define management, leadership, and administration
- Recognize the features of a good decision and explain the steps to make a sound decision
- Describe the role human behavior plays and its influence in the decision-making process
- Recognize decision-making techniques to resolve the problems and decisions faced by the laboratory
- State sources of conflict and resistance to change and discuss the change process and incorporation of the change process in the overall operations of the laboratory
- Describe leadership within the functions of management
- Recognize the factors that determine leadership success
- List and compare the concepts and advantages of major leadership models
- Explain leadership principles to the management of organizations
- Explain the differences between management of health care organizations and other businesses

- List and explain the major managerial “functions”
  - Financial management
  - Human resource management
  - Test system management
  - Operations management
  - Information systems/informatics management

State management and motivational theories, their author, and compare them to one another

- Maslow’s Hierarchy of Needs
- Herzberg’s Motivator-Hygiene Theory
McGregor’s Theory X and Theory Y
Management By Objectives (MBO)
Total Quality Management (TQM)
Quality Management System (QMS)

Apply the different managerial and motivational theories to individual case studies  Level 2
Recognize positive influences as well as major barriers to effective communications  Level 1

Financial Management
Explain cost analysis for selection of test methods, instrumentation and/or establishing test prices  Level 1
Explain laboratory productivity and state appropriate parameters  Level 1
Explain fixed versus variable costs for analyses  Level 1
Explain basic techniques used to plan and forecast trends and developments  Level 1
State the principles of third party payment using insurance coding and reimbursement parameters  Level 1
Describe current and future reimbursement for clinical laboratory services from government agencies, insurers, and managed care groups, e.g., third party payment  Level 1
Define medical necessity, advanced beneficiary notices, Medicare secondary payer documents, and diagnosis coding impact on laboratory reimbursement  Level 1
Define National Coverage Determination (NCD) and Local Coverage Determination (LCD) lists  Level 1
Explain the difference between operational and capital budgets  Level 1
Explain the difference between supply expenses and other budget items  Level 1
Explain the process of material management and inventory control  Level 1
Record inventory levels  Level 1

Information Systems
Demonstrate general information technology literacy (cross reference to General Lab Practice)  Level 2
Use Laboratory Information Systems  Level 2
Use RFID Technology  Level 2
State the characteristics and activities of an information system  
Recognize the features and purpose of networks  
Define information technology terms and explain the use of information technology in the laboratory  
   Medical informatics  
   Bar codes  
Define the goals and objectives of a laboratory information system  
State the purpose of a procedural flow chart  
State information technology system security  
   Use email and required privacy rule(s), encryption  
   Identify required mobile device security  
   Discuss electronic health records (EHR) and explain the laboratory role  

**Human Resources**  
State by name and function the professional organizations associated with the medical laboratory profession  
   American Association of Blood Banks (AABB)  
   American Association of Clinical Chemists (AACC)  
   American Medical Technologists (AMT)  
   American Society for Clinical Laboratory Science (ASCLS)  
   American Society for Clinical Pathology (ASCP)  
   American Society for Microbiology (ASM)  
   Clinical Laboratory Managers Association (CLMA)  
Describe the key elements of a performance appraisal system  
Explain the role of human resource management in the operation and functions of the management process  
List, define, compare and contrast associated credentialing mechanisms  
   Certification  
   Licensure  
   Accreditation
List and compare the certification levels offered and the appropriate initials offered for two year, four year, and doctoral educated laboratorians and the level at which each certification level functions in a clinical laboratory

- Board of Certification (BOC)
- American Medical Technology (AMT)
- American Association of Bioanalysis (AAB)

List items to be included in position descriptions; explain their use and purpose

- Explain the use of conferences in employee evaluations
- Prepare a resume or curriculum vitae
- Recognize situations of unethical professional performance
- State appropriate action to correct unethical or unprofessional situations
- Describe CLIA personnel qualifications and responsibilities
  - Laboratory director
  - Technical consultant
  - Clinical consultant
  - General supervisor
  - Testing personnel

State principles of delegation and, given criteria, determine what and to whom to delegate

State various techniques to motivate employees

List incentives for professional development

Describe workflow productivity

Review career ladders

**Operations Management**

- Describe elements of a Continuous Quality Improvement (CQI) plan
- Apply Clinical and Laboratory Standards Institute (CLSI) standards for technical procedures
- Maintain an effective quality systems assessment program
- Define Six Sigma
- Describe other/additional quality models
Describe standards for quality assessment  

Use an effective quality control system (Cross reference to General Practice section)  

Explain the purpose of a proficiency testing (PT) program  

State personnel standards including required competency assessment  

Describe and utilize method evaluation and validation (Cross reference to General Practice section)  

Utilize process improvement and problem identification  

Explain data gathering, data process, and use of information systems for data comparisons, storage, transformation, and retrieval  

General healthcare  

Explain medical laboratory science’s impact on other healthcare providers and patients  

Discuss the use of clinical laboratory data in the diagnosis and treatment of patients  

Explain model hospital/facility organization  

Typical hierarchy  

Typical committee structure, laboratory role  

Clinical pathway development, laboratory role  

Expanded or other roles for administrative MLS  

a) Technical consultant  

b) Infection control professional  

c) Information technology professional  

d) Marketing or client relations  

e) Compliance officer  

Describe how laboratory services impacts the delivery of care  

Apply CLIA pre-analytical, analytical, and post-analytical aspects to patient care  

Professionalism: Performance standards, roles, philosophy, communication, & ethics  

Exemplify concepts and practice of professional standards  

Discuss and apply confidentiality and legal requirements  

Demonstrate ethical and professional standards  

Describe and promote professionalism and professional development impact on laboratory operations
Explain impact of professionalism on profession and healthcare delivery Level 1
Communicate to other healthcare professionals in an effective manner Level 2

Personnel Safety
Implement a laboratory safety program (Cross reference to Lab Safety in General Practice section) Level 2
Use Globally Harmonized System (GHS) of classification and labeling of chemicals Level 2
Apply OSHA standards Level 2
Apply ergonomic practices to laboratory tasks Level 2
Follow policies and procedures to address bioterrorism or other public health issues Level 2
Follow a disaster preparedness program Level 2

Patient Safety and Testing
Define patient safety and health care quality using the Institute of Medicine (IOM) definitions Level 1
Describe the total testing process including pre-analytic, analytic, and post-analytic processes Level 1
Describe components of health care quality as defined by the Institute of Medicine (IOM)Level 1

Safe: Avoiding injuries to patients from the care that is intended to help them
Effective: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit by avoiding underuse and overuse
Patient-centered: Providing care that is respectful of and responsive to individual preferences, needs, and value and ensuring that patient values guide all clinical decisions
Timely: Reducing waits and sometimes harmful delays for both those who receive and those who give care
Efficient: Avoiding waste, including waste of equipment, supplies, ideas, and energy
Equitable: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status

Explain and utilize methods to measure the effectiveness of laboratory testing Level 2
Testing performed for screening purposes
Testing performed to monitor progress of chronic diseases

Testing performed to monitor rates of disease diagnosis using measurements of positive and negative predictive values

Follow an effective patient safety program Level 2

Describe and apply changes in public health policy and oversight of healthcare delivery system that fosters and improves patient safety Level 2

Use facts and trends in sentinel event investigation Level 2

Explain overuse, underuse, and misuse of laboratory testing Level 1

Distinguish appropriate laboratory tests to order using evidence-based methods Level 2

Testing performed to screen for conditions and diseases

Testing performed for diagnosis of conditions and diseases

Testing performed to monitor prognosis after diagnoses of conditions and diseases

Testing performed to monitor therapy implemented to treat conditions and diseases

Recognize and utilize appropriate protocols to monitor utilization of blood products in transfusion services (Cross reference to Immunohematology) Level 2

Follow protocols for communicating current standards of laboratory practice for laboratory testing related to specific diagnosis or condition Level 2

Describe methods to provide patient-centered laboratory services Level 1

Pre-analytic phase of laboratory total testing process

Cultural differences

Patient preferences

Explain to others the how and why of the laboratory testing process Level 1

Identify and use methods to evaluate the impact of patient turnaround time on other aspects of healthcare delivery Level 2

Identify and use methods to quantify inefficiencies in the pre-analytic, analytic, and post-analytic phases of the total testing process, i.e., quantify savings due to improvement of efficiencies Level 2

Technical consultant

List the CLIA qualifications for a technical consultant (TC) Level 1

List the CLIA TC responsibilities Level 1
Deleted:
Federal regulations, government organizations/agencies and national organizations
Removed old terms and updated
HCFA to CMMS
NCCLS to CLSI
JCHAO to TJC

Tax Equity and Fiscal Responsibility Act (TEFRA)
Hill Burton Act
Medicare Act
CLIA ‘67

General Management Theory
Conduct an interview

Information Systems
Define central processing unit (CPU)

Human Resources
Define registration
NCA
BOR
ISCLT changed to AAB

Added:
Federal regulations, government organizations/agencies and national organizations
Balanced Budget Act (BBA) 1997
HIPPA
Federal and state bioterrorism statutes
ISO

General Management Theory
Features of a good decision
Define leadership within the functions of management
Quality Management Systems
Describe current and future reimbursement for clinical laboratory services
Define medical necessity, advanced beneficiary notices, Medicare secondary payor documents, and diagnosis coding impact on laboratory reimbursement
Define National Coverage Determination (NCD) and Local Coverage Determination (LCD) lists
Explain the difference between operational and capital budgets
Explain the difference between supply expenses and other budget items
Explain the process of material management and inventory control

**Information Systems**
IT accreditation standards
HITECH
IT system security

**Human Resources**
BOC
AAB
DCLS

Key elements of a performance appraisal system
Role of human resource management in the operation and functions of the management process
CLIA personnel qualifications and responsibilities
Describe workflow productivity
Career ladders

**Operations Management**
Six Sigma
Personnel standards and competency assessment requirements
Method evaluation and validation
Process improvement
Data gathering, data process, and use of information systems for data comparisons, storage, transformation, and retrieval

**General healthcare** – new section

**Professionalism: Performance standards, roles, philosophy, communication, and ethics** – new section

**Personnel Safety** – new section

**Technical consultant** -- new section
MLS Entry Level Curriculum – Clinical Chemistry

Mathematics and Chemical Calculations

Perform basic calculations Level 2
Exponents
Logarithms
Molarity/Normality
Percentage
Ratios and proportions
Unit conversions (concentration relationships)
Percent to molarity; molarity to percent
Hydrates
Osmolality
Standard solutions
Define Dilutions (Serial and Ratio) Level 1
Calculate and Perform Dilutions (Serial and Ratio) Level 2
Define units of systems of measurement Level 1
Metric
International system of units (SI units)
Define conversions between and among systems of measurement Level 1
Metric to SI
SI to metric
Perform temperature conversions Level 2
Fahrenheit to Celsius
Celsius to Fahrenheit
Define statistical data for quality control and statistical analyses Level 1
Calculate and utilize statistical data for quality control and statistical analyses Level 2
Mean, Median, Mode
Standard deviation
Coefficient of variation
Confidence limits
Reference intervals
Variance
Probability
Scales, graphs, Levey Jennings charts
Percentiles
Define predictive statistics Level 1
True positive and negative
False positive and negative
Clinical sensitivity and specificity
Positive predictive value (PPV)
Negative predictive value (NPV)
Calculate and utilize statistical data for method verification and comparison studies Level 2
Precision
Coefficient of variation (CV)
F test
Accuracy
  t-test
Linear regression
  Slope
  y intercept
Correlation coefficient

Define medical decision level and total allowable error

**Instrumentation: Troubleshooting**
- Utilize troubleshooting techniques  Level 2
- Interpret maintenance manual
- Correct problem, if possible
- Notify manufacturer’s service department, if necessary

**Instrumentation: Spectrometry**
- Recognize and explain basic concepts of spectrophotometry  Level 1
  - Principles of light absorption
    - wavelength
    - spectrum
    - Beer’s law
    - complementary spectra
- Recognize and describe the function of spectrophotometer components  Level 1
  - Light source
  - Monochromator
  - Cuvettes
  - Light detectors
  - Read-out systems
- Describe the operation of a spectrophotometer  Level 1
- Explain maintenance/quality assurance of instrumentation  Level 1
  - Stray light
  - Sensitivity
  - Linearity
  - Wavelength calibration
- Establish procedures in the use and calibration of a spectrophotometer  Level 2
- Perform test procedures on standards, controls, and unknowns  Level 2
  - Establish a standard curve according to SOP
  - Calculate, if necessary, and record quality control (QC) data
  - Evaluate quality control data and results
  - Accept/reject results
  - Take appropriate corrective action, if necessary
  - Report results, if acceptable
- Perform routine maintenance checks on all spectrophotometers  Level 2
  - Follow a maintenance procedure for all spectrophotometers  Level 1
  - Follow a documentation tool and procedure for all spectrophotometers  Level 1
Correlate test results with other laboratory tests and patient diagnosis  Level 2

**Instrumentation: Turbidimetry and Nephelometry**  
Explain basic concepts of turbidimetry and nephelometry  Level 1  
Principles of light absorption and scatter  
Reflectance

**Instrumentation: Atomic Absorption Spectrometry**  
Recognize and explain basic concepts of atomic absorption spectrophotometry  Level 1  
Principles of light absorption  
- Generation of atoms from molecules  
- Absorption and emission spectrum  
Identify basic components  Level 1  
- Burner assembly  
- Gas regulators  
- Light source (hollow cathode lamp)  
- Monochromator  
- Light detector  
- Signal conversion electronics  
- Read-out systems

**Instrumentation: Fluorometry**  
Identify and explain basic concepts of fluorometry  Level 1  
Principles of light absorption and emission by molecules  
Absorption and emission spectrum  
Recognize basic concepts and use of fluorescent polarization  
Principles of fluorescence polarization

**Instrumentation: Luminometer**  
Recognize basic concepts (Level 1)  
- Principles  
- Components  
- Operation  
- Maintenance/quality assurance  
Correctly operate luminometer (Level 2)  
Perform routine maintenance checks on the luminometer (Level 2)

**Instrumentation: Osmometry**  
Recognize and describe unique components relative to Osmometry  Level 1  
Principles of osmolality  
Definition  
Colligative properties  
Recognize and describe unique components relative to freezing point instrumentation  Level 1  
Basic components
Operation

Maintenance/quality assurance
Calibrate osmometer following established laboratory procedure  Level 2
Describe the measurement of osmolality of solutions  Level 1
Differentiate osmolality and osmolarity  Level 1
Discuss colligative properties of solutions  Level 1
Boiling point
Freezing point
Vapor pressure
Osmotic pressure
Discuss solute concentration  Level 1

Explain the most common colligative property used to detect concentration  Level 1
Calculate osmolality and osmolal gap  Level 2
Explain the significance of results  Level 1
Reflection of electrolyte-fluid balance
Assessment of renal concentrating ability
Abnormal osmolal gap
Perform test procedures on standards, controls, and unknowns Level 2
- Accept/reject results
- Interpret and record quality control data
- Report results, if acceptable
- Perform routine maintenance checks on the osmometer
- Correlate test results with other laboratory tests and patient diagnosis

Instrumentation: Electrochemistry
Recognize and explain basic concepts of electrochemistry  Level 1
Principles of electrochemistry
- Potentiometry
- Electrodes
Summarize the use of the Nernst equation  Level 1
Describe the basic components of electrochemistry  Level 2
- Reference electrode
- Indicator electrode
- Salt bridge
Describe the basic concepts of Ion-selective electrodes  Level 2
- Glass
- Solid state
- Liquid membrane
- Immobilized enzyme
Explain the difference between a direct and indirect ISE  Level 1
Electrolyte exclusion effect
Correct common malfunctions according to manufacturer’s protocol  Level 2
Perform test procedures on standards, controls, and unknowns Level 2
Evaluate quality control data (QC)
Accept/reject results
Take appropriate corrective action, if necessary
Report results, if acceptable
Correlate test results with other laboratory tests and patient diagnosis Level 2

**Instrumentation: Blood Gas Analyzers**
- Recognize and explain basic concepts of blood gas analyzers Level 1
- Describe basic components of blood gas analyzers Level 2
  - pCO2 electrode
  - pO2 electrode
  - pH electrode
  - ISE electrode (if applicable for Ca²⁺, lactate, etc.; see electrochemistry section)
  - Cooximetry
  - Sample chamber
  - Temperature maintenance system
- Describe operation of blood gas analyzers Level 2
  - Function controls
  - Electrode balance with standard gases
  - Adjust slope with standard gases
  - Sample handling
- Perform routine maintenance/quality assurance of blood gas analyzers Level 2
  - Standard gases
  - Electrode and membrane care
  - Interference
- Calibrate the blood gas analyzer following established laboratory procedure Level 2
- Perform test procedures on standards, controls, and unknowns Level 2
  - Accept/reject results
  - Interpret and record quality control data
  - Report results, if acceptable
  - Correlate test results with other laboratory tests and patient diagnosis

**Instrumentation: Refractometer**
- Identify/explain basic concepts of refractometer/light refraction (Level 1)
  - Principle
  - Components
    - Prism
    - Light source
    - Temperature control or compensation
    - Calibration scale
    - Focusing eyepiece
  - Operation
    - Zero calibration
    - Sample selection
    - Focus eyepiece
  - Maintenance/quality assurance
- Calibrate refractometer following established laboratory procedure Level 2
- Perform test procedures on controls, and unknowns Level 2
Accept/reject results  
Interpret and record quality control data  
Report results  
Perform routine maintenance checks on the refractometers  
Correlate test results with other laboratory tests and patient diagnosis  

**Instrumentation: Balances**  
Identify basic mechanisms and types of balances  
Level 1  
Define balancing terminology  
Level 1  
Capacity  
Sensitivity  
Precision  
Readability  
Tare  
Operate balances  
Level 2  
Level device  
Pan arrest  
Weighing paper or boats  
Cleanliness  
Temperature  
Elimination of drafts, vibrations, etc.  
Calibrate balances following established laboratory procedure  
Level 2  
Perform routine maintenance checks on all balances  
Level 2  

**Instrumentation: Centrifuges**  
Explain basic concepts of centrifugation  
Level 1  
Principles of centrifugal force  
Tachometer  
Relative centrifugal force  
Identify basic components of a centrifuge  
Level 1  
Head (rotor)  
Bowl and cover (chassis)  
Shields, cups  
Brushes  
Cushion  
Describe operation of centrifuge  
Level 1  
Function controls  
Balancing  
Perform maintenance/quality assurance of centrifuge  
Level 2  
Lubrication  
RPM (tachometer) check  
Calibrate centrifuges following established laboratory procedure  
Level 2  
Operate centrifuges  
Level 2  
Load and balance  
Lock head
Select appropriate speed (temperature, if applicable)  
Follow safety precautions  
Perform routine maintenance checks on all centrifuges  

**Instrumentation: Heating Units**  
Perform routine maintenance on heating units following established laboratory procedure  
Level 1  
Water baths  
Heating Block  
Check/calibrate temperature setting of heating units  
Correct malfunction according to manufacturer’s manual  

**Instrumentation: Electrophoresis**  
Recognize and explain basic concepts of electrophoresis  
Principles of electrophoresis  
Voltage, current  
pH  
Ionic strength  
Buffers  
Temperature  
Describe the basic components of electrophoresis  
Support media: cellulose acetate/gel/agarose  
Chamber  
Buffer  
Electrodes  
Power supply  
Densitometer  
Describe the operation of electrophoresis  
Sample application  
Time  
Temperature  
Voltage, current  
Stains  
Densitometer  
Perform analyses according to laboratory procedure  
Accept/reject results  
Evaluate and record quality control data  
Report results, if acceptable  
Correlate results with disease/diagnosis  
Perform routine preventive maintenance checks on all electrophoresis systems  
Develop a documentation tool and procedure for all electrophoresis systems  

Level 1  
Level 2  
Level 3
**Instrumentation: Chromatography**

- Recognize basic concepts of chromatography  **Level 1**
- Separation mechanisms (partition, adsorption)
- Describe basic chromatography techniques  **Level 1**
  - Column
  - Thin layer (TLC)
  - Liquid (HPLC)
  - Gas (GLC)
- Describe the basic components of a chromatography system  **Level 1**
  - Flow regulation
  - Mobile phase
  - Stationary phase
  - Column
  - Detectors
- Perform chromatographic calculations  **Level 2**
  - Retention time
  - Retention volume
  - Rf
  - Efficiency
  - Resolution
  - Analyte identification and quantitation
- Perform routine preventive maintenance checks on all chromatography systems  **Level 2**

**Instrumentation: Mass spectrometry**

- Recognize and explain basic concepts  **Level 1**
  - Principles
  - Components
  - Operation
  - Maintenance/quality assurance
- Correctly operate, if available (Level 2)
- Perform routine maintenance checks (Level 2)

**Instrumentation: Automation**

- Recognize and explain basic concepts of automated analyzers  **Level 1**
  - Discrete sample systems, self-contained and special purpose (POC)
- Describe operations and principles of the automated systems  **Level 1**
- Describe the basic components of an automated system  **Level 1**
  - Sample/reagent pick-up/dilution
  - Transfer module/mechanism
  - Spectrophotometer module
  - Control/calibration module
  - Readout/recorder
  - Operation/calibration
  - Maintenance/quality assurance
  - Troubleshooting

*Commented [U2]: Cross reference to general practice*
General Clinical Chemistry

Evaluate quality control data Level 3
Select control materials for use
Analyze data for acceptability
If data unacceptable, identify problems or causes
Take corrective action to resolve problem and document

Verify or establish reference intervals (“Normal ranges”) Level 3
List reference intervals for major analytes Level 1
Correlate all patient test data for acceptability Level 2
Review normal physiology and function (liver, cardiac, kidney, etc.)
Interpret patient test results using reference intervals and previous patient data
Discuss pathophysiology of “abnormal” results
Recognize and respond to abnormal or critical results

Assess pre-analytic and analytic factors that can affect patient results Level 3
Sample integrity, draw time, preservation or storage
Age, gender, ethnicity
Diet, nutritional status, fasting, post prandial
Exercise, position or posture
Sample processing and identification
Sample preservatives (EDTA, heparin, etc.)
Method interfering substances/sources of error
Recording of results

Report results according to laboratory protocol Level 2
Routine
STAT
Action limits (critical values/read back)

General Clinical Chemistry: Carbohydrates

Define and explain carbohydrate structures and classifications Level 1
Monosaccharide
Disaccharide
Polysaccharide
Glycosidic linkage
Aldose
Ketose
Hexose
Pentose
Isomer

State the components of the disaccharides Level 1
Lactose
Maltose
Sucrose

State the composition and function of each of the following polysaccharides Level 1
Starch
Glycogen
Proteoglycans (mucopolysaccharides)
Glycoproteins

Discuss carbohydrate metabolism  Level 1
   Explain the process of digestion and absorption of dietary carbohydrates
   Explain the main transport routes and uptake of carbohydrates
   State the main physiologic functions of carbohydrates
   Explain the following glucose pathways:
      - Insulin and non-insulin routes of entry to cells
      - Glycolysis (aerobic and anaerobic)
      - Glycogenolysis
      - Glycogenesis
      - Gluconeogenesis
      - Kreb's cycle (citric acid or TCA cycle)
      - Pentose phosphate pathway (hexose monophosphate shunt)

Explain the effect of hormones in regulation of blood glucose levels  Level 1
   Insulin
   Glucagon
   Cortisol
   Adrenocorticotropic hormone (ACTH)
   Epinephrine
   Thyroxine
   Growth hormone (GH)
   Human placental lactogen (HPL)

Discuss the maintenance of blood glucose levels in the “fed state” (parenteral) and “fasting state”  Level 1

Discuss glucose metabolism in relationship to lipid and protein metabolism  Level 1
   Explain the formation and significance of hemoglobin A1C

Discuss disease states and disorders associated with carbohydrate metabolism  Level 1
   Explain etiology, symptoms, and effects of hyperglycemia
   Type 1; Type 2, and gestational diabetes mellitus (GDM)
   Cushing's syndrome
   Hyperthyroidism
   Hyperpituitarism
   Pheochromocytoma
   other diseases/conditions

Explain the diagnostic criteria for Type 1, 2 (impaired glucose tolerance and provisional) and GDM  Level 1

Explain etiology, symptoms, effects and diagnostic criteria of hypoglycemia  Level 1

State the cause and resulting disorder(s) for inborn errors of metabolism  Level 1
   Fructosuria
   Hereditary fructose intolerance
   Galactosemia
   Glycogen storage disorders
   Lactose intolerance

Discuss methodologies for carbohydrate determinations  Level 1

Commented [JP3]: Cross-reference to Urinalysis
State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness of each Level 1

- Glucose oxidase
- Hexokinase
- Glucose dehydrogenase
- Glycated hemoglobin (A1C)
- Glycated serum protein (GSP) / fructosamine

Explain the usefulness of, patient preparation, and the procedure for a glucose tolerance test; include normal and diagnostic levels Level 1

- State the qualitative or quantitative method used for detection Level 1
  - Other reducing substances
  - Ketones
  - Lactic acid
  - Urinary sugars
  - Cerebrospinal fluid (CSF) glucose

Explain the usefulness of miscellaneous tests Level 1

- Insulin and C-peptide
- Insulin antibodies
- Lactose tolerance

Perform carbohydrate analyses according to established laboratory protocol Level 2

- Determine acceptability of results
- Report results according to laboratory protocol
- Perform, document, and evaluate quality control
- Correlate all patient results and patient outcomes with disease state or disorder Level 2
- Discuss the usefulness of bedside or at-home glucose monitoring devices; compare results to non-point-of-care analyzer results and include effects of whole blood vs plasma Level 1
- Explain usefulness of estimated average glucose (eAG)
- Discuss recent advances in the measurement and detection of analytes associated with the diagnosis or monitoring of carbohydrate disorders Level 1

**General Chemistry: Lipids**

- Define lipid associated terminology Level 1
  - Lipid / Lipase
  - Simple / Complex lipid
  - Lipemia
  - Lecithin
  - Sphingomyelin
  - Glycolipid
  - Lipoprotein
  - Apoprotein
  - Esterification
  - Saturated/Unsaturated

- Differentiate among structural characteristics of lipids Level 2
  - Fatty Acids
Cholesterol
Triglycerides
Phospholipids
Steroids

Prostaglandins

Explain the usefulness of prostaglandins Level 1
Explain and compare the lipoproteins using the difference in lipid and protein composition Level 2

Chylomicron
Very low density lipoproteins (VLDL)
Low density lipoproteins (LDL)
High density lipoproteins (HDL)

Discuss lipid metabolism Level 1
Explain the processes of emulsification, digestion, and absorption of dietary lipids
Explain the main transport route of dietary lipids
State the main physiologic functions of lipids
State the origin and main function of each lipoprotein; include major enzymes involved and apoprotein(s) required for normal function

Discuss lipid metabolism in the “fed state” and the “fasting state” Level 1
Discuss lipid metabolism in relationship to glucose and protein metabolism Level 1

Correlate disease states and disorders associated with hyperlipemias Level 2

Locate familial lipoprotein disorders nomenclature and the most likely defect Level 1
State most common disorders/causes associated with secondary hyperlipidemia Level 1
State National Cholesterol Expert Panel (NCEP) lipid levels associated with an increased risk for coronary heart disease (CHD) or cerebrovascular accident (CVA) Level 1

Describe the most likely cause, clinical significance, and lipid levels associated with hereditary hypolipemias Level 1
abetalipoproteinemia
hypobetalipoproteinemia

Explain the usefulness of the ASCVD (atherosclerotic cardiovascular disease) risk calculator (ACC/AHA recommendations); identify the six variables used in the ASCVD calculation Level 1
Tangier disease

Explain the cause and/or effect of disorders associated with lipid imbalances Level 1
Atherosclerosis
Malabsorption states
Biliary obstruction
Pregnancy
Postmenopause
Ketosis
Fatty liver
Lipid storage diseases
Respiratory distress syndrome (Hyaline membrane disease)
Metabolic syndrome

Discuss and perform methodologies for lipid determinations Level 1
State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness Level 1

Cholesterol methods
Triglycerides
LDL methods
HDL methods
Explain the calculation for LDL
Explain the usefulness of apolipoprotein measurements and state the most common methods used for analysis Level 1
Explain the usefulness of patient preparation and the procedure for a fecal fat analysis; include normal and diagnostic levels Level 1
State the qualitative or quantitative method used to detect fat in the urine Level 1
Explain recommended patient preparation protocol, specimen requirements, and abnormal serum appearance when collecting or handling specimens for lipid analysis Level 1
Perform lipid analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2
Discuss the usefulness of Point of Care (POC) cholesterol monitoring devices and compare results to non-POC analyzer results Level 1
Discuss recent advances in the measurement and detection of analytes associated with the diagnosis or monitoring of lipid disorders Level 1

General Chemistry: Proteins
Define the following terms Level 1
Isoelectric point
Zwitterion
Ampthoteric
Amino acid
Peptide bond
Complex or conjugated protein
Discuss protein structures and classifications Level 1
Differentiate among protein structures Level 2
- Primary
- Secondary
- Tertiary
- Quaternary

Discuss protein metabolism Level 1
- Explain the process of digestion and absorption of dietary proteins Level 1
- Explain the main transport route of dietary amino acids Level 1
- Discuss synthesis Level 1
  - Non-essential amino acids
  - Cellular proteins; include DNA and RNA involvement (including transcription and translation)

translate

Protein targeting
- Hormones involved in regulation

State the main physiologic functions of plasma proteins Level 1
- Identify the main site of synthesis for plasma proteins Level 1

Discuss the degradation of amino acids Level 1
- Transamination and oxidative deamination
- Ketogenic and glycogenic amino acids

State the electrophoretic fraction in which each is located, the normal function, and disease states associated with abnormal levels Level 1
- Albumin
- Alpha-1-antitrypsin
- Alpha-2-macroglobulin
- Haptoglobin
- Ceruloplasmin
- Transferrin
- Fibrinogen
- C-reactive protein
- Immunoglobulins

Explain the cause for elevated urine levels Level 1
- Albumin (microalbumin)
- Immunoglobulin
- Immunoglobulin light chains (Bence-Jones protein)
- Beta-2-microglobulin

Explain the role of fetal fibronectin in preterm delivery Level 1

Correlate disease states and disorders associated with total protein levels and other test results Level 2
- State the reference range for serum total protein and albumin Level 1
- Explain the cause for the abnormal serum protein Level 1
  - Dehydration
  - Multiple myeloma
  - Nephrotic syndrome
  - Malabsorption
Liver disease
Hemolytic anemia
Acute phase reaction/inflammation/infection
Hypogammaglobulinemia
Congestive heart failure (beta-natriuretic peptide)

Correlate the serum protein electrophoresis pattern with disorders Level 2
Nephrotic syndrome
Monoclonal gammopathy
Hypogammaglobulinemia
Liver cirrhosis
Acute phase reaction
Polyclonal gammopathy/inflammation

Discuss and perform methodologies for protein determinations Level 1
State the principle of the chemical reaction, sample types required, reference interval, most
common interfering substances/sources of error, and the usefulness Level 1
Biuret
Turbidimetry/nephelometry
Dye binding
Protein electrophoresis
UV absorption by peptide bonds

State the property of proteins that allows separation or classification Level 1
Electrophoresis
Isoelectric focusing
Ion exchange chromatography
Ultracentrifugation
Gel chromatography
Immunochromatography
Immunofixation

Perform protein analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
(redundant)

Discuss DNA technology detection techniques Level 1
Explain the principle of DNA probe use, sample types required, usefulness of the technique, and
common sources of error Level 1
Explain the usefulness of PCR Level 1
Perform PCR and DNA techniques according to established laboratory protocol Level 2
Determine the acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with diseases state or disorder Level 3

General Chemistry: Enzymes
Explain/define the terms associated with enzymes Level 1
Enzyme
Catalyst
Cofactor
Apoenzyme
Coenzyme
Prosthetic Group
Active Site
Substrate
Product
Inhibitor
Kinetic
International Unit
Isoenzyme
Vmax
Km
Activation Energy
Michaelis-Menten Constant
First Order Reaction
Zero Order Reaction
Discuss enzyme classification and structure
State the chemical composition of an enzyme
Discuss the classification and naming of enzymes (types of reactions catalyzed)
Discuss enzyme metabolism
State the most common physiologic functions of enzymes
Discuss enzyme kinetics
Basic enzyme reaction/mechanism of catalysis
Activation energy
Active site
Discuss theories of substrate binding by enzymes
Lock and key
Induced fit
Identify the Michaelis-Menten equation/constant
Explain the usefulness of Km and Vmax (Michaelis-Menten curve/Lineweaver-Burke plot) and how to determine given the curve or plot
Explain reaction orders (zero order/ first order)
Discuss factors affecting enzyme reaction rates
Temperature
Substrate concentration
pH
Enzyme concentration
Time
Isoenzymes
Substrate specificity
Co-factors
Discuss function and type of activators
Discuss function and type of inhibitors (reversible/ irreversible)
Discuss the synthesis and catabolism of enzymes
Describe the different types of enzyme regulation
Feedback
Product inhibition
Chemical modification (phosphorylation/dephosphorylation)
Synthesis
Proteolytic cleavage
Discuss disease states and disorders associated with enzyme measurement/assay and patient outcomes Level 1
Discuss clinically significant enzymes Level 1
Lactate dehydrogenase (LD)
Creatine kinase (CK)
Aspartate amino transferase (AST)
Alanine amino transferase (ALT)
Gamma glutamyl transferase (GGT)
Alkaline phosphatase (ALP)
Amylase (AMY)
Lipase (LIP)
Cholinesterase/pseudocholinesterase
Discuss the usefulness of measuring enzymes Level 1
Explain the difference in plasma specific vs. non-plasma specific enzymes Level 1
Explain the difference in origin of enzymes of secretion vs. organ specific enzyme Level 1
Explain how plasma/serum levels are used to assess the extent or severity of disease or effectiveness of treatment Level 1
State the primary tissue source(s) of clinically significant enzymes Level 1
Explain the significance of abnormal serum levels of enzymes and correlate with specific disease states or disorders Level 2
Myocardial infarction
Liver disease
Muscle disease
Bone disease
Malignancy
Hematological disorders
Pancreatitis
Discuss the kinetic measurement (first order, zero order) that is preferred for use in an analytical method Level 1
Explain the difference between endpoint and continuous monitoring kinetic methods and the usefulness of each Level 1
Discuss the use of enzymes as analytical reagents and give examples Level 1
Discuss quantitative or qualitative methods for determining levels of the clinically significant enzymes Level 1
Chemical principle and reaction of the most commonly used methods
Method of quantitation (kinetic, endpoint, immunoassay, etc.)
Specimen required, special preservation, sample treatment
Most common interfering substances/sources of error
Reference interval and units
Perform enzyme analyses according to established laboratory protocol Level 2
General Chemistry: Disease markers

Explain the origin and the usefulness in the detection of and risk assessment for an MI
Level 2
- CK/MB (if applicable)
- Troponin
- Myoglobin (if applicable)
- hs-CRP
- Lp(a)
- Homocysteine

Explain the most common quantitative or qualitative chemical reaction used for detection
Level 1
- CK/MB (if applicable)
- Myoglobin (if applicable)
- Troponin
- hs-CRP

General Chemistry: Non-protein nitrogen

Explain the chemical structure, synthesis and mode of excretion of urea Level 1
Discuss disease states and disorders associated with urea measurement Level 1
- Pre-renal causes
- Renal causes
- Post-renal causes
- Decreased formation (liver disease)
- Over-hydration; dilution
- End stage renal disease

Discuss methodologies for urea nitrogen Level 1
- State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness Level 1
- Perform urea nitrogen analyses according to established laboratory protocol Level 2
- Evaluate acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
- Correlate patient results with disease state or disorder Level 3

Explain the chemical structure, synthesis and mode of excretion of creatinine Level 1
Discuss disease states and disorders associated with creatinine measurement Level 1
- Renal disease
- Muscle wasting disease

Discuss methodologies for creatinine Level 1
For the most common methods, state the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error Level 1
Perform creatinine analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

State the reference range and explain the usefulness of the **BUN/creatinine ratio** Level 1
Discuss the advantage and disadvantages of substances for determination of renal clearance

Creatinine
Inulin
Cystatin C
Discuss factors that can influence creatinine clearance results (timing, complete collection, body size) Level 1
Use protocol for performing creatinine clearance tests Level 2
Calculate creatinine clearance results using body surface area normalization Level 2
Differentiate eGFR and GFR Level 2
Recognize factors that can influence eGFR results (age, muscle mass, gender, race)
Recognize optimal eGFR calculation formulas for clinical use

Explain the chemical structure, synthesis and mode of excretion of uric acid Level 1
Discuss disease states and disorders associated with uric acid measurement Level 1
Renal disease
Gout
Increased cell turnover (Leukemia, Chemotherapy, Tumor lysis syndrome)
Discuss methodologies for uric acid Level 1
Perform uric acid analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

Explain the chemical structure, synthesis and mode of excretion of ammonia Level 1
Discuss methodologies for ammonia Level 1
For the most common methods, state the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error Level 1
Perform ammonia analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2
General Chemistry: Electrolytes and Trace Elements

Define terminology associated with **electrolytes** Level 1

- Electrolyte
- Anion
- Cation
- Intracellular/extracellular
- Anion Gap
- Trace element

Discuss electrolyte metabolism Level 1

Explain the physiologic function and distribution of the following Level 1

- Sodium
- Potassium
- Chloride
- Bicarbonate
- Calcium
- Magnesium
- Phosphate

Describe the regulation of Sodium Level 1

- Dietary intake
- Aldosterone
- Renin
- Atrial natriuretic peptide (ANP)
- Kidney function

Describe the regulation of Potassium Level 1

- Dietary intake
- Blood pH
- Kidney function

Describe the regulation of Chloride Level 1

- Follows sodium
- Blood pH

Explain the regulation of Bicarbonate Level 1

- Blood pH
- Renal

Describe the regulation of Calcium/ionized calcium Level 1

- Parathyroid hormone (PTH)
- Calcitonin
- Protein effects on total calcium
- Blood pH
- Vitamin D

Explain the regulation of Magnesium Level 1

- Renal
- PTH

Explain the regulation of Phosphate Level 1

- PTH
- Calcitonin
- Vitamin D
Discuss **trace element** metabolism Level 1

Explain the physiologic function and distribution Level 1

- Iron
- Copper
- Zinc
- Manganese
- Chromium

Explain the regulation of Iron Level 1

- Intestinal absorption
- Transferrin
- Serum iron
- Ferritin

Explain the regulation of Copper Level 1

- Absorption
- Ceruloplasmin

Discuss water metabolism Level 1

- Intracellular
- Extracellular

Explain water movement Level 1

- Osmosis
- Maintenance of electrical equilibrium
- Effect of macromolecules

Explain water regulation Level 1

- Anti-diuretic hormone (ADH) (vasopressin)
- Renin-angiotensin-aldosterone system
- Thirst center
- Effective arterial blood volume (EABV)

Explain the lack of regulation Level 1

- Salt intoxication
- Water intoxication
- Edema

Discuss and perform methodologies for electrolyte and trace element measurement Level 2

Describe the principle of operation and identify components of Ion-Selective Electrodes (ISE) / Colorimetric Procedures/ Atomic Absorption Level 1

State specimen requirements of Ion-Selective Electrodes (ISE) / Colorimetric Procedures/ Atomic Absorption Level 1

State most common sources of error of Ion-Selective Electrodes (ISE) / Colorimetric Procedures/ Atomic Absorption Level 1

Perform electrolyte and trace elements analyses according to established laboratory protocol Level 2

Determine acceptability of results Level 3

Report results according to laboratory protocol Level 2

Perform, document, and evaluate quality control Level 3

Correlate patient results with disease state or disorder Level 2
Discuss disease states and disorders associated with electrolyte metabolism Level 1

Explain effect on electrolyte levels Level 1

- Edema
- Dehydration
- Dilution (water movement into plasma)
- Diuretic therapy

State reference intervals and critical values Level 1

- Sodium
- Potassium
- Chloride
- Bicarbonate
- Calcium
- Magnesium
- Phosphate

Given the following conditions, list and explain causes, symptoms and diagnostic levels associated with each condition Level 1

- Hyponatremia/pseudohyponatremia
- Hypernatremia
- Hypokalemia
- Hyperkalemia
- Hypochloremia
- Hyperchloremia
- Increased levels of bicarbonate
- Decreased levels of bicarbonate
- Hypocalcemia
- Hypercalcemia
- Hypomagnesemia
- Hypermagnesemia
- Hypophosphatemia
- Hyperphosphatemia

Define and explain the usefulness of the Anion Gap Level 1

Given electrolyte data, calculate the anion gap Level 2

Correlate an increased or decreased anion gap with specific disorders or conditions Level 2

Utilize the anion gap as a quality control measure when performing electrolyte analyses Level 2

Recognize electrolyte patterns that are consistent with disease and those that are consistent with error(s) such as hyperproteinemia, lipidemia, incorrect anticoagulant, etc. Level 1

Discuss disease states and disorders associated with trace element metabolism Level 1

Correlate each with specific diseases or disorders or iron deficiency or iron excess Level 2

- Serum iron
- Transferrin
- Total iron binding capacity (TIBC)
- Serum ferritin
- Free erythrocyte protoporphyrin (FEP)
- Hemosiderin
Correlate each with specific diseases or disorders: Serum copper, Urine copper, Ceruloplasmin. List disorders associated with deficiency or excess: Chromium, Zinc. Discuss recent advances in the measurement and detection of electrolytes and trace elements.

**General Chemistry: Acid-Base and Blood Gas Studies**

- Define terminology associated with blood gas analysis: Acid, acidosis, acidemia, Base, alkalosis, alkalemia, base excess, Buffer, pH.
- Oxygen saturation, PSO, oxygen capacity, Hypoxia, hypoxemia, Henderson-Hasselbalch equation.
- Explain the plasma buffering systems: Bicarbonate/carbonic acid, Phosphate, Proteins; imidazole group of histidine.
- Explain the RBC/hemoglobin buffering mechanism.
- Discuss blood buffer systems.
- Discuss the regulation of acid-base balance.
- Discuss the reabsorption of bicarbonate by the renal tubules: Sodium-hydrogen exchange/H+ secretion, Sodium-potassium exchange/secretion of K+.
- Explain factors affecting bicarbonate reabsorption.
- Explain carbon dioxide excretion via the lungs: Mechanism for expiration of CO2.
- Explain compensatory mechanisms. Pulmonary compensation with primary metabolic change (change in HCO3), Hypoventilation if bicarbonate increased (increased pCO2 if increased). Hyperventilation if bicarbonate decreased (decreased pCO2 if decreased). Renal compensation with primary respiratory change (change in CO2), Retention of bicarbonate, if CO2 is retained.
Excretion of bicarbonate, if CO2 is blown off
Discuss disease states associated with imbalance (may be uncompensated or partly compensated)
List causes for metabolic acidosis = bicarbonate deficit
List causes for metabolic alkalosis = bicarbonate excess
List causes for respiratory alkalosis = decreased carbonic acid
List causes for respiratory acidosis = increased carbonic acid
List causes for mixed acidosis (metabolic and respiratory)
List causes for mixed alkalosis (metabolic and respiratory)
List causes for compensated metabolic acidosis or respiratory acidosis
List causes for compensated metabolic alkalosis or respiratory alkalosis
Evaluate blood gas results to determine defect Level 3
Discuss oxygen metabolism Level 1
Explain the availability of oxygen
Alveolar oxygen tension
Hemoglobin oxygen saturation
Explain factors that affect oxygen dissociation from hemoglobin
2,3-diphosphoglycerate (DPG) Level 1
pH
Temperature
Carbon monoxide (CO)
Define and explain causes for a shift to the left Level 1
Define and explain causes for a shift to the right Level 1
Discuss blood gas analysis Level 1
Explain the principle of blood gas analysis Level 1
pH electrode
pCO2 electrode
pO2 electrode
Explain the principle of cooximetry Level 1
O2 saturation
Hemoglobin
CO
PSO
Explain specimen collection and handling requirements Level 1
Explain most common sources of error Level 1
If available, perform blood gas analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

General Chemistry: Therapeutic Drug Monitoring (TDM) and Toxicology
Define the terminology associated with drug monitoring Level 1
Therapeutic drug monitoring
Toxicology
Pharmacodynamics
Pharmacokinetics
Steady State
Half-life (t1/2)
Therapeutic range
Peak and trough
Discuss pharmacokinetics Level 1
Explain the absorption process of a drug Level 1
Route of administration (oral, IM, subcutaneous, IV)
Transport across cell membrane (passive, active, facilitated)
Factors affecting absorption (size & shape, ionization, lipid solubility)
Explain the process of drug distribution in the body Level 1
Two-compartment model
Effect of body size
Effect of total water content
Effect of overall cardiac function
Effect of pKa of the drug
Plasma protein binding
Volume of distribution (VD)
Explain the basic metabolism or biotransformation in the body Level 1
Explain the mechanisms involved in metabolism/biotransformation Level 1
Exponential rate (t1/2)
Active metabolites
Cellular & tissue locations (liver, kidney, etc.)
Explain the reactions involved in basic metabolism/biotransformation Level 1
Conjugation
Oxidation
Hydrolysis
Reduction
Discuss factors causing enzyme induction or inhibition Level 1
Discuss other factors associated with biotransformation Level 1
Liver function
Kidney function
Change in GI motility or pH
Change in urine pH
Cardiac function
Explain the process of elimination Level 1
Kidney
Glomerular filtration rate
Tubular secretion or reabsorption
Bile
Sweat
Feces
Lungs
Saliva
Define and discuss terminology associated with clinical toxicology Level 1
Drugs of abuse (DOA)
Emergency toxicology
Chronic poisoning
Explain mechanisms of toxicity Level 1
- Interference with enzyme actions and systems
- Blockage of oxygen usage and transport
- Interference with cell function
- Hypersensitivity reactions

Explain factors that influence toxicity Level 1
- Nature of toxicant
- Exposure variables (Dose/route of administration/time)
- Biologic variables (age/ race/ethnicity/ genetics)

Discuss and perform analytical methods Level 1
- Explain and demonstrate proper specimen collection Level 2
  - Time of blood draw relative to last dose
- Requirements for legal samples
- Requirements for forensic samples

Explain the usefulness of screening methods Level 1

State the most common analytical methods Level 1
- Spectrophotometry
- Immunoassay
- Chromatography
- Atomic absorption
- Nuclear magnetic resonance (NMR)
- Mass spectroscopy

Perform drug analyses according to established laboratory protocol Level 2
- Determine acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
- Correlate patient results with disease state or disorder Level 2

Discuss recent advances in the measurement and detection of therapeutic drugs and toxicologic agents Level 1

General Chemistry: Vitamins, Provitamins, Derivatives
- Recognize basic concepts relating to the clinical significance of vitamins Level 1
- Identify classifications of vitamins Level 1
- Water soluble (Thiamine-B1, Riboflavin-B2, Niacin, Pyridoxine-B6, Pantothenic acid, Biotin, Folic Acid, Cyanocobalamin-B12)
- Fat soluble (A, D, E, K)
- Describe the metabolism of vitamins Level 1
  - Absorption, transport
  - Ingestion/Digestion (lipase, bile salts)
  - Transportation by LDL
  - Storage (Liver, tissues, RBCs)
  - Degradation or elimination
  - Fat soluble-feces
  - Water soluble-urine
- Describe the synthesis of Vitamin D
State the function of vitamins as precursors for activators, coenzymes, and accelerators
Level 1

State the specific function of vitamins Level 1
Vitamin A (vision, cell differentiation, growth, reproduction, immune system function)
Vitamin D (mineralization of skeleton, calcium and phosphate homeostasis)
Vitamin E (antioxidant, breakdown of peroxide, integrity of cells)
Vitamin K (formation of coagulation factors)
Vitamin C (H+ ion transfer, redox reactions, amino acid metabolism, collagen synthesis)
Thiamine (coenzyme in energy metabolism)
Riboflavin (precursor for coenzymes FMN or FAD, redox reactions
Niacin (precursor for coenzyme NAD, dehydrogenase reactions
Pyridoxine (amino acid metabolism & transport, heme synthesis)
Pantothenic acid (component of Coenzyme A)
Biotin (coenzyme for carboxyl unit transfer)
Folic acid (coenzyme for one-carbon transfer reactions)
Cyanocobalamin (hematopoiesis, fatty acid metabolism)

Describe the symptoms and consequences of vitamin deficiencies and excesses Level 1

General Chemistry: Porphyrias
Identify basic concepts relating to the clinical significance of porphyrins Level 1
Discuss the biochemical reactions involved in heme synthesis Level 1
  amino levulinic acid (δ-ALA)
  porphobilinogen (PBG)
  uroporphyrinogen (Type I and III)
  Coproporphyrinogen III
  Protoporphyrinogen IX
  Protoporphyrin IX
  Heme
Recognize diseases associated with primary porphyrins Level 1
  Erythropoietic
    Congenital erythropoietic porphyria (CEP)
    Erythropoietic protoporphria (EPP)
  Hepatic
    Acute intermittent porphyria (AIP)
    Hereditary coproporphyria (HCP)
    Variegate porphyria (VP)
    Porphyria cutanea tarda (PCT)
State diseases associated with secondary porphyrins Level 1
  Lead poisoning
  Hereditary tyrosinemia
  Liver disease
  Iron deficiency anemia
Recognize basic principles of porphyrin analysis Level 1
  Porphobilinogen – Watson-Schwartz & Hoesch
  Delta-ALA
  Porphyrins – Chromatography, Fluorometry, Spectrophotometry
Zinc protoporphyrin
Heme biosynthetic enzymes

Discuss basic concepts relating to the significance of bilirubin
Heme catabolism
Bilirubin conjugation

Recognize and explain diseases associated with bilirubin metabolism
Prehepatic jaundice (neonatal/hemolytic anemia)
Dubin-Johnson syndrome
Rotor’s
Crigler-Najjar
Hepatitis
Cirrhosis
Post-hepatic jaundice

Discuss methods of analysis for total/direct bilirubin
Evelyn-Malloy
Jendrassik-Grof
Spectrophotometry

Perform porphyrin/ bilirubin analyses according to established laboratory protocol

Determine acceptability of results
Report results according to laboratory protocol
Perform, document, and evaluate quality control
Perform and document routine preventative maintenance
Correlate patient results with disease state or disorder

General Chemistry: Endocrinology

Define endocrine terminology
Hormone
Endocrine
Releasing factor/hormone
Tropic hormone
Effector hormone
Glucocorticoid
Mineralcorticoid
Diurnal variation

Discuss hormone structures and classifications
Describe the mechanism of action of protein hormones

Growth hormone
Adrenocorticotropic hormone (ACTH)
Thyroid stimulating hormone (TSH)
Follicle stimulating hormone (FSH)
Luteinizing hormone (LH)
Prolactin (PRL)
Antidiuretic hormone (ADH)/vasopressin
Calcitonin
Parathyroid hormone (PTH)
Insulin
Glucagon
Gastrin
Secretin
Human chorionic gonadotropin (HCG)

Describe the mechanism of action of steroid hormones Level 1
Cortisol
Aldosterone
Androgens
Testosterone
Dehydroepiandrosterone (DHEA)
Dehydroepiandrosterone-sulfate (DHEA-S)
Progesterone
Estrogens/estradiol/estril

Describe the mechanism of action of amine hormones Level 1
Catecholamines
Thyroxine (T4)
Triiodothyronine (T3)
Serotonin/5-hydroxyindolacetic acid (5-HIAA)

Discuss hormone metabolism Level 1
Explain the physiologic function and effects of hormones Level 1
Discuss biosynthesis of hormones Level 1
Significant precursors
Pathways/reactions
Control of hormone secretion
Source of hormone
Target gland or tissue(s)
Discuss the catabolism of hormones Level 1
Pathways/reactions
Mechanism(s) for elimination

Explain how non-protein hormones are transported in the blood Level 1
Discuss disease states and disorders associated with endocrine metabolism Level 1
Explain the difference between primary, secondary, and tertiary disorders Level 1
Explain the cause and symptoms associated with each disorder Level 1
Explain most common screening and diagnostic testing for hypothyroid disorders Level 1

Hashimoto’s thyroiditis
Myxedema
Congenital

Explain most common screening and diagnostic testing for hyperthyroid disorders Level 1
Grave’s disease
thyrroid adenoma
toxic multinodular goiter

Explain the primary causes of abnormal thyroid tests with non-thyroid illness (NTI) Level 1
Explain the most common screening and diagnostic testing for adrenal disorders Level 1
Conn's syndrome (primary hyperaldosteronism)
Secondary hyperaldosteronism
Cushing's syndrome
  Cushing's disease
  Adrenal tumor
  Adrenal hyperplasia
  Ectopic production of ACTH
Congenital adrenal hyperplasia (CAH)
Hypoadrenocorticolism
  Acute
  Addison's disease
Adrenal medulla disorders
  Pheochromocytoma
  Neuroblastoma
Pituitary dysfunction
  Hypopituitarism and panhypopituitarism
  Hyperpituitarism
Discuss factors that affect hormone levels other than endocrine diseases Level 1
Emotional stress
Time of day
Menstrual cycle
Menopause
Food intake/diet
Hormone therapy
Drugs
Discuss relevant hormone and/or metabolite determinations in Thyroid Testing Level 1
For each hormone/metabolite, state the principle of the method, any special patient preparation, sample types required, reference interval, most common interfering substance/source of error, and the usefulness of each (screening vs. diagnostic tests)
  TSH
  Free T4
  Free T3
  Reverse T3
  Thyroxine binding globulin (TBG)
  Antithyroid antibodies (TSI, TPO, ATA)
Discuss relevant hormone and/or metabolite determinations in Adrenal Testing Level 1
  Cortisol
  Urinary/Primary free cortisol
  ACTH
  DHEA-S
  Dexamethasone suppression test
  Metyrapone test
  ACTH stimulation test
  Aldosterone
  Renin
  Catecholamines
Vanillylmandelic acid (VMA) and metanephrines
Discuss relevant hormone and/or metabolite determinations in Metastatic carcinoid tumor
analysis  Level 1
Serotonin
5'-HIAA
Discuss relevant hormone and/or metabolite determinations in Infertility Testing
Level 1
FSH
LH
Testosterone
Progesterone
Estrogens
Discuss relevant hormone testing for pituitary/hypothalamus testing
ADH
ACTH
GH
Prolactin
Perform hormone analyses according to established laboratory protocol  Level 2
Determine acceptability of results  Level 3
Report results according to laboratory protocol  Level 2
Perform, document, and evaluate quality control  Level 3
Correlate patient results with disease state or disorder  Level 2

Genetic Disorders
Define genetic disease  Level 1
Categorize and list examples of genetic diseases  Level 1
Chromosomal aberration
Inborn errors of metabolism
Polygenic disorders
Describe tests used to evaluate the risk of fetal chromosomal abnormalities
Human chorionic gonadotropin (hCG)
Estrogens
Alpha fetoprotein (AFP)
Pregnancy-associated plasma protein-A (PAPP-A)

Commented [JP9]: Cross reference to UA
MLS ELC Clinical Chemistry
Deleted items

Math and Instrumentation
Perform basic calculations –specific gravity
Define units of systems of measurement – nonmetric
Define conversions between and among systems of measurement – metric to nonmetric, nonmetric to metric and SI, SI to nonmetric
Calculate and utilize statistical data for quality control and statistical analyses – sampling
Discuss principles of basic electronics: Components, Voltage, current, resistance concepts-OHM’s law
Activate and calibrate spectrophotometer following established laboratory procedure
Establish procedures to be used in the activation of a spectrophotometer
Identify basic concepts of coulometric amperometry
Instrumentation: pH meter (a stand-alone meter)
Develop a maintenance procedure for all balances
Develop a maintenance procedure for all centrifuges
Perform routine maintenance on a hot plate
Establish lab procedures for electrophoresis

Proteins:
Discuss the role of gene therapy in treating genetic disorders
Compare recent advances in the measurement and detection of analytes associated with the diagnosis or monitoring of protein disorders

Enzymes:
Discuss clinically significant enzymes – CK isoforms, Acid phosphatase
Ischemia modified albumin (IMA)

Electrolytes and Trace Elements:
Correlate UIBC with specific diseases or disorders or iron deficiency or iron excess

Endocrine:
Total T4, Total T3, T uptake, Free thyroxine estimate/index (FTE/FTI)
Genetic Disorders:
Perform laboratory screening procedures for the diagnosis of each metabolic disorder
- Urine color
- Urine odor
- Urine crystals
- Colorimetric tests on urine

Added items

Math and Instrumentation
Perform basic calculations – normality
Define predictive statistics: True positive and negative, False positive and negative, Clinical sensitivity and specificity, Positive predictive value (PPV), Negative predictive value (NPV)
Calculate and utilize statistical data for method verification and comparison studies
  - Precision - Coefficient of variation (CV); F test
  - Accuracy - T-test, Linear regression- slope(m), - y intercept(b); Correlation coefficient(r)

Identify basic components of atomic absorption- Burner assembly, Gas regulators, Light source (hollow cathode lamp), Monochromator, Light detector, Signal conversion electronics, Read-out systems

Identify basic concepts and principles of fluorescent polarization

Identify basic concepts of a luminometer: Principles, Components, Operation, Maintenance/quality assurance
  - Correctly operate luminometer
  - Perform routine maintenance checks on the luminometer

Calibrate an osmometer following established laboratory procedure & perform test procedures on standards, controls, and unknowns

Identify/explain basic concepts of refractometer/light refraction; calibrate; perform testing

Identify basic concepts of mass spectrometry
  - Principles
  - Components
  - Operation
  - Maintenance/quality assurance

Correctly operate (if available) and perform routine maintenance checks

Carbohydrates:
State the components of the disaccharides: Lactose, maltose, sucrose

State the composition and function of each of the following polysaccharides: starch, glycogen, proteoglycans (mucopolysaccharides), glycoproteins
Explain the following glucose pathways:
- Insulin and non-insulin routes of entry to cells
- Glycolysis
- Glycogenolysis
- Glycogenesis
- Gluconeogenesis
- Kreb’s cycle (citric acid or TCA cycle)
- Pentose phosphate pathway (hexose monophosphate shunt)

Explain diagnostic criteria for Type 1, 2 (impaired glucose tolerance and provisional diabetes mellitus), and GDM

Explain the difference between adrenergic and neuroglycopenic symptoms

Explain the usefulness of estimated average glucose (eAG)

**Lipids:**
Given serum appearance, and cholesterol and triglyceride levels, classify the lipoprotein disorder according to familial lipoprotein disorders nomenclature and explain the most likely defect

State most common disorders/causes associated with secondary hyperlipidemia

State National Cholesterol Expert Panel (NCEP) lipid levels associated with an increased risk for coronary heart disease (CHD) or cerebrovascular accident (CVA)

Explain the usefulness of the ASCVD (atherosclerotic cardiovascular disease) risk calculator (ACC/AHA recommendations); identify the six variables used in the ASCVD calculation

**Proteins:**
Explain the role of fetal fibronectin in preterm delivery

Congestive heart failure (beta-naï triumetic peptide)

**New Disease Markers:**
Explain the origin and the usefulness in the detection of and risk assessment for an MI
- hs-CRP
- Lp(a)
- Homocysteine

**Non-protein nitrogen:**
Discuss the advantage and disadvantages of cystatin for determination of renal clearance

Differentiate eGFR and GFR

**Electrolytes and Trace Elements:**
Explain the role of atrial natriuretic peptide (ANP) in sodium regulation
State the most common methods of analysis - nuclear magnetic resonance (NMR), mass spectroscopy

**Genetic disorders:**
Describe tests used to evaluate the risk of fetal chromosomal abnormalities
- Human chorionic gonadotropin (hCG)
- Estrogens
- Alpha fetoprotein (AFP)
- Pregnancy-associated plasma protein-A (PAPP-A)
Education
MLS Entry Level Curriculum

Compare and contrast competency and proficiency Level 2
Describe the characteristics and qualities of an effective instructor Level 1
Define basic educational terms Level 1
  Competence or competency
  Objectives
  Curriculum (as it applies to laboratory science programs)
  Articulation (as it applies to laboratory science programs)
  Continuing education unit (CEU)
  Accreditation
  Certification
  Continual Maintenance Program (CMP)
  Licensure
  Reciprocity
  Evaluation
Discuss the three domains of learning Level 1
  Cognitive
  Psychomotor
  Affective
Describe the three modified taxonomy levels for the cognitive domain Level 1
  Level 1: Recall of information (knowledge)
  Level 2: Understand information and applying it to other material or new situations (comprehension/application)
  Level 3: Problem solving (analysis/synthesis/evaluation)
Explain the purposes and uses of objectives Level 1
List the components of a well written objective Level 1
Given an example of an objective, distinguish the domain and taxonomic level Level 2
Given an example of a learning activity, identify the domain and taxonomic level  

State the purposes for evaluating learner performance and the type of evaluation instruments available for use with each educational domain  

Define terms used with various evaluation instruments  

- Criterion referenced and norm referenced examinations  
- Formative and summative evaluation  
- Subjective and objective evaluation  

Choose the most objective and effective evaluation method to use for a given learner performance  

Develop effective examination questions  

- True-false  
- Multiple choice  
- Matching  
- Short answer  
- Essay  

Analyze multiple choice questions to evaluate whether the question is correctly written; strengthen the item when needed  

Prepare an examination correlating objectives with test items  

Explain at least three common errors made by evaluators when using “rating scales”  

Describe and contrast instructional methods; give examples for the appropriate use of each method  

- Lecture  
- Discussion/tutorial  
- Demonstration  
- Simulation/role playing/practice  
- Individualized/self-instruction/computer instructional unit  
- Problem-based learning  
- Cooperative learning  

Use instructional technology while delivering educational materials using best practices  

- Audio-visual program
Computer assisted programs
Blended/hybrid methods
Online instruction
Simulation models

Prepare, deliver, and evaluate an effective experience Level 3

A presentation

A one-on-one clinical teaching activity

State the elements needed to create an effective environment for clinical education, including the relationship of clinical methods to theoretical knowledge Level 1

Describe the accreditation process Level 1

Discuss the importance of staff development programs and continuing education Level 1
MLS ELC Education

Deleted and added items

**Deletions**

Define Registration

Establish in-service programs

**Additions**

Define reciprocity

Compare and contrast competency and proficiency

Replaced distance learning with hybrid, online, simulation, etc.

Changed establish staff development programs to discuss the importance of staff development
General Lab Practice
MLS Entry Level Curriculum

Laboratory Safety
Identify the following safety equipment and explain their use Level 1

- Fire extinguishers, blankets
- Fume hood
- Eye wash
- Safety shower
- Personal Protective Equipment
- Splash guards
- Vented storage cabinets
- Acid storage cabinets
- Flammable storage cabinets
- Broken glass/sharps containers
- Spill kits
- Biological safety cabinet
- Engineering controls

Inspect and maintain safety equipment Level 2

- Follow procedures and techniques for maintenance, inspection and use of safety equipment
- Determine location of safety of safety equipment
- Monitor inspection, maintenance and documentation of safety equipment
- Locate, maintain, and utilize safety data sheets (SDS)

Recognize and report hazardous situations Level 2

- Identify potential sources of lab hazards
  - Fire
  - Electrical
  - Chemical
  - Biological/bioterrorism
Document laboratory accidents and unsafe procedures Level 2

Utilize appropriate safety equipment and procedures according to established laboratory protocol Level 2

Stock and maintain emergency medical supplies Level 2

Follow laboratory protocol for disposal of contaminated materials Level 2

Properly decontaminate work surfaces Level 2

General Laboratory Supplies and Equipment

Glassware/Plasticware

Identify attributes, advantages, advantages and disadvantages of specific type of labware Level 1

Select appropriate labware for specific procedures Level 2

Nonvolumetric

  Beakers

  Flasks

  Cuvettes

  Pipettes

Volumetric

  Flasks

  Pipettes

Automated pipets

Correctly use labware Level 2

Correctly dispose of used labware Level 2

Describe how to clean nondisposable labware Level 1

Describe or perform calibration of pipets Level 1

Reagent water

Describe methods of water purification Level 1

  Distilled

  Deionized

  Reverse osmosis
Explain types of (CLSI) reagent grade water

**Chemicals**

Explain grades of purity

- Commercial or technical
- Commercially pure
- Reagent grade
- United States Pharmacopeia certified (USP)

Perform solution preparation

- Select correct chemical
- Perform necessary calculations
- Weigh/measure concentrates
- Label and store
- Observe safety requirements

**Standards/controls**

Define types of standards

- Primary
- Secondary

Define types, uses and limitations of controls

- Assayed
- Unassayed

**Microscopes**

Prepare microscope for optimized viewing

- Clean microscope components using appropriate care
- Adjust light source for proper illumination level
- Place filters (e.g., neutral density) in light path appropriately
- Protect microscope from dust when not in use, i.e., dust cover

Select type of microscopy and adjust appropriately for optimum viewing (brightfield, phase contrast, polarizing, interference contrast, red compensating filters)

Optimize condenser position

- Height
Centration
Adjust diaphragms appropriately for optimum viewing  Level 2
Field iris
Condenser aperture
Check and perform phase ring alignment for phase microscopy, if available  Level 2
Place polarizing filters in light path correctly for polarizing microscopy, if available  Level 2
Operate microscope, i.e., place, focus, and scan mounted specimen  Level 2
Secure microscope slide on mechanical stage  Level 2
Check and perform interpupillary and diopter adjustments  Level 2
Select and interchange objectives  Level 2
Use coarse and fine adjustments  Level 2
Use mechanical stage adjustment knobs to scan mounted specimen  Level 2

Information Technology
Define the essential components of software  Level 1
Operating systems
Drivers
Application programs
Word processing
Spreadsheet
Data base management
Graphics
Communication (e-mail)
Internet/web-based options
Presentation programs (PowerPoint, etc.)
Perform basic operation of computer systems  Level 2
Enter data
Transmit
Retrieve data
Present data/information
Quality Control  (cross reference to clinical chemistry)
Define and apply basic QC theory, methods, and statistics  Level 2
  Mean
  Mode
  Median
  Standard deviation
  Coefficient of variation
  Reference intervals
  Variance
  Linear regression
  Correlation coefficient
  Gaussian distribution
  Scales, graphs, charts
  Levey-Jennings charts
  Westgard Multirule system
Define and properly utilize controls and reference materials/standards  Level 2
  Assayed/unassayed controls
  Primary/secondary standards
Define type of laboratory errors and biases  Level 1
  Preanalytical
  Analytical
    Random
    Systematic
  Postanalytical
Identify sources of lab error  Level 1
Monitor and prevent laboratory errors  Level 2
Explain quality control programs  Level 1
  Internal
  External
Interpret statistical data                      Level 2
Define, explain and interpret patterns         Level 2
  Shifts
  Trends
Perform all quality control procedures according to established protocol     Level 2
  Collect data and perform statistical analyses
Monitor and interpret quality control data     Level 2
  Recognize shifts, trends and other deviations
  Identify sources of error
  Verify laboratory proficiency
  Implement corrective action

Control of equipment and supplies
  Perform maintenance, calibration and storage of laboratory supplies and equipment     Level 2
  Document quality assurance schedules                                             Level 2
  Maintain and troubleshoot quality control logs                                 Level 3
  Define and/or use a document control system                                  Level 1

Method selection and evaluation (cross reference to clinical chemistry)
  Discuss why new tests or methods may need evaluation and implementation       Level 1
  Physician request
  Method replacement
Define basic concepts of method selection and evaluation                        Level 1
  Positive Predictive Values
  Negative Predictive Values
  Pediatric method
  Stat method
  Routine procedure
Perform cost analysis of new methods                                             Level 2
  Reagents
List and explain basic concepts of equipment selection and evaluation

Supplies
Space requirements
Sample requirements
Throughput/turnaround time
Waste requirements
Chemical hazard and safety considerations
Laboratory information system interface
Service contracts

Explain analytical performance parameters

Accuracy
Precision
Sensitivity
Specificity
Linearity/reportable range
Comparison studies
Regression analysis
Interference studies
Recovery studies
Verification of manufacturer’s performance

Explain how to determine a reference interval

Review literature
Selection of population for specimens
Collections and handling of specimens
Statistical analysis of data

Review literature for new methodology Level 2

Perform evaluation studies according to accepted protocol Level 2

Management of Services and Quality

Comply with federal laws, regulations, and guidelines e.g., HHS, CDC, OSHA, EEOC, CLIA, HIPAA Level 3

Comply with voluntary accrediting and inspection requirements e.g., CAP and Joint Commission Level 3

Maintain patient confidentiality Level 3

MLS ELC General Lab Practice

Deleted and Added items

Deletions
Basic elements of a computer

Basic elements of software – languages, authoring

Identify types, use and correct disposal of plasticware

Method evaluation – ROC curve

Additions
Define or use a document control system

Microcomputers section changed to Information Technology

Microscope section
Normal hematopoietic system

Define hematopoiesis Level 1
Theory of pluripotent stem cell development
Stem cell kinetics: Generative cell cycle
Hematopoietic inductive environment of regulatory growth factors and inhibitors
Apoptosis

Identify phases and site of origin for cellular development of active hematopoietic tissue in embryo and fetus Level 1
Yolk sac
Mesoblastic phase
Hepatic phase (extramedullary)
Medullary/myeloid phase

Identify phases and site of origin for cellular development of active hematopoietic tissue in infant and young child Level 1
All red marrow spaces (all cell lines)
Thymus fully developed (T lymphs)
Secondary lymphoid tissue (B-cell, T-cell and NK-cell)

Identify phases and site of origin for cellular development of active hematopoietic tissue in adult Level 1
Red marrow (axial skeleton and proximal ends of long bones)
Primary and secondary lymphoid tissue (B-cell, T-cell and NK-cell)

Explain the role of other organ systems in hematopoiesis Level 2
Mononuclear phagocyte system
Spleen (Structure, blood flow, function)
Liver (Structure, blood flow, function)
Lymph nodes (Structure, blood flow, function)
Thymus (Structure, blood flow, function)

State the physical findings commonly present in hematologic disease Level 2
Splenomegaly
Hypersplenism
Hepatosplenomegaly
Lymphadenopathy

Bone Marrow Tissue

List indications for performing bone marrow examination Level 1
Describe bone marrow collection techniques Level 1
Aspiration
Core biopsy

Prepare and stain bone marrow smears Level 2
Romanowsky polychrome stain
Prussian Blue (Iron) Stain
Cytochemical stains (not used by all facilities)
   Enzymatic techniques (esterase, myeloperoxidase)
   Nonenzymatic techniques (PAS, Prussian blue (iron))
Describe preparation and/or process specimen for specialized testing Level 2
Flow cytometry

MLS Hem 1
Molecular assays
Cytogenetics
Fluorescent in-situ hybridization (FISH)

Describe key terms and apply concepts used to assess bone marrow structure and function

- Myeloid to erythroid ratio (M:E)/erythroid to granulocyte ratio (E:G)
- Erythropoiesis
- Granulopoiesis
- Megakaryopoiesis
- Non-hematopoietic cells
- Cellularity: fat (yellow marrow) to cell (red marrow) ratio
- Aplastic marrow
- Hypoplastic marrow
- Hyperplastic marrow

Describe concepts related to the assessment of iron stores and sideroblast population in the bone marrow

- Type I
- Type II
- Type III

Perform differential count on normal bone marrow specimens

Distinguish between normal and abnormal hematopoietic elements found within the peripheral blood

Correlate bone marrow findings with peripheral blood evaluation

Prepare peripheral blood for routine hematologic procedure and smear analysis

- Determine specimen acceptability
- List appropriate anticoagulants and mechanism of anticoagulation
- Identify acceptable ratio of anticoagulant to blood for specimens obtained from venipuncture and skin puncture
- List reasons for rejecting specimens

Stain smears using Romanowsky dyes and techniques according to established procedures

- Manual
- Automated

- List and define components of stain and explain the principle
- Judge the acceptability of blood smears through microscopic evaluation and established criteria
- Random distribution of cells
- Good stain quality
- Absence of artifact

- Troubleshoot staining problems
- Correlate peripheral blood evaluation with automated cell analysis
- Enumerate and morphologically evaluate blood cells on Romanowsky stained smears
Research new concepts and emerging technologies

Describe advanced technologies Level 1
Therapeutic use of growth factors and stem cells to stimulate hematopoietic recovery
Bone marrow/stem cell transplant to treat hematologic disease
Allogeneic
Autologous
Immunophenotyping by flow cytometry
Cell surface antigens
Intracellular staining
Molecular diagnostic techniques
DNA/RNA extraction and purification
Gene rearrangement
Clonality in lymphocyte populations
Polymerase chain reaction
Reverse transcriptase
Qualitative
Quantitative
Southern blot
Fluorescent in-situ hybridization
DNA sequencing
Microarray analysis, comparative genomic hybridization array, molecular karyotype (SNP array)
Cytogenetics

Erythropoiesis

Describe the distinctive features used to characterize developing cells Level 1
Overall cell diameter or volume
Nucleus (diameter or volume, relative diameter or volume, staining reaction, chromatin pattern, presence or absence of nucleoli)
Cytoplasm (relative amount, staining reaction)
Nuclear:cytoplasmic ratio

List the maturation sequence of developing erythrocytes given Romanowsky stained smears, electronic images or other visual means of representation of blood and bone marrow Level 1
Distinguish nucleated erythrocyte precursors from other hematopoietic elements Level 2

Categorize red cells Level 2
Diameter or volume
Shape
Color
Inclusions
Distribution patterns

Describe nutritional and regulatory factors associated with erythropoiesis Level 2
Erythropoietin (EPO)
Iron
Vitamins (B₁₂ / folate)

List hormones associated with erythropoiesis Level 1
Estrogen/Androgens/Thyroxine/Growth hormone
Identify and discuss components of the mature red cell that are essential for survival and function Level 2

Membrane composition
Lipids/Proteins/Skeletal proteins

Membrane Function
Maintain RBC shape, deformability, and permeability
Support system for surface antigens
Transport and exchange of gases and ions (cationic pumps)

Describe metabolic pathways for maintenance of cell function Level 1
Embden-Meyerhof/glycolytic
Hexose monophosphate shunt
Methemoglobin reductase
Luebering-Rapoport

Erthrocytic Hemoglobin
Summarize the mechanisms by which normal hemoglobin is structured and synthesized in the developing red cell Level 1
Iron transport, uptake, and supply
Protoporphyrin IX (heme) formation
Globin synthesis and genetic control (Chromosome 11 and 16)
Embryonic hemoglobins (Gower I, Gower II, Portland)
Adult hemoglobins (Hb A, Hb F, Hb A₂)

Describe normal hemoglobin-oxygen function using the oxygen dissociation curve (ODC) Level 1
Identify the effect various conditions can have on the oxygen dissociation curve Level 3
pH (Bohr effect)
Temperature
CO₂
2,3-DPG (2,3-BPG)
Hb S, F and other variants

Interpret the effect of various factors on the concentration of hemoglobin Level 3
Age and gender
Pregnancy
Altitude
Smoking
Associated disease
Altered hemoglobin derivatives (carboxyhemoglobin/methemoglobin/sulfhemoglobin)

Erythrocytic Catabolism
Summarize the mechanism by which red cells are catabolized Level 2
Identify phases Extravascular, intravascular Level 1
Extravascular
Intravascular
Trace the basic steps associated with each phase {Level 1}
Define {Level 1} and apply {Level 2} terms associated with red cell destruction {Level 1}

- Biliverdin
  - Bilirubin (unconjugated/Conjugated)
- Urobilinogen
- Urobilin
- Hemoglobin dimers
- Haptoglobin
- Hemopexin
- Hemoglobinemia
- Hemoglobinuria
- Hemosiderinuria
- Methemalbumin

**Erythrocyte Evaluation**

Describe {Level 1} and/or perform {Level 2} standard operational procedures to evaluate erythrocytes and their physical properties {Level 1} using patient blood and quality control samples

Perform procedures to evaluate erythrocytes and their physical properties {Level 2} using patient blood and quality control samples

State the clinical utility of principles of method analysis and histogram review in erythrocyte evaluation {Level 1}

Determine if results are in accordance with prescribed criteria for accuracy {Level 3}

Discuss automated hemogram parameters used for erythrocyte evaluation {Level 1}
- Red cell count
- Hemoglobin
- Hematocrit
- Mean cell volume (MCV)
- Mean cell hemoglobin (MCH)
- Mean cell hemoglobin concentration (MCHC)
- Red cell distribution width (RDW)

MLS Hem 5
Microhematocrit (centrifuged)
Calculate red blood cell indices when provided appropriate data Level 2
State the principles of method analysis for hemoglobin determination Level 1

MCV, MCH, MCHC calculations
Hemoglobin measured at the point-of-care
Cyanmethemoglobin method
Other instrument methods for hemoglobin

Perform erythrocyte sedimentation rates Wintrobe Level 2
Wintrobe
Westergren and its modifications
Automated

Perform standard reticulocyte assays Level 2s
Supravital smear method with Miller disc
Supravital smear method without Miller disc
Automated methods

Perform and interpret calculations associated with reticulocyte assays Level 3
Corrected
Absolute
Production index (RPI)
Reticulocyte hemoglobin concentration
Reticulocyte mean volume
Immature reticulocyte fraction (IRF) or reticulated hemoglobin content (CHR)

Determine the appropriate area of a peripheral blood smear to evaluate red blood cell morphology Level 2
Distinguish between normal and abnormal red blood cell morphology Level 2
Peripheral smear examination for red cell morphology
List red blood cell count and indices reference intervals values that account for variations Level 1

Correlate and verify automated hemogram parameters and calculated indices with each other and with peripheral smear exam results Level 3

Calibrate and perform preventive maintenance on instruments used to evaluate erythrocytes and their physical properties Level 2
Recognize and troubleshoot pre-analytical (pre-examination), analytical (examination), Level 3 and post-analytical (post examination) causes of problems or unexpected results

Take corrective action to resolve unexpected results and/or events on instruments Level 3
used to evaluate erythrocytes
Make decisions to recommend appropriate follow-up to prevent unexpected results and/or events from reoccurring

MLS Hem 6
Leukopoiesis

State cite reference intervals values that reflect for variations in gender and age for the leukocyte Level 1 counts in peripheral blood Level 1.

- Total leukocyte count
- Relative and absolute values for neutrophil, lymphocyte, eosinophil, basophil and monocyte counts

Identify Level 1 and recognize Level 2 factors that may alter leukocyte values Level 1.

- Physiologic variation
- Pathologic abnormalities

Enumerate and/or calculate leukocyte cell types counts Level 2.

- Relative values
- Absolute values

List Characterize morphologic features used to differentiate developing leukocytes Level 2.

- Overall cell diameter or volume
- Nucleus
- Shape
- Relative diameter
- Nuclear to cytoplasmic ratio (N:C)
- Staining reaction
- Chromatin pattern
- Presence or absence of nucleoli

- Relative amount of Cytoplasm

- Relative amount of Cytoplasmic Staining properties

- Presence or absence of granules and staining reaction in cytoplasm

Leukopoiesis: Granulocytes

List Level 1 the maturation sequence of neutrophils, eosinophils, and basophils Level 1.
Differentiate and identify (Level 2) distinguishing morphology for stages of developing blood granulocytes using Romanowsky stained smears, photographs, electronic images of blood and bone marrow or other visual means of representation.

- Neutrophils
- Eosinophils
- Basophils

Identify Explain mechanisms that regulate and modulate granulopoiesis (Level 2).

Regulatory growth factors and inhibitors

- Kinetics (Life span, Circulation)

Biochemistry
- Granule content and surface membrane receptors,
- Energy metabolism

Explain the functions associated with granulocytes (Level 2)

Energy metabolism
- Function
- Chemotaxis
- Phagocytosis and killing
- Allergic response (eosinophils and basophils)
- Host defense against parasites (eosinophils)
- Hypersensitivity mediator (basophils and mast cells)

Leukopoiesis: Agranulocytes

- Recognize and summarize structural and functional features that characterize monocytes and macrophages (Level 2)
- Kinetics (life span, circulation, tissue phase)
- Function (phagocytosis, antigen-presenting cells (APC), pathogen presenting cells)
- List the maturation sequence of monocytes and macrophages (Level 1)
- List the maturation sequence of lymphocytes (Level 1)

(MS Hem 8)
1. Structure
   a) Life span
   b) Circulation
   c) Tissue phase

2. Function
   a) Phagocytosis
   b) Antigen-presenting cells (APC)
   c) Pathogen-presenting cells

Summarize structural and functional features that characterize lymphopoiesis

Sites of formation and production
- Bone marrow
- Thymus
- Lymph nodes
  and secondary lymphoid tissue

Kinetics
- Life span
- Migration

Function

- Humoral immunity (B lymphocytes and subsets)
- Cell mediated immunity (T lymphocytes and subsets)
- Natural killing and antibody dependent cellular cytotoxicity

Recognize morphology of developing monocytes and macrophages using
Romanowsky stained smears, photographs, electronic images, or kodachrome slides of blood and bone marrow

Recognize morphology of developing lymphocytes using Romanowsky stained smears, photographs, electronic images, or kodachrome slides of blood and bone marrow

Describe the use of monoclonal antibodies to differentiate lymphocytes by

Recognize and summarize features that characterize lymphopoiesis (Level 2)

Morphology of developing cells using Romanowsky stained smears, photographs, electronic images, or other visual means of representation of blood and bone marrow

Lymphocytes and precursors
- Plasma cells
- Differentiation by immunophenotype

B-cell lymphocytes and subsets

T-cell lymphocytes and subsets

Natural Killer (NK) cells

MLS Hem 9
Plasma cells

**Leukocyte Evaluation**

- Sites of formation and production
  - Bone marrow
  - Thymus
  - Lymph nodes and secondary lymphoid tissue
- Kinetics
- Life-span
- Migration
- Function
  - Humoral immunity (B lymphocytes and subsets)
  - Cell-mediated immunity (T lymphocytes and subsets)
  - Natural killing and antibody-dependent cellular cytotoxicity

Perform commonly used methods to evaluate leukocytes __________________________ (Level 2)

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State the principles and clinical utility of method analysis and histogram/scatterplot review ___  

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Determine absolute and relative white cell counts on patient and control specimens Level 2 
using manual and automated methods in accordance with prescribed criteria for 
accuracy and precision.

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Calibrate and perform preventive maintenance on instruments used to evaluate _______ Level 2 
white cells (Level 2)

---

Determine differential cell counting using automated methods ______________________ (Level 2)____

Evaluate white cell histograms and scatterplots for diagnostic and quality _________ Level 3 control purposes (Level 3)

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Identify and classify normal and abnormal white cells on a properly prepared stained ____ Level 2 Romanowsky stained blood smear (Level 2)

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Correlate and verify automated cell counts and differentials with established criteria ____and/or 
peripheral smear exam (Level 3)____

Estimate the total white blood count from a smear _____________________________ (Level 2)____

Correct leukocyte counts for the presence of nucleated red cells ________ (Level 2)

- Calibrate and perform preventive maintenance on instruments used to evaluate ____ Level 2 
leukocytes and their physical properties
- Recognize and troubleshoot pre-analytical (pre-examination), analytical (examination), Level 3 
and post-analytical (post examination) causes of problems or unexpected results
- Take corrective action to resolve unexpected results and/or events on instruments ____ Level 3 
used to evaluate leukocytes
- Make decisions to recommend appropriate follow-up to prevent unexpected results ____ Level 3 
and/or events from reoccurring
Nonmalignant Leukocyte Disorders

Explain the classification of nonmalignant leukocytic disorders Level 1

Quantitative changes

Qualitative changes Characterize granulopoietic alterations Level 1

Compare and contrast absolute values with relative values Level 2

Neutrophilia
Neutropenia
Eosinophilia
Eosinopenia
Basophilia

Associate Discuss pathophysiology, causes and condition quantitative and qualitative leukocyte disorders with expected results Level 1

Bone marrow production and release
Rate of entry into peripheral circulating pools
Shifts between circulating and marginating pools
Rate of exit into tissues

Identify on Romanowsky stained smears, photographs, electronic images or kodachrome slides morphologic changes in neutrophils that may accompany nonmalignant Level 2 neutrophilic disorders

Shift to the left
Toxic granulation
Dohle bodies
Vacuolization
Leukemoid reaction
Leukoerythroblastic reaction
Agranulocytosis
Hyposegmentation
Hyperegenerationation

Review and compare State characteristic abnormalities and clinical features for the qualitative/functional Level 1 disorders of neutrophils

L3
Pelger-Huet anomaly
Alder-Reilly anomaly
Chediak-Higashi anomaly
May-Hegglin anomaly
Chronic granulomatous disease (CGD)
Myeloperoxidase deficiency

Describe qualitative and quantitative alterations of monocytes Level 1
Define monocytosis Level 1
Compare absolute monocyte values with relative values Level 1
Identify causes and conditions of monocytosis Level 1

Identify abnormal lipid accumulations within monocytes and macrophages List the defect, substance accumulated, and clinical features for the major disorders characterized by an accumulation of lipids in monocytes and macrophages Level 1

Gaucher’s disease
Neimann-Pick disease
Tay-Sachs disease
Mucopolysaccharidoses
Sea-blue histiocytosis
Identify from Romanowsky-stained smears, photographs, electronic images, or kodachrome slides of the bone marrow

Gaucher’s cells
Neimann-Pick cells
Sea-blue histiocytes

Appraise: Identify causes of non-neoplastic disorders of lymphocytes and plasma cells

Define lymphopenia/lymphocytosis
Compare lymphocyte absolute values with relative values

Contrast and compare: Compare and contrast morphologic features that characterize reactive/variant lymphocytes and from normal lymphocytes

Size
Nucleus
Cytoplasm
Heterogeneity

Differentiate between reactive and resting/variant lymphocytes on Romanowsky stained smears, photographs, electronic images, or kodachrome slides of peripheral blood

Identify the causes of reactive lymphocytosis

Red Blood Cell Disorders: Anemia

Recognize (Level 2) and troubleshoot (Level 3) pre-analytical (pre-examination), analytical (examination) and post-analytical (post-examination) causes for problems or unexpected results

Take corrective action to resolve unexpected results and/or events (Level 3)

Make decisions to recommend appropriate follow-up to prevent unexpected results and/or events from reoccurring (Level 3)

Hematologic disorders

1. General concepts

Define anemia

Clinical signs and symptoms of anemia

Hematologic findings

Hemoglobin
Hematocrit
Red blood cell count
RBC indices
Red cell distribution width (RDW)
Peripheral smear
Reticulocyte count

MLS Hem 12
Bone marrow evaluation

Describe the categories used in a morphological classification of the anemias.

Describe the expected laboratory results seen in the various pathophysiologic classifications of the anemias.

- Decreased red cell production
  - Bone marrow failure
  - Ineffective hematopoiesis
  - Myelophthisic

- Increased red cell destruction, hemolytic processes

- Loss of red blood cells

Discuss the clinical utility of the RBC indices as relates to physiologic conditions.

Define and calculate RBC indices and explain sources of error of the red cell indices.

Interpret values of the RBC indices and relate results to physiologic conditions.

Use the RBC indices as a quality control mechanism for assessing the validity of the erythrocyte count, hemoglobin, and hematocrit values.

Define common terms used to describe red cell morphology and correlate the following variations in red blood cell diameter or volume.

Anisocytosis
- Poikilocytosis
- Polychromatophilia
- Rouleaux
- Agglutination
- Acanthocyte
- Codocyte
- Dacryocyte
- Drepanocyte
- Echinocyte
- Elliptocyte
- Keratocyte
- Schistocyte
- Spherocyte
- Stomatocyte
- Basophilic stippling
- Cabot rings
- Heinz bodies
- Howell-Jolly bodies
- Malarial parasites
- Pappenheimer bodies/siderotic granules
Hemoglobin crystals

Hemoglobin H

(2) Microcytes
(3) Macrocytes

Define polychromatophilia (Level 1) and relate to clinical significance (Level 2)

(1) Normal
(2) Increased

Define hypochromia and describe clinical significance (Level 1)
State the criteria that define poikilocytosis (Level 1) and relate (Level 2) the morphologic changes in erythrocytes and possible clinical significance

(1) Acanthocyte (spur cell)
(2) Codocyte (target cell)
(3) Dacrocyte (tear drop cell)
(4) Degmacyte (bite cell)
(5) Drepanocyte (sickle cell)
(6) Echinocyte (burr cell)
(7) Elliptocyte (oval cell)
(8) Keratocyte (helmet cell)
(9) Schistocyte (fragmented cell) (bite cell, blister cell)
(10) Spherocyte
(11) Stomatocyte (mouth cell)

d) Microscopically, identify alterations in red cell distribution (Level 2)

(1) Rouleaux
(2) Agglutination

Describe the composition and morphology and list the possible pathologic conditions of various red blood cell inclusions

Basophilic stippling
Cabot rings
Heinz bodies
Howell-Jolly bodies
Malarial and other blood parasites
Pappenheimer bodies/siderotic granules
Hemoglobin crystals (C, S, SC, H inclusion bodies)

Red Blood Cell Disorders: Erythrocytosis (Polycythemia)

Erythrocytosis (Polycythemia)

Define (Level 1) and differentiate (Level 3) between absolute polycythemia and relative polycythemia

Differentiate between absolute polycythemia and relative polycythemia (Level 2)
Compare and contrast secondary polycythemia, and relative erythrocytosis (Level 3)

Etiology
Clinical features
Laboratory findings
Prognosis

**Identify and describe changes in the bone marrow and peripheral blood with polycythemia vera** Level 2

**Red Blood Cell Disorders: Hypochromic Anemias**

- **Define hypochromic anemia** Level 1
- **List the causes of hypochromic anemias** Level 1
- **Discuss the etiology and pathophysiology of hypochromic anemias** Level 2
  - Iron deficiency anemia
  - Sideroblastic anemia
  - Anemia of chronic disease
  - Hemochromatosis/ Hemosiderosis
  - Porphyrias
  - Thalassemia

**Compare and contrast laboratory findings in iron deficiency anemia, anemia of chronic disease/inflammation and sideroblastic anemia** Level 2
- Serum ferritin
- Serum iron
- Transferrin/ Total Iron Binding Capacity (TIBC)
- Percent transferrin saturation
- Bone marrow evaluation for ringed sideroblasts
- Free erythrocyte protoporphyrin (FEP)/zinc protoporphyrin (ZPP)
- Transferrin receptor tests
- Hepcidin

**Outline a laboratory approach to the evaluation of a patient’s iron status** Level 3

**Red Blood Cell Disorders: Megaloblastic Anemias**

**Megaloblastic anemias**

- **Explain the sources, daily requirement, and the absorption and metabolism of vitamin B₁₂ and folate** Level 2
- **Describe clinical features of megaloblastic anemia** Level 1

  e) **Explain megaloblastic transformation (Level 2)**

  1) **Mechanism**
  2) **Cellular changes**

- **Identify the hematologic abnormalities present in megaloblastic anemia** Level 2
- **Peripheral blood changes**

  Bone marrow-morphological changes

- **Compare and contrast pernicious anemia to the other types of vitamin B₁₂ deficiency** Level 3

**Outline a sequential approach to the differential diagnosis of megaloblastic** Level 3
anemia using the following laboratory procedures (Level 3)
Mean corpuscular volume (MCV)
Blood and bone marrow smear evaluation
Serum B₁₂
Serum folate
Red cell folate
Anti-intrinsic factor antibodies
Anti-parietal cell antibodies
Methylmalonic acid
Homocysteine

Differentiate nonmegaloblastic macrocytosis from megaloblastic anemia (Level 3)
Peripheral blood and bone marrow characteristics
Serum vitamin B₁₂ level
Serum folate level
Red cell folate level
Reticulocyte findings


Hypoproliferative anemias

Acquired aplastic anemia
Define aplastic anemia (Level 1)
Identify common factors associated with the development (Level 1)
Describe the possible clinical features and pathophysiology (Level 2)

Acquired aplastic anemia
Fanconi’s anemia
Congenital pure red blood cell aplasia
Anemia caused by myelophthisis (Level 1)
Describe the clinical features (Level 1)
Describe the laboratory findings (Level 1)
Peripheral blood changes
Bone marrow changes
Other laboratory findings

Fanconi’s anemia
Define Fanconi’s anemia (Level 1)
Describe the genetics and possible pathophysiology (Level 2)
Describe the laboratory findings (Level 1)
Peripheral blood changes
Bone marrow changes
Other laboratory findings

g) Congenital pure red cell aplasia (Diamond-Blackfan anemia)
Define pure red cell aplasia (Diamond-Blackfan anemia) _________________________ (Level 1)
Describe the clinical features and possible pathophysiology ________________________ (Level 2)
Describe the laboratory findings ________________________________________________ (Level 1)

Peripheral blood changes
Bone marrow changes
Other laboratory findings

Define and differentiate Congenital dyserythropoietic anemias (types I, II, and III) Level 2
(1) Differentiate the three types (Level 3)
Describe the clinical features ___________________________________________________ (Level 1)
Describe the laboratory findings ________________________________________________ (Level 1)

h) Anemia caused by myelophthisis
Define myelophthisis ___________________________________________________________ (Level 1)
Describe the clinical features ___________________________________________________ (Level 1)
Describe the laboratory findings ________________________________________________ (Level 1)

Peripheral blood changes
Bone marrow changes
Other laboratory findings

Red Blood Cell Disorders: Hemolytic Anemias
Describe the etiology, pathophysiology, clinical features, and laboratory findings of red cell membrane defects Level 1
Hereditary spherocytosis
Hereditary elliptocytosis
Paroxysmal nocturnal hemoglobinuria (PNH)
Hereditary pyropoikilocytosis
Hereditary acanthocytosis
Hereditary stomatocytosis (hydrocytosis)
Hereditary xerocytosis

Identify and correlate data from laboratory tests that are used to detect increased RBC destruction and production due to RBC membrane abnormalities Level 2
Discuss the principle of the Osmotic fragility test Level 1
Describe the clinical features Level 1
Describe the laboratory findings Level 1
Perform / observe the procedure Level 2
Apply appropriate quality control procedures Level 2
Evaluate results Level 3
Describe the utility of flow cytometry in assessing red cell membrane defects Level 2
Describe the etiology, pathophysiology, and clinical features of red cell Level 1
enzyme abnormalities
- Glucose-6-phosphate dehydrogenase (G6PD) deficiency
- Pyruvate kinase (PK) deficiency
- Methemoglobin reductase

Discuss the principles of G6PD assay, pyruvate kinase assay and staining for Heinz Bodies

Identify laboratory test results based upon
- Describe the laboratory findings
- Perform /observe the procedure
- Apply appropriate quality control procedures
- Evaluate results

Level 1

Red Blood Cell Disorders: Hemoglobinopathies

Define hemoglobinopathy

Distinguish between qualitative and quantitative hemoglobin defects

Describe clinical and laboratory findings of hemoglobinopathies

2. Hemoglobinopathies

a) Define hemoglobinopathy (Level 1)

b) Distinguish between qualitative and quantitative hemoglobin defects (Level 2)

c) Describe the physiologic abnormalities and clinical findings (Level 1)

Hb SS
Hb AS
Hb CC
Hb AC
Hb DD
Hb EE
Hb SC

Hb SS
Hb AS
Hb CC
Hb AC
Hb SC
Hb DD
Hb EE

Identify the amino acid substitutions associated with sickle cell anemia and hemoglobin C disease

Describe the physiologic abnormality associated with hemoglobin variants with altered oxygen affinity (Unstable hemoglobins, Methemoglobinemia) (Level 1)

Describe the physiologic abnormality (Level 1)

Hemoglobin variants with altered oxygen affinity

Unstable hemoglobins

Methemoglobinemia
DefineDescribe the hemoglobin gene defect in alpha and beta thalassemia (Level 1)
Define the hemoglobin defect in thalassemia Level 1
Describe the terminology associated with thalassemias Level 1
Alpha thalassemia
4 gene deletion
3 gene deletion (Hb H disease)
2 gene deletion
1 gene deletion
Beta thalassemia
Beta-thalassemia major
Beta-thalassemia intermedia
Beta-thalassemia minor
Describe the clinical features associated with different gene combinations in alpha and beta thalassemia Level 1
Describe the pathophysiology of thalassemias Level 1
Hemoglobin Lepore
Delta-beta thalassemia
Hb H
Bart’s hemoglobin
Hereditary persistence of fetal hemoglobin
Hb Constant Spring
Identify the characteristic clinical and laboratory findings associated with thalassemia
Describe the peripheral blood morphology associated with different gene combinations in alpha and beta thalassemia

Alpha thalassemia
4 gene deletion
3 gene deletion (Hb H disease)
2 gene deletion
1 gene deletion

Beta thalassemia
Beta-thalassemia major
Beta-thalassemia intermedia
Beta thalassemia minor
Discuss the principle of the solubility test for sickling hemoglobin
Level 1 Describe the laboratory findings
Level 1 Perform /observe the procedure
Apply appropriate quality control procedures
Evaluate results
Discuss the principles of hemoglobin electrophoresis (cellulose acetate, alkaline pH vs. citrate agar, acid pH)
Describe the laboratory findings
Perform /observe the procedure
Apply appropriate quality control procedures
Evaluate results
d) Describe the clinical features associated with different gene combinations in alpha and beta thalassemia (Level 1)

e) Describe the pathophysiology of alpha and beta thalassemia (Level 1)

f) Identify the characteristic laboratory findings associated with the different gene combinations in alpha and beta thalassemia (Level 1)

g) Describe the peripheral blood morphology associated with different gene combinations in alpha and beta thalassemia (Level 1)

h) Describe pathophysiology (Level 1)

(1) Hemoglobin Lepore
(2) Delta-beta thalassemia
(3) Hb H
(4) Bart's hemoglobin
(5) Hereditary persistence of fetal hemoglobin
(6) Hb Constant Spring

i) Describe the solubility test for sickling hemoglobin (Level 1)

(1) Principle
(2) Clinical significance
(3) Appropriate quality control procedure
(4) Sources of error

j) Perform (Level 2) the procedure for sickling hemoglobins and interpret (Level 3) the results

k) Describe hemoglobin electrophoresis (cellulose acetate, alkaline pH vs. citrate agar, acid pH) (Level 1)

(1) Principle
(2) Clinical significance
(3) Appropriate quality control procedure
(4) Sources of error

l) Perform (Level 2) hemoglobin electrophoresis (if available) and interpret (Level 3) results

Describe the separation of hemoglobin by capillary electrophoresis (Level 1)

Discuss the principles of hemoglobin quantification (HbA, HbA2, HbF) (Level 1)

Describe the laboratory findings (Level 1)

Perform / observe the procedure (Level 2)

Apply appropriate quality control procedures (Level 2)

Evaluate results (Level 3)
### Hemoglobinopathies

- Describe acid elution test (Kleihauer-Betke) or flow cytometry in regards to
- Correlate screening test for sickling hemoglobin with peripheral blood morphology and electrophoretic patterns of hemoglobin
- Identify the electrophoretic patterns (cellulose acetate, alkaline pH vs. citrate agar, acid pH)

#### Principle

#### Clinical significance

#### Appropriate quality control procedure

#### Sources of error

- Perform (Level 2) the Kleihauer-Betke acid elution test (if available) and interpret (Level 3) results
- Correlate screening test for sickling hemoglobin with peripheral blood morphology and electrophoretic patterns of hemoglobin (Level 3)
- Identify the electrophoretic patterns (cellulose acetate, alkaline pH vs. citrate agar, acid pH) or HPLC/capillary electrophoresis (Level 2)

- Hb F₂
- Hb A₂
- Hb S
- Hb C
- Hb D₂
- Hb E₂
- Hb A₂
- Recognize specialized testing used to detect abnormal hemoglobins, e.g., DNA/globin chain testing (Level 2)

#### Hemolytic Anemias

- Identify mechanisms of immune hemolytic anemias
- Define and describe the etiology and clinical features and laboratory findings of alloimmune hemolytic anemias
- Acute hemolytic transfusion reaction
- Delayed hemolytic transfusion reaction
- Hemolytic disease of the newborn (HDN)
Define and describe the etiology and clinical features and laboratory findings of Autoimmune hemolytic anemias (Level 2)

Hemolytic anemias
- Intracorporcular/intracellular defects
- RBC membrane abnormalities

Describe the etiology, pathophysiology, clinical features, and laboratory findings (Level 1)

Hereditary spherocytosis
Hereditary elliptocytosis
Paroxysmal nocturnal hemoglobinuria (PNH)
Hereditary pyropoikilocytosis
Hereditary acanthocytosis

Identify and describe laboratory tests that are used to diagnose RBC membrane abnormalities (Level 1)

Describe disorders of membrane cation permeability (Level 1)
Hereditary stomatocytosis (hydrocytosis)
Hereditary xerocytosis

RBC enzyme abnormalities
Describe the etiology, pathophysiology, and clinical features (Level 1)
Glucose-6-phosphate dehydrogenase (G6PD) deficiency
Pyruvate kinase (PK) deficiency
Methemoglobin reductase deficiency

Identify laboratory test results (Level 1)
Describe the G6PD assay (Level 1)
Principle
Appropriate quality control procedure
Sources of error
Perform (Level 2) the G6PD assay (if available) and interpret (Level 3) results

Describe the pyruvate kinase assay (Level 1)
Principle
Clinical significance
Appropriate quality control procedure
Sources of error
Perform (Level 2) the pyruvate kinase assay (if available) and interpret (Level 3) results

Describe the stain for Heinz bodies (Level 1)
Principle
Clinical significance
Appropriate quality control procedure
Sources of error

Stain (Level 2) for Heinz bodies and interpret (Level 3) results

Extracorporcular/extracellular defects
Alloimmune hemolytic anemia
Identify mechanisms of immune hemolytic anemias (Level 1)

Define and describe the etiology and clinical features (Level 1)
Acute hemolytic transfusion reaction
Delayed hemolytic transfusion reaction
Hemolytic disease of the fetus and newborn (HDN)
Identify laboratory findings (Level 1)
Acute hemolytic transfusion reaction
Delayed hemolytic transfusion reaction
Hemolytic disease of the fetus and newborn (HDN)
ABO
Rh
Autoimmune hemolytic anemia (AIHA)
Describe the etiology and clinical features (Level 1)

Warm autoimmune hemolytic anemia (WAIHA)

Cold autoimmune hemolytic anemia

Cold agglutinin syndrome

(2) Secondary
Paroxysmal cold hemoglobinuria

Identify mechanisms of drug-induced immune hemolytic anemia Level 1
Identify the etiology of nonimmune hemolytic anemia Level 1

Infectious organisms
Mechanical agents
Chemicals

Describe the hematologic findings associated with nonimmune hemolytic anemias Level 1

Malaria
Babesiosis
Bartonellosis
Clostridium perfringens (welchii) infection
Cardiac prosthetic devices
Microangiopathic hemolytic anemia
Chemicals and venoms
Thermal injury
Disseminated intravascular coagulation

Acute Blood Loss
Describe the etiology of anemia of acute blood loss Level 1
List the clinical symptoms of acute blood loss Level 1
Identify the laboratory findings of acute blood loss Level 1

Anemias associated with systemic disorders
Describe the etiology and pathophysiology and identify clinical features and laboratory findings associated with nonhematologic disorders Level 1
Chronic disorders and inflammation
Connective tissue disorders
Neoplastic Disorders

Define and list categories associated with Neoplastic Disorders of Leukocytes  Level 1
Leukemias
Myelodysplastic syndromes
Myeloproliferative disorders
Lymphoproliferative disorders

Identify major systems used to classify neoplastic disorders of leukocytes  Level 1
French, American-British (FAB) Cooperative Group (1976)
World Health Organization (WHO) (2001)

Observe and/or perform procedures, apply appropriate quality control procedures, and interpret laboratory findings for laboratory procedures used in the identification, classification and differentiation of neoplastic disorders

Complete blood count
Hemograms
Scatterplots and histograms
Identify laboratory findings (Level 1)
Warm autoimmune hemolytic anemia (WAIHA)
Cold autoimmune hemolytic anemia
Cold agglutinin syndrome
Idiopathic
Secondary
Paroxysmal cold hemoglobinuria
Identify mechanisms of drug-induced immune hemolytic anemia (Level 1)
Nonimmune hemolytic anemia
Identify the etiology (Level 1)
Infectious organisms
Mechanical agents
Chemicals
Describe the hematologic findings (Level 1)
Malaria
Babesiosis
Bartonellosis
Bacterial sepsis (e.g., Clostridium perfringens infection)
Cardiac prosthetic devices
Microangiopathic hemolytic anemia (HUS, TTP, DIC, HELLP)
Chemicals and venoms
Thermal injury
Acute blood loss
Describe the etiology of anemia of acute blood loss (Level 1)
List the clinical symptoms (Level 1)
Identify the laboratory findings (Level 1)
Anemia associated with systemic disorders
Describe the etiology and pathophysiology (Level 1)
Chronic renal disease
Liver disease
Endocrine diseases
Systemic lupus erythematosus
Determine significant laboratory findings for each (Level-2)
White blood cell disorders

Nonmalignant leukocyte disorders
Review the criteria used to classify nonmalignant leukocytic disorders (Level 1)
_______ Quantitative changes
_______ Qualitative changes
\[\text{Inherited, Acquired}\]
Identify on Romanowsky stained smears, photographs, electronic images or other visual means of representation of morphologic changes in neutrophils that may accompany nonmalignant neutrophilic disorders (Level 2)
Characterize granulopoietic alterations (Level 2)
Calculate (Level-2) and compare (Level-3) absolute values with relative values
Neutrophilia
Neutropenia
Eosinophilia
Eosinopenia
Basophilia
Agranulocytosis

(2) Review pathophysiology (Level 1)
(a) Bone marrow production and release
(b) Rate of entry into peripheral circulating pools
(c) Shifts between circulating and marginating pools
(d) Rate of exit into tissues

(3) List causes and conditions (Level-1)

(4) Identify on Romanowsky stained smears, photographs, electronic images or other visual means of representation of morphologic changes in neutrophils that may accompany nonmalignant neutrophilic disorders (Level-2)
Shift to the left
Toxic granulation
Döhle bodies
Vacuolization
Leukemoid reaction
Leukoerythroblastic reaction
Agranulation, hypogranulation
Hyposegmentation
Hypersegmentation
Intracellular microorganisms

Compare and contrast characteristic abnormalities and clinical features for the (Level 3)
qualitative/functional disorders of neutrophils (Level 3)
- Pelger-Hüet anomaly
- Alder-Reilly anomaly
- Chédiak-Higashi anomaly
- May-Hegglin anomaly
- Chronic granulomatous disease (CGD)
- Myeloperoxidase deficiency
- Lazy leukocyte syndrome
- Leukocyte adhesion deficiency

Define monocytosis and describe alteration of monocytes (Level 1)
Calculate (Level 2) and compare (Level 3) absolute values with relative values
Identify causes and conditions (Level 1)
List the defect, substance accumulated, and clinical features for the major disorders characterized by an accumulation of lipids in monocytes and macrophages (Level 1)
- Gaucher disease
- Niemann-Pick disease
- Tay-Sachs disease
- Mucopolysaccharidoses
- Sea-blue histiocytosis
Identify from Romanowsky stained smears, photographs, electronic images, or other visual means of representation of the bone marrow (Level 2)
- Gaucher cells
- Niemann-Pick cells
- Sea-blue histiocytes
Evaluate non-neoplastic disorders of lymphocytes and plasma cells (Level 3)
Define (Level 1)
Lymphocytopenia
Lymphocytosis
Calculate (Level 2) and compare (Level 3) lymphocyte absolute values with relative values
Recognize (Level 2) and compare (Level 3) morphologic features that characterize reactive/variant lymphocytes from normal lymphocytes
Diameter or volume
Nucleus
Cytoplasm
Heterogeneity
Identify reactive/variant lymphocytes on Romanowsky stained smears, photographs, electronic images or other visual means of representation of peripheral blood (Level 2)
Differentiate among benign causes of lymphocytosis (Level 3)
Infectious mononucleosis evaluation
Presence of reactive/variant lymphocytes
Positive immunologic tests
Cytomegalovirus (CMV)
Toxoplasmosis
Pertussis (whooping cough)
Infectious lymphocytosis
Viral hepatitis
Others
List the major immune deficiencies in relation to T and B cell development (Level 1)
Recognize hematologic alterations in acquired immune deficiency syndrome (AIDS) (Level 2)
Lymphocytopenia (T-cell CD4 and CD8 ratio)
Leukopenia
Anemia
Thrombocytopenia
Neoplastic disorders of leukocytes
Describe the theoretical basis used for characterizing leukocyte disorders as neoplastic (Level 1)
Identify major systems used to classify neoplastic disorders of leukocytes (Level 1)
French, American-British (FAB) classification (1976)
World Health Organization (WHO) classification (2001)
Compare and contrast criteria used by FAB and WHO to formulate each classification scheme (Level 3)
Group neoplasms into distinct categories (Level 2)
Non-lymphoid
Acute myeloid leukemias
Myelodysplastic syndromes
Myeloproliferative neoplasms
Myelodysplastic/myeloproliferative neoplasms
Lymphoproliferative
Precursor lymphoid neoplasms (B and T)
Mature B-cell neoplasms
Mature T and NK cell neoplasms
Hodgkin lymphoma
Observe and/or perform procedures (Level 2), apply (Level 2) appropriate quality control procedures, and interpret (Level 3) laboratory findings for laboratory procedures used in the identification, classification and differentiation of neoplastic disorders
Complete blood count
Hemograms
Scatterplots and histograms
Enumeration and morphologic evaluation of blood and bone marrow cells on Romanowsky stained smears
Compare and contrast the principles of various cytochemical stains and the cell lineages they react with
Cytochemical stains (not performed by all labs)
Myeloperoxidase
Sudan black B (SBB)
Esterases
Specific substrate/
Non-specific substrate (sodium fluoride inhibition)
Periodic-acid Schiff (PAS)
Leukocyte alkaline phosphatase (LAP)
Tartrate resistant acid phosphatase (TRAP)
Iron staining
Describe the use of various diagnostic techniques used to assess neoplastic disorders of blood and bone marrow cells
Immunophenotyping
Terminal deoxynucleotidyl transferase (TdT)
Monoclonal antibodies
myeloid from lymphoid
T and B cell immunophenotypes
Acute myelocytic leukemia (AML) subgroups cell lineages
Cytogenetics
Molecular genetics

Immunophenotyping by flow cytometry or immunohistochemical stains
Terminal deoxynucleotidyl transferase (TdT) and other hematopoietic precursors
Monoclonal antibodies
Myeloid cell lineage
Erythroid cell lineage
B-cell lineage
T-cell and NK cell lineage
Megakaryoblastic
Stem cell

(5) Cytogenetics
(6) Molecular genetics

Diagnosis
Prognosis
Minimal residual disease

Apply knowledge and skills in interpreting laboratory results and recognizing clinical syndromes that are unique to the neoplasm
Read case studies of neoplastic disorders and apply knowledge and skills in interpreting laboratory results

Acute Leukemias
Apply general criteria to classify leukemias
Cell maturity (Acute/Chronic)
Cell lineage (Myeloid/nonlymphoid)
Lymphoid

Describe the clinical findings and laboratory results for each leukemia
Compare the FAB with the WHO acute myeloid leukemia subgroups and apply diagnostic blood and bone marrow findings to the differential identification

FAB classification
M0--acute myeloid leukemia with minimal differentiation
M1--acute myeloid leukemia without maturation
M2--acute myeloid leukemia with maturation
M3--acute promyelocytic leukemia
M4--acute myelomonocytic leukemia
M5--acute monoblastic leukemia
M6--acute erythroleukemia
M7--acute megakaryoblastic leukemia

WHO classification
AML with recurrent genetic abnormalities
AML with myelodysplasia-related changes
MLS Hem 28
Therapy-related myeloid neoplasms

**AML, not otherwise specified**

List the WHO acute leukemia subgroups

- AML with recurrent genetic abnormalities
- AML with myelodysplasia-related changes
- Therapy-related myeloid neoplasms
- AML, not otherwise specified

Interpret findings from immunophenotypic, cytogenetic and molecular findings and apply to criteria used by WHO

Describe for each leukemia

- Clinical findings and symptoms
- Incidence and epidemiology
- Risk factors associated with the development of leukemia
- Hereditary abnormalities
- Environmental
- Viral infections
- Immunologic disorders

Identify the pathophysiology of leukemia

- Stem cell clonality
- Oncogene and tumor suppressor gene development

Describe the survival rates and prognosis

Describe the treatment options and correlation with hematologic complications

- Chemotherapy
- Bone marrow/stem cell transplant

Identify diagnostic findings on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images by which the FAB cooperative group and WHO classify acute leukemia

- Morphology, number, and differentiation of blast and immature cells: Greater than 30%
- Predominant cell type
- Auer rods

Define the reactivity of leukemic cells with cytochemical stains

Apply diagnostic blood and bone marrow findings to the differential identification

- Acute myeloid leukemia (AML)
- Acute nonlymphocytic leukemia (ANLL)
- M0--acute myelogenous with minimal differentiation
- M1--acute myelogenous without maturation
- M2--acute myelogenous with maturation
- M3--acute promyelocytic leukemia
- M3m--acute promyelocytic leukemia variant
- M4--acute myelomonocytic leukemia
- M4Eo--acute myelomonocytic leukemia variant
- M5--acute monocytic leukemia
- M5a--poorly differentiated
- M5b--well differentiated
- M6--acute erythroleukemia
- M7--acute megakaryocytic leukemia
Acute lymphocytic leukemia (ALL): L1, L2, L3-Burkitt’s
List the subgroups (WHO) and apply diagnostic blood, bone marrow, immunophenotype, cytogenetics and molecular findings to the differential identification
B lymphoblastic leukemia/lymphoma, not otherwise specified
T lymphoblastic leukemia/lymphoma
Interpret findings from an immunologic workup to formulate an immunophenotypic classification for ALL apply to criteria used by WHO
B lineage
Early B precursors
“Common” CALLA (CD10) positive
Pre-B
T-cell lineage and early T precursor (pro-T, pre-T, cortical-T, medullary-T)
Precursor lymphoid neoplasms
List cytogenetic and molecular abnormalities commonly associated with the major acute leukemic subtypes

**Myelodysplastic Syndromes (MDS)**

Define and describe cellular features that characterize the MDS in general
Level 2
Dyserythropoiesis
Dysgranulopoiesis
Dysmegakaryocytopenia

List subgroups recognized by the French, American, and British (FAB) World Health Organization (WHO) Cooperative Groups for the MDS classification and discuss the rationale for revisions to the classification
Refractory cytopenia with unilineage dysplasia (RCUD)
Refractory anemia (RA)
Refractory neutropenia (RN)
Refractory thrombocytopenia (RT)
Refractory anemia with ringed sideroblasts (RARS)
Refractory cytopenia with multilineage dysplasia (RCMD)
Refractory anemia with excess blasts (RAEB)
RAEB-1
RAEB-2
Myelodysplastic syndrome, unclassifiable (MDS-U)
Myelodysplastic syndrome with isolated del (5q)

List subgroups recognized by the French, American, and British (FAB) Cooperative Group for the MDS classification
Refractory anemia (RA)
Refractory anemia with ringed sideroblast (RARS)
Refractory anemia with excess blast (RAEB)
Chronic myelomonocytic leukemia (CMML)
Refractory anemia with excess blasts in transition (RAEB-t)
Myelodysplastic syndromes/neoplasms (MDS)

Define and describe (Level 1) cellular features that characterize (Level 2) the MDS in general

Dyserythropoiesis
Dysgranulopoiesis
Dysmegakaryocytopoiesis

Identify (Level 2) key morphologic features on permanently stained blood and bone marrow smears, photographs, electronic images or other visual means of representation

Correlate the diagnostic blood and bone marrow findings to the differential identification

and correlate (Level 3) the diagnostic blood and bone marrow findings with the differential identification

List (Level 1) subgroups recognized by WHO for the MDS classification and discuss (Level 2) the rationale for revisions to the classification

Refractory cytopenia with unilineage dysplasia (RCUD)
Refractory anemia (RA)
Refractory neutropenia (RN)
Refractory thrombocytopenia (RT)
Refractory anemia with ringed sideroblasts (RARS)
Refractory cytopenia with multilineage dysplasia (RCMD)
Refractory anemia with excess blasts (RAEB)
RAEB-1
RAEB-2
Myelodysplastic syndrome, unclassifiable (MDS-U)
Myelodysplastic syndrome with isolated del (5q)

Describe characteristics of MDS (Level 2)

Median age of onset

Epidemiology

Chromosomal association with pathogenesis

Clinical course with associated hematologic changes

Treatment options

Prognosis

Chronic Myeloproliferative Disorders (MPD)

Classify MPD by cell type (Level 1)

Granulocytes—Chronic myelogenous/granulocytic leukemia (CML/CGL)
Erythrocytes—polycythemia vera (PV)
Megakaryocytes—essential thrombocythemia (ET)
Fibroblasts—agnogenic myeloid metaplasia (AMM)
List MPD subtypes

Chronic myelogenous leukemia (CML) BCR/ABL1 positive
Essential thrombocytopenia (ET)
Primary myelofibrosis (PMF)
Chronic neutrophilic leukemia (CNL)
Chronic eosinophilic leukemia not otherwise specified (CEL, NOS)
Mastocytosis

List subgroups recognized by WHO for the myelodysplastic/myeloproliferative classification and discuss the rationale for the classification

Chronic myelomonocytic leukemia (CMML)
CMML-1
CMML-2
Atypical chronic myeloid leukemia (aCML), BCR-ABL1 negative
Juvenile myelomonocytic leukemia (JMML)
MDS/MPN, unclassifiable

Discuss and compare features commonly shared by MPD

Clinical manifestations
Pathophysiologic mechanisms
Blood and bone marrow findings
Transitional forms between stages
Disease evolution with potential for blastic transformation

Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images

Myeloproliferative neoplasms (MPN)

(1) List subtypes (Level 1)

(a) Chronic myelogenous leukemia (CML) BCR/ABL1 positive
(b) Polycythemia vera (PV)
(c) Essential thrombocytopenia (ET)
(d) Primary myelofibrosis (PMF)
(e) Chronic neutrophilic leukemia (CNL)
(f) Chronic eosinophilic leukemia not otherwise specified (CEL, NOS)
(g) Mastocytosis

(2) Compare and contrast features commonly shared by MPN (Level 3)

(a) Median age of onset
(b) Clinical manifestations
(c) Pathophysiologic mechanisms
(d) Blood and bone marrow findings
(e) Transitional forms between stages
(f) Disease evolution with potential for blastic transformation

Identify (Level 2) key morphologic features on permanently stained blood and bone marrow smears, photographs, electronic images or other visual means of representation and correlate (Level 3) diagnostic criteria to these findings for the differential identification

Chronic myelogenous leukemia (CML)
Leukocytosis with absolute neutrophilia and left shift maturation

Absolute basophilia and eosinophilia

Thrombocytosis

Bone marrow hypercellularity with granulocytic proliferation

Cytogenetic (karyotype): t(9;22)(q34;q11)

Molecular products: BCR/ABL fusion gene, fusion mRNA

Polycythemia vera (PV)

Increased red blood cell (RBC) mass

Leukocytosis with mild left shift maturation and basophilia

Thrombocytosis

Bone marrow hypercellularity with all cell lines increased

Molecular studies (JAK2)

Red cell morphology

Initial phase

“Spent” phase

Essential thrombocythemia (ET)

Marked thrombocytosis with platelet aggregates and abnormal forms

Megakaryocytic hyperplasia of bone marrow

Molecular studies

Primary myelofibrosis (PMF)

Leukoerythroblastosis with teardrop-shaped red cells

Leukocytosis with left shift maturation to occasional immature myeloid cell

Bone marrow fibrosis and relationship to megakaryocytic hyperplasia

Molecular studies

Identify treatment options and recognize effects on peripheral blood white cells, red cell

Correlate treatment options and recognize effects on peripheral blood white cells, red cell

MLS Hem 33
**Chronic Lymphoproliferative Disorders**

**Name and classify the chronic lymphoid leukemias by T and B cell lineage**

- **Chronic lymphocytic leukemia (CLL)**
- **B-cell prolymphocytic leukemia (PLL)**
- **Plasma cell neoplasms**
- **Hairy cell leukemia (HCL)**
- **Adult T-cell leukemia**
- **Sézary syndrome**
- **Extranodal marginal zone lymphoma or mucosa-associated lymphoid tissue (MALT lymphoma)**
- **Follicular lymphoma**
- **Mantel cell lymphoma**
- **Diffuse large B-cell lymphoma, not otherwise specified**
- **Burkitt lymphoma**

**Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images**

1. **List diagnostic features CLL**

2. **List diagnostic features MDS/MPN**

   **Subgroups recognized by WHO for the myelodysplastic/myeloproliferative classification and discuss the rationale for the classification**

   - **Chronic myelomonocytic leukemia (CMML)**
     - CMML-1
     - CMML-2
   - **Atypical chronic myeloid leukemia (aCML), BCR-ABL1 negative**
   - **Juvenile myelomonocytic leukemia (JMML)**
   - **MDS/MPN, unclassifiable**

**Identify key morphologic features on stained blood and bone marrow smears, photographs, or electronic images or other means of visual representation and correlate the diagnostic blood and bone marrow findings with the differential identification**

**Relate the significance of recovering the Philadelphia chromosome or BCR/ABL fusion gene to the diagnosis**

**Median age of onset**

**Symptoms and clinical findings**

**Blood and bone marrow findings**
Peripheral blood absolute lymphocytosis

**Morphology:** leukemic cell line of mature, small lymphocytes with monotonous morphology and smudge/basket cells

Immunophenotypic cell surface markers and clonality

Bone marrow lymphocytosis

- **Recognize and describe features associated with aggressive forms of the disease** Level 1
  - Describe (Level 1) and recognize (Level 2) features associated with aggressive forms of the disease
  - Autoimmune hemolytic anemia (AIHA)
  - Chromosome and/or molecular abnormalities
  - Richter’s syndrome
  - Immunophenotypic cell surface markers

**Name and compare systems used to stage disease severity and progress** Level 2

- Modified Rai

**Binet**

Discuss the diagnostic features of PLL Level 2

- Prolymphocytic leukemia (PLL)
- List diagnostic features (Level 1)
- Median age of onset and gender
- Clinical finding of severe splenomegaly

- Discuss blood and bone marrow findings (Level 2)

- Markedly elevated white count with absolute lymphocytosis

- White cell differential predominantly of prolymphocytes (greater than 55%)

- Immunophenotypic profile

- Chromosome and/or molecular

Discuss the diagnostic features of HCL Level 2

- Hairy cell leukemia (HCL)
- List diagnostic features (Level 1)

- Median age of onset and gender

- Clinical finding of severe splenomegaly

- Discuss blood and bone marrow findings (Level 2)

- Pancytopenia

- Morphology: leukemic cell line of “hairy” cells

- Immunophenotypic B-cell profile

- “Dry” tap; marrow fibrosis and infiltrates

MLS Hem 35
Recognize-Discuss treatment options

- Splenectomy
- Other drugs

Describe laboratory findings seen in the variant form of HCL.

List diagnostic features of Adult T-cell leukemia

- T-cell large granular lymphocytic leukemia (LGL)
- Human T-cell lymphotropic virus-1 (HTLV-1)

Endemic areas

Apply diagnostic criteria to blood and bone marrow findings for the differential identification of Adult T-cell leukemia

- Lymphoid cell line of small to large cells with cloverleaf/knotty nucleus
- Immunophenotypic T cell associated profile

Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, electronic images or other means of visual representation

List diagnostic features of Sézary syndrome

- Relationship to mycosis fungoides
- Clinical findings—skin involvement

(b) Review blood and bone marrow findings of Sézary syndrome

Sézary syndrome

(i) List diagnostic features (Level 1)

(a) Relationship to mycosis fungoides

(b) Clinical findings—skin involvement

Discuss blood and bone marrow findings (Level 2)

Absolute lymphocytosis

- Morphology: lymphoid cell line of medium cells with cerebriform nucleus
- Immunophenotypic T cell associated profile

Lymphoma

Define lymphoma and generally classify using key terminology

- Hodgkin
- Reed-Sternberg cells
- Rye modified cells
- Non-Hodgkin

Outline a multidisciplinary workup and list laboratory findings used to diagnose and stage Hodgkin lymphoma

- Complete blood count (CBC)
- Liver function tests
- Renal function tests
- Blood and bone marrow findings of Hodgkin’s lymphoma
- Radiologic studies
- Physical examination
- Lymph node biopsy

Recognize key morphologic features and correlate with diagnostic criteria for the presence of lymphoma cells on permanently stained blood and body fluid smears.
Plasma Cell Disorders

Name disorders based on proliferation of plasma cells and abnormal production of immunoglobulins

Discuss classification based on proliferation of plasma cells and abnormal production of immunoglobulins

Multiple myeloma
Waldenström’s macroglobulinemia
Plasma cell leukemia (PCL)
Heavy-chain disease
Monoclonal gammopathy of undetermined significance (MGUS)

Compare and contrast classification based on proliferation of plasma cells and abnormal production of immunoglobulins

Compare and contrast the following for plasma cell disorders

Pathophysiology

Clinical findings
Laboratory findings

Complete blood count (CBC) and peripheral smear review
Bone marrow biopsy including immunophenotypic cell markers
Blood and urine protein electrophoresis and immuno electrophoresis

Quantitative immunoglobulins
Chemistry panels—blood urea nitrogen, creatinine, calcium, lactic dehydrogenase
Serum viscosity
Beta-2-microglobulin
Radiologic studies of bones

Identify key morphologic features for plasma cell disorders on permanently stained blood and bone marrow smears, photographs, electronic images or other visual means of representation

Flaming plasma cell
Mott cells
Rouleaux formation of red blood cells

Thrombopoiesis/megakaryopoiesis

Plasma cell neoplasms

1. Name disorders (Level 1) and compare and contrast (Level 3) classification based on proliferation of plasma cells and abnormal production of immunoglobulins

   a. Multiple myeloma
   b. Waldenström macroglobulinemia
   c. Plasma cell leukemia (PCL)
   d. Heavy-chain disease
   e. Monoclonal gammopathy of undetermined significance (MGUS)
(2) Compare and contrast the following for plasma cell disorders (Level 3)
   (a) Pathophysiology
   (b) Clinical findings
   (c) Prognostic indicators
   (d) Laboratory findings
      i. Complete blood count (CBC) and peripheral smear review
      ii. Bone marrow biopsy including immunophenotypic cell markers
      iii. Blood and urine protein electrophoresis and immuno electrophoresis
      iv. Quantitative immunoglobulins
      v. Chemistry panels—blood urea nitrogen, creatinine, calcium, lactic dehydrogenase
      vi. Serum viscosity
      vii. Beta-2-microglobulin
      viii. Radiologic studies of bones

Identify key morphologic features for plasma cell disorders on permanently stained blood and bone marrow smears, photographs, electronic images or other visual means of representation (Level 2)
Plasma cell variants
Flaming plasma cell
Mott cell
Others
Rouleaux formation of red blood cells
Mature T- and NK-cell neoplasms
T-cell large granular lymphocytic leukemia (LGL)
Apply diagnostic criteria to blood and bone marrow findings for the differential identification of chronic lymphoid leukemias (Level 2)
Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, electronic images or other means of visual representation (Level 2)
Adult T-cell leukemia/lymphoma (ATLL)
List diagnostic features (Level 1)
Human T-cell lymphotropic virus-1 (HTLV-1)
Endemic areas
Discuss blood and bone marrow findings (Level 2)
Morphology: lymphoid cell line of small to large cells with cloverleaf/knotty nucleus
Immunophenotypic T-cell associated profile
Sézary syndrome
List diagnostic features (Level 1)
Relationship to mycosis fungoides
Clinical findings—skin involvement
Discuss blood and bone marrow findings (Level 2)
Absolute lymphocytosis
Morphology: lymphoid cell line of medium cells with cerebriform nucleus
Immunophenotypic T-cell associated profile
Hodgkin lymphoma
Define lymphoma (Level 1)
Outline a multidisciplinary workup and list laboratory findings used to diagnose and stage Hodgkin lymphoma (Level 2)
Complete blood count (CBC)
Liver function tests
Renal function tests
Morphology: Bone marrow and lymph node biopsy
Reed-Sternberg cells
Architecture
Radiologic studies
Physical examination
Identify (Level 1) key morphologic features and correlate (Level 3) with diagnostic criteria for the presence of lymphoma cells on permanently stained blood and body fluid smears, photographs, electronic images or other visual means of representation
Thrombopoiesis/megakaryopoiesis
List (Level 1) the maturation sequence and identify (Level 2) distinguishing morphology for stages of developing megakaryocytes using _________ Level 1
Romanowsky stained smears, photographs, electronic images, -or kodachrome slides
Cite reference values for absolute platelet counts in the peripheral blood _________ Level 1
Correlate quantitative variations with disease manifestations _________ Level 3
Thrombocytopenia
Thrombocytosis representation
C—Cite reference intervals for peripheral blood platelet counts (Level 1)
D—Correlate quantitative variations of platelets with disease manifestations (Level 3)
1.—Thrombocytopenia
2.—Thrombocytosis
Correlate functional or qualitative variations of platelets with disease manifestations _________ Level 3
Perform absolute platelet counts on patient and control specimens using manual and _________ Level 2 automated methods in accord with prescribed criteria for accuracy and precision. Perform commonly used methods to evaluate platelets _________ (Level 2)
State the principles of method analysis and histogram/scatterplot review _________ (Level 1)
Compare absolute count with those estimated from blood smear exam _________ (Level 3)
Identify platelets and platelet morphologic variations on a properly prepared _________ Level 2 Romanowsky stained blood smear and/or recognize factors that alter hemogram results _________
Platelet satellitism
Platelet aggregates
Giant platelets
Cell fragments
Extreme microcytosis
Evaluate platelet histograms and scatterplots for diagnostic and quality control _________ Level 3 purposes
Platelet satellitism
Platelet aggregates
Giant platelets
Cell fragments
Extreme microcytosis
Agranular and hypogranular platelets

Recognize and troubleshoot pre-analytical (pre-examination), analytical (examination) and post-analytical (post-examination) causes for problems or unexpected results

Make decisions to recommend appropriate follow-up to prevent unexpected results and/or events from reoccurring (Level 3)

3.---results and/or events from reoccurring_Determine platelet counts on patient and control specimens using manual and automated methods in accord with prescribed criteria for accuracy and precision (Level 2)

4.---Compare platelet count with blood film platelet estimate (Level 3)

Calibrate and perform preventive maintenance on instruments used to evaluate platelets (Level 2)

Evaluate automated hemogram parameters such as MPV and IPF with the peripheral blood film morphology (Level 3)

5.---Evaluate platelet histograms and scatterplots for diagnostic and quality control purposes (Level 3)

6.---Identify platelets and platelet morphologic variations on a properly prepared Romanowsky stained blood smear and/or recognize factors that alter hemogram results (Level 2)

a)---Platelet satellitism
b)---Platelet aggregates
c)---Giant platelets
d)---Cell fragments
e)---Extreme microcytosis
f)---Agranular and hypogranular platelets

7.---Recognize (Level 2) and troubleshoot (Level 3) pre-analytical (pre-examination), analytical (examination) and post-analytical (post-examination) causes for problems or unexpected results

8.---Take corrective action to resolve unexpected results and/or events (Level 3)

Make decisions to recommend appropriate follow-up to prevent unexpected results and/or events from reoccurring (Level 3)

Hemostasis/ Coagulation

Define hemostasis Level 1

Explain the general interaction of systems involved in maintaining hemostasis Level 1

Of systems involved in maintaining hemostasis describe how changes in one effect the other Level 2

Vasculature
Platelets
Plasma coagulation factors
Fibrinolysis

Differentiate between primary and secondary hemostasis Level 3
Vascular

Explain the functions of the vascular system in maintaining hemostasis

Describe metabolic functions of the endothelium and substances contributing to the thromboresistance properties of endothelium

- Heparan sulfate
- Thrombomodulin
- Tissue plasminogen activator
- Prostacyclin (PGI2)
- Tissue factor pathway inhibitor

Platelets

Discuss the production of platelets

State the average time in circulation, normal peripheral count, and total body distribution of platelets

Describe the ultrastructural components of a platelet

- Alpha granules
- Dense bodies
- Lysomes
- Microtubules
- Open canalicular system
- Platelet membrane
- Glycocalyx

Discuss the physiological role of platelets in hemostasis

- Platelet plug formation
- Maintaining normal vascular integrity

Describe the series of morphologic changes that occur in platelets following physiologic stimulation

- Adhesion
- Aggregation
- Activation

Discuss the effect of aspirin on platelet function

- Biochemical mechanism
- Duration of the effect

Discuss principle for platelet aggregometry and platelet function analyzers

Perform a bleeding time test

Interpret results of platelet function assay tests

- Significance in terms of platelet function
- Associated abnormal conditions
- Sources of error

Discuss the principle and clinical significance of platelet aggregation

- Describe the principle of light transmittance, whole blood impedance and lumiaggregometry

Perform the procedure

- Describe the procedure
- Describe appropriate quality control procedures and sources of error

Interpret results and clinical significance

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Plasma coagulation factors

 Define the coagulation factors
   Roman numerals
   Common names
   Synonyms

 Discuss the physiological role of the coagulation phase within the hemostatic process

 Discuss characteristics of the coagulation factors
   Contact group
   Prothrombin group
   Fibrinogen group

 List and describe the vitamin K-dependent factors

 Compare and contrast the plasma-based (in vitro) and cell-based (in vivo) mechanisms of coagulation (Level 3)
   Plasma-based (in vitro) mechanism
     Intrinsic
     Extrinsic
     Common
   Cell-based (physiologic, in vivo) mechanism
     Initiation
     Amplification
     Propagation

 Identify substances that are contact activators *in vitro*

 Summarize the interaction of the coagulation system with the vascular and platelet systems to form a hemostatic plug

 Describe the physiologic controls of hemostasis
   Blood flow
   Feedback inhibition
   Liver clearance

 Identify the inhibitors of hemostasis
   Antithrombin III
   Heparin cofactor II
   Tissue factor pathway inhibitor (TFPI)
   Protein C
   Protein S
   Alpha-2-macroglobulin
   Alpha-1-antitrypsin
   C1 inactivator
   Z-dependent protease inhibitor (ZPI)

 Identify the special precautions that must be taken in the collection and subsequent handling of specimens for coagulation testing (Level 1)
   Anticoagulant
   Ratio of blood to anticoagulant
   Patient hematocrit values
   Centrifugation

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Storage conditions including temperature
Transport
Phlebotomy procedure
(e.g., time tourniquet is on arm, needle gauge, probing, etc.)

Identify and describe tests that are used to monitor the coagulation phase of Hemostasis

Discuss the principle and clinical significance of the Prothrombin time test Level 1
Perform the procedure Level 2
Describe the procedure Level 2
Describe appropriate quality control procedures and sources of error Level 1
Interpret results Level 3
Describe the International Normalized Ratio (INR) Level 1
Calculate an INR given the international sensitivity index of the thromboplastin Level 2

Prothrombin time test
State principle (Level 1)
Discuss clinical significance (Level 2)
Describe procedure (Level 1)
Perform procedure (Level 2)
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Describe the International Normalized Ratio (INR) (Level 1)
Calculate an INR given the international sensitivity index of the thromboplastin (Level 2)
Describe interferences and sources of error Level 1

Discuss the principle and clinical significance of the Activated partial thromboplastin time Level 1
Perform the procedure Level 2
Describe the procedure Level 2
Describe appropriate quality control procedures and sources of error Level 1
Interpret results Level 3

Activated partial thromboplastin time
(1) State principle (Level 1)
(2) Discuss clinical significance (Level 2)
(3) Perform (Level 2) and describe (Level 1) procedure
(4) Apply appropriate quality control procedures (Level 2)
(5) Interpret results (Level 3)
Describe interferences and sources of error Level 1

Discuss the principle and clinical significance of the Activated clotting time Level 1
Perform the procedure Level 2
Describe the procedure Level 2
Describe appropriate quality control procedures and sources of error Level 1
Interpret results Level 3
Describe interferences and sources of error Level 1
<table>
<thead>
<tr>
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<td><strong>Fibrinolytic system</strong></td>
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<td>Discuss the physiological role of the fibrinolytic system</td>
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<td>Identify the major components of the fibrinolytic system</td>
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<td>Discuss the mechanisms of the activation of plasminogen</td>
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<td>Intrinsic activators</td>
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<td>Extrinsic activators</td>
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<td>List the major fragments of fibrinogen degradation</td>
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<td>Explain the role and clinical significance of physiologic controls</td>
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<td>Alpha-2-antiplasmin</td>
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<td>Alpha-2-macroglobulin</td>
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<td>Plasminogen activator inhibitors (PAI)</td>
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<td>Identify and describe laboratory procedures that are used to evaluate fibrinolysis</td>
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<td>Discuss the principle and clinical significance of the FDP assay</td>
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<td>Perform the procedure</td>
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<td>Perform the procedure</td>
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</table>
Describe appropriate quality control procedures and sources of error (Level 1)
Interpret results (Level 3)

Identify technical conditions that cause false coagulation testing results (Level 1)
with or without established protocol

Activated clotting time
State principle (Level 1)
Discuss clinical significance (Level 2)
Perform (Level 2) and describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Describe interferences and sources of error (Level 1)

Thrombin clotting time
State principle (Level 1)
Discuss clinical significance (Level 2)
Perform (Level 2) and describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Describe interferences and sources of error (Level 1)

Fibrinogen assay
State principles of clot-based and chromogenic assays (Level 1)
Discuss clinical significance (Level 2)
Perform (Level 2) and describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Describe interferences and sources of error (Level 1)

Factor assays
State principle (Level 1)
Discuss clinical significance (Level 2)
Perform (Level 2) and describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Describe interferences and sources of error (Level 1)
Identify technical conditions that cause unexpected coagulation testing results (Level 1)

Disorders of primary hemostasis
Differentiate between disorders of the vasculature (Level 2)
Acquired purpura
Henoch-Schölein purpura
Hereditary hemorrhagic telangiectasia
Ehlers-Danlos syndrome
Pseudoxanthoma elasticum
Define the following terms associated with hemostasis disorders (Level 1)
Thrombocytopenia
Thrombocytosis
Describe the etiology, pathophysiology, clinical features, and laboratory findings of _____ Level 3
quantitative defects of platelets

- Idiopathic thrombocytopenic purpura
- Autoimmune thrombotic thrombocytopenic purpura
- Post-transfusion purpura
- Disseminated intravascular coagulation
- Hemolytic uremic syndrome
- MYH9 inherited thrombocytopenias, e.g. May-Hegglin anomaly

- Wiscott Aldrich anomaly
- Neonatal alloimmune thrombocytopenia
- HELLP syndrome
- Heparin-induced thrombocytopenia
- Drug-induced immune thrombocytopenia
- Myeloproliferative disorders
- Secondary (reactive) conditions

Describe the etiology, pathophysiology, clinical features, and laboratory findings of _____ Level 3
qualitative defects of platelets

- von Willebrand’s disease
- Bernard-Soulier syndrome
- Glanzmann’s thrombasthenia
- Storage pool deficiencies
- Acquired platelet function disorders

**Disorders of secondary hemostasis**

Describe the inheritance pattern, pathophysiology, clinical features, and laboratory findings _____ Level 1

- Factor I deficiency
- Factor II deficiency
- Factor V deficiency
- Factor V Leiden
- Factor VII deficiency
- Factor VIII deficiency (Hemophilia A)
- Factor IX deficiency (Hemophilia B)
- Factor X deficiency
- Factor XI deficiency
- Factor XII deficiency
- Factor XIII deficiency
- Prekallikrein deficiency
- High-molecular-weight kininogen deficiency
- von Willebrand’s disease
- Alpha-2-antiplasmin deficiency
- Antithrombin III deficiency
- Heparin co-factor II deficiency
- Protein C deficiency
Protein S deficiency
Plasminogen deficiency
Homocystinemia/homocystinuria

Describe clinical features and laboratory findings of acquired coagulation disorders

Vitamin K deficiency
Liver disease
Renal disease

Describe the significance and clinical implications of the development of circulating anticoagulants

Specific factor inhibitors
Nonspecific factor inhibitors
Global inhibitors

Identify and describe laboratory procedures that are used to evaluate circulating anticoagulants or inhibitors

Discuss the principle and clinical significance of Correction study using normal plasma

Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results

Discuss the principle and clinical significance of APTT screening with moderate-high LA responsive reagent (LA-sensitive, low phospholipid)

Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results

Discuss the principle and clinical significance of the Dilute Russell viper venom time (DRVVT)

Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results

Discuss the principle and clinical significance of the Low-phospholipid (LA-sensitive) vs. high-phospholipid APTT

Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results

Discuss the principle and clinical significance of the Platelet neutralization procedure

Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results

Outline a protocol to follow when investigating a patient with an
unknown bleeding disorder

Fibrinolytic system

- Define fibrinolysis (Level 1)
- Discuss the physiological role of the fibrinolytic system (Level 2)
- Identify the major components of the fibrinolytic system (Level 1)
- Summarize the mechanisms of the activation of plasminogen (Level 2)

Intrinsic activators

Extrinsic activators

- List the major fragments of fibrinogen/fibrin degradation (Level 1)
- State the role and clinical significance of physiologic controls—plasminogen activator-inhibitors (Level 1)
- Identify and describe laboratory procedures that are used to evaluate the fibrinolytic system (Level 1)

D-dimer assay

- State principle (Level 1)
- Discuss clinical significance (Level 2)
- Perform (Level 2) or describe (Level 1) procedure
- Apply appropriate quality control procedures (Level 2)
- Interpret results (Level 3)
- Describe interferences and sources of error (Level 1)
- Describe the limitation of the traditional semiquantitative and quantitative fibrin degradation products assay (Level 1)
- Identify technical conditions that cause unexpected coagulation testing results (Level 1)

Disorders of primary hemostasis

Differentiate among disorders of the vasculature (Level 3)

- Acquired
  - Acquired purpura
  - Henoch-Schönlein purpura
  - Von Willebrand disease

- Inherited
  - Hereditary hemorrhagic telangiectasia
  - Ehlers-Danlos syndrome
  - Von Willebrand disease

- Define (Level 1)

- Thrombocytopenia
- Thrombocytosis
- Thrombocythemia

Describe the etiology, pathophysiology, clinical features, and laboratory findings of quantitative defects of platelets (Level 1)

Immunologic thrombocytopenic purpuras

Autoimmune thrombocytopenic purpura

Post-transfusion purpura

Drug-induced immune thrombocytopenia

Neonatal alloimmune thrombocytopenia

Heparin-induced thrombocytopenia

Microangiopathic hemolytic anemias
Thrombotic thrombocytopenic purpura
Disseminated intravascular coagulation
Hemolytic-uremic syndrome
HELLP syndrome
MYH9 inherited thrombocytopenias, e.g. May-Hegglin anomaly
Wiskott-Aldrich anomaly
Thrombocytosis
Myeloproliferative neoplasms
Secondary (reactive) conditions
Describe the etiology, pathophysiology, clinical features, and laboratory findings of qualitative defects of platelets (Level 1)
Bernard-Soulier syndrome
Glanzmann’s thrombasthenia
Storage pool deficiencies
Acquired platelet function disorders
Disorders of secondary hemostasis
Describe the inheritance pattern, pathophysiology, clinical features, and laboratory findings (Level 1)
Qualitative and quantitative fibrinogen disorders
Rare autosomal recessive coagulopathies: II, V, VII, X
Factor VIII deficiency (Hemophilia A)
Factor IX deficiency (Hemophilia B)
Factor XI deficiency
Factor XIII deficiency
Describe clinical features and laboratory findings of acquired coagulation disorders (Level 1)
Vitamin K deficiency
Liver disease
Renal disease
Describe the significance and clinical implications of the development of inhibitors (Level 1)
Specific factor inhibitors
Lupus anticoagulant (LA)/antiphospholipid antibodies
Global inhibitors
Identify and describe laboratory procedures that are used to evaluate inhibitors (Level 1)
APTT screening with moderate-high LA responsive reagent (LA-sensitive, low-phospholipid)
State principle (Level 1)
Perform (Level 2) or describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
APTT based mixing study using pooled normal plasma
State principle (Level 1)
Perform (Level 2) or describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Interpret results (Level 3)
Dilute Russell viper venom time (DRVVT)
State principle (Level 1)
Perform (Level 2) or describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Low-phospholipid (LA-sensitive) vs. high-phospholipid APTT
State principle (Level 1)
Perform (Level 2) or describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Interpret results (Level 3)
Factor assays with dilutions for detection of nonparallel results

Bethesda titer for factor VIII or IX inhibitors

Describe interferences and sources of error

Disorders of fibrinolysis
Differentiate between primary and secondary fibrinolysis Level 1
Define disseminated intravascular coagulation (DIC) Level 1
Identify mechanisms by which clotting is initiated during DIC Level 1
Describe the effect of DIC on laboratory procedures Level 1
Prothrombin time
Activating partial thromboplastin time
Thrombin clotting time
Platelet count
Fibrinogen
Fibrin/fibrinogen degradation products (FDP)
D-dimer
Blood smear
Describe conditions that are predisposing to recurrent thrombosis Level 1
Antithrombin III deficiency
Heparin cofactor II deficiency
Primary antiphospholipid antibody syndrome
Protein C deficiency
Protein S deficiency
Activated Protein C resistance
Prothrombin gene mutation (G20210A)
Hyperhomocystinemia
Acquired risk factors to thrombophilia (e.g., age, malignancies, including leukemias, chronic inflammation, surgery, immobilization, obesity, pregnancy, hormone replacement therapy, oral contraceptives, PNH, autoimmune disorders)
Describe laboratory tests for antithrombin III, protein C, and protein S comparing activity vs. antigen techniques Level 1

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Perform the procedure  Level 2  
Describe the procedure  Level 2  
Describe appropriate quality control procedures and sources of error  Level 1  
Interpret results  Level 3

**Anticoagulant therapy**

- Explain the action of anticoagulant therapy  Level 1
  - Oral anticoagulant therapy (warfarin)
  - Vitamin K Reductase inhibitors
  - Direct acting oral anticoagulants
  - Heparin high/low molecular weight

- Antiplatelet agents
  - Oral direct Xa inhibitors; anti-Xa

- Heparin high/low molecular weight
  - Low molecular weight heparin; chromogenic anti-Xa
  - Unfractionated heparin; PTT and chromogenic anti-Xa
  - Pentasaccharide, e.g., fondaparinux sodium (chromogenic anti-Xa)

- Outline a protocol to follow when investigating a patient with an unknown bleeding disorder  Level 3

**Disorders of the fibrinolytic system**

- Define disseminated intravascular coagulation (DIC)  Level 1
- Identify mechanisms by which clotting is initiated during DIC  Level 1
- Discuss the effect of DIC on laboratory procedures  Level 2
- Prothrombin time (PT)
- Activated partial thromboplastin time (APTT)
- Thrombin clotting time (TT)
- Platelet count
- Fibrinogen
- D-dimer
- Peripheral blood film

- Describe conditions that are predisposing to recurrent thrombosis  Level 1
  - (Antithrombin) deficiency
  - Primary antiphospholipid antibody and lupus anticoagulant
  - Protein C deficiency
  - Protein S deficiency
  - Activated Protein C resistance and factor V Leiden mutation
  - Prothrombin gene mutation (G20210A)
  - Hyperhomocystinemia
  - Acquired risk factors to thrombophilia (e.g., age, malignancies, including leukemias, chronic inflammation, surgery, immobilization, obesity, pregnancy, hormone replacement therapy, oral contraceptives, PNH, autoimmune disorders)

- Describe laboratory tests used to assess thrombophilia and recurrent thrombosis  Level 1
Identify principle (Level 1)
Perform (Level 2) or describe (Level 1) procedure
Apply appropriate quality control procedures (Level 2)
Indicate sources or error due to timing of testing and interference from anticoagulants (Level 1)
Interpret results (Level 3)
Describe the action of anticoagulant therapy (Level 1)
Vitamin K antagonist (e.g., warfarin /Coumadin®)
Heparin
Low molecular weight heparin
High molecular weight unfractionated heparin
Antiplatelet agents
Identify (Level 1) laboratory tests used to monitor anticoagulant therapy, indicate therapeutic intervals and sources of error and discuss emerging assays (Level 2)
Vitamin K antagonist: Warfarin (Coumadin®), PT/INR and chromogenic factor X
Heparin
Low molecular weight heparin; chromogenic anti-Xa
Unfractionated heparin; PTT and chromogenic anti-Xa
Pentasaccharide, e.g., fondaparinux sodium (chromogenic anti-Xa)
Oral direct Xa inhibitors; anti-Xa
Direct thrombin inhibitors; APTT, ecarin clotting time, dilute thrombin assay
__Antiplatelet agents; platelet aggregometry
Aspirin
Thienopyridines: Clopidogrel, prasugrel
Glycoprotein IIbIIIa inhibitors

Instrumentation
Identify basic concepts of electrical impedance, optical detection, radio frequency, and of light scatter plus cytochemical stain systems
Discuss the principle
List components
Describe operation
Perform Analysis
Describe maintenance and troubleshooting
Perform maintenance/ corrective action
Identify basic concepts of quality assurance for automated hematology cell counting systems
Describe acceptable practices
Perform basic quality assurance
Assess data to ensure quality.
Monitor quality assurance program
Describe the limitations and list interfering substances
Identify and describe hemogram parameters
Evaluate patient data
Describe the flagging system
Correlate scatter plots, histograms and data plots with the peripheral smear
Describe the mathematical calculations used to monitor instruments
II. Instrumentation

III. Automated hematology cell counting systems

IV. Identify (Level 1) basic concepts of electrical impedance, optical detection, radio frequency, light scatter, cytochemical stain, selective lysing agents, and fluorescence activated flow cytometry systems

V. State the principle (Level 1)

VI. List components (Level 1)

VII. Describe (Level 1) the operation and/or perform (Level 2) an analysis

VIII. Describe the maintenance (Level 1) and/or perform (Level 2) maintenance and basic trouble shooting. Identify basic concepts of quality assurance for automated hematology cell counting systems

IX. Describe acceptable practices (Level 1)
X. Perform basic quality assurance (Level 2)
XI. Assess data to ensure quality (Level 3)
XII. Monitor quality assurance program (Level 2)
XIII. Describe the limitations and list interfering substances (Level 1)
XIV. Identify and describe hemogram parameters (Level 1)
XV. Evaluate patient data (Level 3)
XVI. Describe the flagging system (Level 1)
XVII. Correlate scatter plots, histograms and data plots with the peripheral smear (Level 3)
XVIII. Evaluate findings generated by automated imaging systems (Level 3)
XIX. Describe the mathematical calculations used to monitor instruments (Level 1)
XX. Recognize unexpected results (Level 2) and take (Level 3) corrective action
XXI. Automated reticulocyte counting
XXII. State the principle (Level 1)
XXIII. List components (Level 1)
XXIV. Describe (Level 1) the operation and/or perform (Level 2) an analysis
XXV. Describe the maintenance/quality assurance (Level 1)
XXVI. Describe the limitations and list interfering substances (Level 1)
XXVII. Evaluate and correlate patient data with other test results. (Level 3)
XXVIII. Recognize unexpected results (Level 2) and take (Level 3) corrective action
XXIX. Automated coagulation instruments
XXX. Identify basic concepts of electromechanical, spectrophotometric, chromogenic substrate assays
XXXI. State the principle (Level 1)
XXXII. List components (Level 1)
XXXIII. Describe (Level 1) the operation and/or perform (Level 2) an analysis
XXXIV. Describe the maintenance (Level 1) and/or perform (Level 2) maintenance and basic trouble shooting
XXXV. Identify basic concepts of quality assurance (Level 1)
XXXVI. Describe acceptable practices (Level 1)
XXXVII. Perform basic quality assurance (Level 2)
XXXVIII. Assess data to ensure quality (Level 3)
XXXIX. Monitor quality assurance program (Level 2)
XL. Describe the limitations and list interfering substances (Level 1)
XLI. Recognize unexpected results (Level 2) and take (Level 3) corrective action
XLII. Evaluate patient data (Level 3)
XLIII. Identify basic concepts of platelet aggregation and the platelet function analyzer (PFA) (Level 1)
XLIV. State the principle (Level 1)
XLV. Light transmittance aggregometry
XLVI. Whole blood impedance aggregometry
XLVII. Lumiaggregometry
XLVIII. List components (Level 1)
XLIX. Describe (Level 1) the operation and/or perform (Level 2)
L. Describe the limitations and list interfering substances (Level 1)
LI. Recognize unexpected results (Level 2) and take (Level 3) corrective action
LII. Evaluate patient data (Level 3)
MLS Entry Level Curriculum – Immunohematology

Whole blood donation -- principles of donor selection
Review donor information (testing and interview responses) and determine if the donor is suitable for his/her category of donor
   Routine allogeneic
   Therapeutic
   Autologous
   Apheresis (platelet, plasma, double RBC)

Maintain donor records

Respond to questions regarding donor suitability consulting with medical director as appropriate

Blood collection
List the different anticoagulant/preservative solution used in blood collection/storage bags

Use the formula to correct the amount of preservative solution
When donor is less than acceptable weight

Perform the appropriate pre-donation testing for apheresis products (e.g., Platelet count for plateletpheresis)

Maintain produce sterility and integrity

Donor reactions
Describe the signs and symptoms of adverse donor reactions

Processing donor blood
Discuss the required standard of care tests and deferral criteria for infectious disease
   Hepatitis B and C antibody and NAT
   Syphilis
   HIV 1 / 2 (antibody and NAT)
   HTLV I/II
   CMV (as necessary)
   Chaga’s disease
   Bacterial testing of platelets

Analyze results of infectious disease tests to determine acceptability of donor

Perform ABO grouping and Rh typing tests and record results
Interpret ABO group and Rh type results and determine if a discrepancy exists Level 3

Perform antibody screen Level 2

Interpret results of antibody screen, and if positive identify antibody(ies) Level 3

Monitor quality of blood products Level 2

Store blood products according to product requirements Level 1

**Autologous donors**
Compare advantages and disadvantages of autologous and allogeneic donation and transfusion Level 2

Discuss and compare criteria for autologous collection with that of random allogeneic donor Level 2

Test and label blood as required for autologous units Level 2

Dispose of unused autologous units as indicated Level 1

**Preparation of cellular and plasma components from donor units**
Describe the process for separating units of whole blood and/or preparing cellular components Level 1

- Packed red blood cells (PRBC)
- Leukocyte-poor PRBC
- Washed PRBC
- Frozen, deglycerolized PRBC
- Irradiated PRBC
- Platelet concentrate

Discuss the preparation of single donor platelets by plateletpheresis using automated methods Level 1

Store each component within required parameters Level 1

Prepare components according to protocol Level 2

- fresh frozen plasma (FFP)
- cryoprecipitate (CRYO) from fresh frozen plasma
- single donor plasma from whole blood

Discuss pathogen inactivation methods for platelet and plasma products Level 1
Discuss the indications for and use of plasma derivatives (e.g., Factor VII, VIII, IX) Level 1

Label units/component with required information Level 2
- Name of component
- Expiration date
- Amount of product
- Storage temperature
- Results of tests

List quality control standards for methods used in component preparation Level 1

Test components to determine if they meet the QC requirements Level 2

Document and evaluate QC results to determine if corrective action should be taken Level 3

**Storage of blood components** Level 1
List the biochemical changes that take place in stored blood units and relate to the specific anticoagulant used, time and temperature of storage

Monitor equipment Level 2
- Document temperatures for refrigerators and freezers at required intervals
- Check temperature sensors at required intervals
- Document corrective action when temperatures vary beyond limits

Package and ship components Level 1
- Select units for shipping to fill routine and emergency orders
- Prepare transfer records
- Package components for shipping to maintain required conditions
- Maintain inventory

Trace donor unit and components for final disposition Level 1

**Blood group serology** Level 2
Evaluate suitability of specimen
- List rejection criteria
- Ascertained that specimen has been correctly collected and labeled
- Discuss possible sources of error in testing that may result
Correlate specific factors with their effect on reactions  
- Incubation time / temperature  
- Class of antibody  
- Antigen/antibody ratio  
- Centrifugation time/speed  
- Suspending media (e.g., pH, saline, high protein, low ionic strength)

Prepare red blood cell suspension using required equipment and reagents  
- Choose appropriate reaction tubes and prepare saline cell concentrations  
- Dispense cells and reagents  
- Balance and use a centrifuge  
- Wash cells manually and using a cell washer

Perform testing (e.g., tube, gel and solid phase tests) and record results  
- Shake out tube tests without dispersing true agglutination  
- Read and grade hemolysis and agglutination  
- Use controls as appropriate

Interpret and evaluate results of tests (e.g., tube, gel, solid phase)  
- Identify any factors that may have affected reactions and/or interpretation of reactions to resolve discrepancies

**Antiglobulin tests**  
Compare the principle and purpose of the direct antiglobulin test and indirect antiglobulin test (antibody screen)

Discuss the use of appropriate controls including autocontrol

Explain the principle and purpose of IgG sensitized cells

Choose polyspecific and monospecific antiserum for the appropriate test

Perform the antiglobulin test according to protocol and record results

Interpret results including control and determine reportability

Investigate and resolve false positive and/or false negative results

**Special methods**  
Describe criteria and/or situations for use of specific elution techniques (e.g., Lui freeze-thaw, chemical)
Describe the principle of special methods and discuss procedure Level 1

- Prewarm
- enzyme
- adsorption
- elution
- absorption
- neutralization
- titration

Select appropriate cells, reagents, controls and/or cell preparation methods for special techniques Level 2

Perform special methods tests and document results Level 2

Evaluate results of special methods tests and determine reportability or necessity of further testing Level 3

Describe criteria and/or situations for use of autologous or allogeneic Absorptions Level 1

List cells used in each type of absorption Level 1

List antibodies that can be neutralized and the appropriate source of antigen/substance to use Level 1

Perform antigen typing (tube, gel, solid phase) and record results Level 2

Interpret results of antigen typing and determine if further testing is required Level 3

Discuss use of molecular genotype testing for prediction of red cell antigens Level 1

Perform (tube, gel and solid phase) testing for antibody screening & identification and document results Level 2

Interpret results of tests for antibody screen/identification and evaluate for further testing or reportability Level 3

Apply knowledge of limitations of test procedure to test results and interpretation Level 2
Principles for recognition or differentiation of blood group antigens and antibodies

For the more common blood group systems list and compare characteristics of red cell antigens with their specific antibody
- Enzyme enhancement or inhibition
- Dosage
- Complement binding
- Other optimal conditions or reaction (e.g., pH, temperature, enhancement media)

Name and use a source of information to identify characteristics reactions of rare unexpected antibodies

Apply characteristics of blood group antigens to interpret an antibody screen,

Evaluate clinical significance of antibodies identified, and determine safety of blood components for transfusion
- Specificity and immunogenicity
- Biochemistry (noting similarity in behavior of structurally similar antigens)
- Variable expression of antigens
- Dosage
- Prevalence
- Number and location of antigen sites
- Modes of inheritance
- Effects of genotype on expression of genes at other loci and effects of gene linkage
- Antigen development including changes from newborn through adult to aged
- Disease-related antigen changes
- Correlation of genotype with disease and or cell membrane function
- RBC blood group antigens present on other tissue
- Soluble blood group substances
- Molecular genotyping

Apply properties of antibodies directed toward blood cell antigens to interpret antibody screens,
- Primary vs. secondary response
- Non-red cell vs. red cell stimulation
- Expected (e.g., A, B, H) vs. unexpected
- Avidity
- Titer
- Effects of patient age, specimen age, disease
- Clinical significance
- Immunoglobulin class
- Phase of reactivity (in vivo vs. in vitro)
Correlate immunoglobulin class with other properties
   Form of stimulation
   Class of antibody
   Subclass of antibody

Evaluate clinical significance of antibodies present, and determine safety of blood components to be issued

Explain the effects of complement on hemagglutination reactions
   Aid in enhancing Kidd system antibody reactions
   Interfere in immediate spin crossmatches

**Pre-transfusion testing**
Determine acceptability of recipient specimen based on specified criteria

Check records for previous ABO group and Rh type, antibody problems, and transfusion history of patient

Perform and document results for required tests on recipient blood sample
   ABO forward and reverse typing
   Rh typing including weak D when appropriate
   Antibody screen and identification
   Antigen typing for special antigens as necessary employing negative and weakly-reacting positive control cells

Interpret and evaluate results of recipient blood sample tests to determine if further testing is necessary

Correlate test results with potential causes of discrepant results
   Subgroups of A and B
   Weakened or altered antigen expression due to disease
   Missing antibody in newborn, elderly or immunosuppressed
   Unexpected alloantibody
   Autoantibody
   Transplantation of non-ABO–identical bone marrow/stem cells

Analyze patient history, diagnosis, transfusion history and antibody screen results and correlate with ABO discrepancies

Discuss regent variability between monoclonal typing reagents when interpreting discrepant results
Resolve discrepancies of ABO typing results
Perform and interpret tests using appropriate methods
(e.g., lectins, saline replacement, and reverse grouping with A2 and O cells)

Perform antibody screening and identification for antibodies that can be resolved using routine procedures
Perform and interpret antibody screening results including antiglobulin phase
Perform and identify antibodies using routine antibody identification panels on serum or eluate

Confirm antibody identification
Perform and interpret antigen typing of patient cells
Choose selected cells of appropriate phenotype
Select perform and interpret a cell panel using a
95% probability level of cells (3 cells positive and 3 cells negative)
for the antigen against which a suspected antibody is directed

Resolve complex antibody problems

Evaluate clinical and/or laboratory data to determine when each specific technique is appropriate

Alter reaction conditions to include appropriate controls and interpret results
Increased serum volume
pH adjustment
Neutralization techniques
Pre-warm technique
Saline replacement technique
Autologous or allogeneic adsorption
Special antigen typings
Separation and identification of multiple antibodies by adsorption/elution procedure

Interpret multiple antibody reactions on a panel
Differentiate clinically significant and insignificant antibodies

**Compatibility of recipient and donor**

Evaluate the necessity for compatibility testing depending on component required and nature of request
Type and screen with negative screen results vs. positive screen results
Routine transfusion
Emergency transfusion
Massive transfusion
Intrauterine and neonatal transfusion
List the blood groups that are compatible with each ABO blood group Level 1

Select blood for compatibility testing
when group specific blood is available
when groupspecific blood is not available
if the patient has been recently transfused with non-group specific blood

Prepare donor sample from attached sealed segment or segment with number matching it to donor sample Level 2

Perform crossmatch and document results
  immediate spin crossmatch to detect ABO incompatibility
  routine antiglobulin crossmatch
  computer crossmatch

Interpret crossmatch results and determine follow-up procedures if necessary Level 3

Perform phenotype frequency calculations to determine the number of donor units needed to find compatible units for a patient with alloantibody(ies) Level 2

Select blood for compatibility testing that is negative for the antigen against which clinically significant recipient antibody(ies) is/have been detected Level 2

Discuss selection of blood or blood products requiring special criteria
  Hemoglobin S negative
  CMV negative
  Irradiated Level 1

Release compatible units for transfusion and complete appropriate records Level 2

Retain specimen from donor and recipient for appropriate length of time Level 1

Resolve compatibility problems using methods used to resolve antibody identification problems Level 3

Correlate results of compatibility testing with causes for incompatible results
  Atypical antibody(ies)
  Rouleaux
  Autoantibody(ies)
  Positive DAT on donor cells Level 2

Apply appropriate labels/tags to units including cases of incompatibility, emergency release of non-crossmatched unis, least incompatible, etc. Level 2
Testing for disease states associated with a positive direct antiglobulin test

Explain the principle of the direct antiglobulin test (DAT) Level 1

Perform DAT including use of IgG sensitized cells and record results
   Use monospecific antiglobulin sera as indicated and compare results with polyspecific serum results

Interpret results and correlate with the patient history to determine appropriate follow-up testing Level 3

Investigate and resolve cases of positive DAT
   Correlate patient history and perform appropriate testing to confirm warm autoimmune hemolytic anemia, cold agglutinin syndrome
   Correlate drug history, IVIG infusion and test results to confirm drug-induced DAT and/or drug-induced hemolytic anemia using appropriate procedure
   Correlate results of maternal and infant testing to confirm hemolytic disease of the fetus and newborn
   Perform adsorption / elution as necessary to aid in antibody identification

Hemolytic disease of the fetus and newborn

Describe the immune process which causes hemolytic disease of the fetus and newborn (HDFN) Level 1

Discuss the mechanism of fetal and neonatal alloimmune Thrombocytopenia Level 1

Predict the risk for HDFN from parental phenotypes
   Using parental phenotypes discuss the probability of infant phenotype
   Consider the mechanism of immunization for risk of ABO-HDFN, Rh-HDFN, and HDFN due to other antigens
   Discuss protective factors in determination of risk for HDFN Level 2

List the common antibodies responsible for HDFN and compare their characteristics with antibodies that do not cause HDFN Level 2

Perform prenatal testing
   Perform and interpret ABO and Rh typings and antibody screen on maternal sample
   Identify the antibody present in maternal sample and perform antibody titration if appropriate Level 2
Perform testing on fetal blood samples and report results  Level 2

Procure safe blood for intrauterine transfusion  Level 2
   Select fresh blood of appropriate ABO and Rh type
   Select or prepare leukocyte-reduced, irradiated, washed, hemoglobin S
   negative and CMV negative units as necessary

Perform and record results of compatibility testing using  Level 2
   using maternal serum or eluate or fetal serum (when available through umbilical
   cord sampling)

Interpret results of compatibility test and determine if results can be  Level 3
   reported or if followup testing is necessary

Perform neonatal testing  Level 2
   Perform ABO (forward typing only) and Rh typing
   and direct antiglobulin test and record results
   Perform elution and antibody identification where indicated
   Perform ABO and Rh typing and antibody screen on maternal postnatal specimen
   Identify antibody (ies) if present

Interpret results of neonatal testing on mother and baby and  Level 3
   determine clinical significance and further testing if necessary

Perform testing for exchange transfusion  Level 2
   Select blood for transfusion that is appropriate to the clinical
   needs of the recipient
   Perform compatibility test using appropriate samples

Interpret results of compatibility testing and determine  Level 3
   reportability and further action if necessary

Perform testing to determine necessity for administration of  post-natal
   RhIg to prevent Rh-HDFN
   Review patient history for evidence of antenatal administration of RhIg
   Perform D and weak D tests on maternal and newborn samples
   Perform antibody screen on maternal serum

Interpret and correlate results to determine eligibility for RhIg  Level 2

Perform testing to identify and quantitate fetal maternal hemorrhage  Level 2
   Rosette
   Kleihauer-Betke
   Flow cytometry
Calculate dosage of RhIg based on test results Level 2

Issue product and complete records Level 2

**Issuing of blood and blood components**

Discuss the clinical necessity for, and effects of transfusion Level 1

Evaluate indications for transfusion of red cells, blood components, and factor concentrates Level 3

Interpret changes expected in patient function / laboratory values Level 2

Prepare blood and blood components for transfusion Level 2
  - Maintain adequate supply of appropriate blood and blood components
  - Inspect blood and components for date of expiration and evidence of contamination or deterioration
  - Perform confirmatory verification of ABO group and Rh type on donor units as specified
  - Verify patient identification and perform comparison checks on ABO and Rh of patient and complete records

Discuss bacterial testing for platelet units Level 1

Prepare products for transfusion Level 2
  - Wash cells
  - Irradiate product according to protocol
  - Pool platelets or cryoprecipitate
  - Thaw fresh frozen plasma and cryoprecipitate
  - Prepare red blood cells to specified hematocrit or small volume aliquot for pediatric patients
  - Perform volume reduction on apheresis units

Control return of unused blood or components Level 2
  - Note time and estimate conditions under which blood components were maintained when out of the laboratory
  - Inspect for evidence of improper storage
  - Determine whether blood components can be reissued, complete appropriate records and store as required
  - Appropriately dispose of blood components that cannot be reissued and complete paperwork
**Investigation of suspected adverse outcome to transfusion**

Perform required preliminary investigation to determine whether a hemolytic reaction has occurred
- Obtain and review completed transfusion report
- Check identification of pre-transfusion sample of donor and patient and of blood container
- Confirm correctness of interpretation of pre-transfusion test results
- Compare plasma of pre-transfusion and post-transfusion specimens for evidence of hemoglobin or icterus
- Perform and interpret a direct antiglobulin test (DAT) and ABO/Rh typing on post-transfusion sample and compare with pre-transfusion sample

Evaluate results of preliminary checks and correlate test results with clinical evidence to determine cause of transfusion reaction
- Acute hemolytic
- Febrile non-hemolytic
- TRALI
- Circulatory overload
- Allergic
- Anaphylactic
- Non-immunologic reaction caused by method of blood administration
- Hemolytic caused by an alloantibody
- Reaction (septic shock) caused by bacterial contamination (send unit to microbiology for gram stain and culture)
- Infectious disease transmission

Follow up reports of infectious disease transmission associated with transfusion
- Review test results on donor blood for markers of infectious disease or perform testing on patient sample as suggested by clinical symptoms and review
- Report positive test results to physician, blood suppliers and to appropriate regulatory agencies
- Perform a ‘look back’ procedure

Perform additional testing where appropriate to determine if a hemolytic reaction is the result of an alloantibody
- Repeat ABO, Rh, compatibility testing and antibody screening on patient pre-transfusion and post-transfusion samples and compare results
- Repeat ABO and Rh typing on donor unit and compare pre-transfusion and post-transfusion results
- Identify unexpected alloantibody found in patient serum
- Type donor cells for antigen corresponding to the recipient antibody identified
- When DAT on patient cells is positive with anti-IgG prepare and test a red cell eluate for unexpected alloantibody
Separate transfused from autologous cells by capillary centrifugation and perform appropriate testing on separated cells
Use molecular typing to identify cell populations

Advise health care team of appropriate blood for future transfusions   Level 2

**Human leukocyte antigens (HLA)**

Describe the genetic origin, biological functions, and cell distribution of the major human leukocyte antigens   Level 1

Discuss the clinical importance for identifying HLA antigens or antibodies and matching HLA antigens
  Disease association
  Transplantation
  Platelet transfusion

Discuss results of HLA typing, antibody screening, and crossmatching procedures including DNA hybridization methodologies for more specific identification of HLA alleles
  Flow cytometry bead techniques
  Microlymphocytotoxicity assay for HLA-A, HLA-B, and HLA-DR
  SSP
  RT-PCR
  Oligonucleotide probes
  DNA sequencing

**Quality assurance**

Follow good manufacturing practices for environment within the facility   Level 1
  Adequate space
  Ventilation
  Sanitation and trash disposal
  Temperature control
  Water systems

Maintain/follow a Standard Operating Procedure (SOP) manual for all procedures   Level 2

Participate in laboratory quality assessment   Level 2

Discuss competency assessment   Level 1

Discuss process improvement indicators   Level 1
Participate in personnel QA
  Provide and/or participate in continuing education programs
  Participate in proficiency testing

Perform calibration and preventive maintenance at required intervals,
  trouble shooting and complete appropriate records
  Centrifuge
  Refrigerators/freezers / platelet chambers
  Timers
  Automated cell washers
  Automated blood grouping or antibody screening instrumentation

Perform, interpret and record appropriate quality control (QC) on reagents
  Typing sera and cells
  Antibody screening and panel cells
  Antiglobulin sera and IgG sensitized control cells

Perform positive and negative control testing as required in tandem with
  patient tests when tests are not performed daily
  Lectins
  Special antigen typing sera

Monitor results of quality control procedures for reagents

Discuss the criteria for adequate recovery of prepared component

Test an appropriate percentage of blood units or components, interpret
  results for acceptability and determine corrective action
  Packed red blood cells  for volume  and hematocrit
  Number of platelets and volume
  Number of units of Factor VIII in cyoprecipitate

Maintain inventory records
  Have available the records for: ABO, Rh testing performed in the
  last 12 months and
difficulties encountered in transfusion testing according to state and
  federal requirements
  Store and retrieve testing results and other information from a database

Maintain records of errors or adverse outcomes in patients
Report adverse events to the collecting facility and/or FDA Center for Biologics Evaluation and Research

Report units implicated in post-transfusion disease transmission to the collecting facility
Report fatalities related to blood collection or transfusion to the FDA

**Agencies regulating blood banks**

Maintain copies of standards/regulations for blood banks and evidence of compliance

Have available current copies of regulations and standards: required by law (CLIA ’88) and those for agencies from whom licensure or accreditation is required (FDA) agencies from which the institution has voluntarily applied for /received accreditation (e.g., AABB, CAP, TJC)

Maintain documentation of conformance to FDA nd CLIA ’88 regulations and to those of agencies from which the institution has voluntarily applied/for received accreditation

Interact/communicate with agencies according to regulations/standards

Prepare accreditation documents

Subscribe to appropriate proficiency testing

Document and report adverse events/errors as required by regulating agencies
DELETIONS
Allogeneic Donation:
- Removed section dealing with donors
- Take donor history
- Perform physical examination
- Perform hemoglobin
- Obtain informed consent
- Perform phlebotomy use supplies for treating donor reactions

Autologous donation:
- Select donor
- Adapt history questions
- Collect blood

Sections such as developing and modifying procedures/guidelines (not-entry level)

HLA
- Changed “perform testing” to “observe testing “

ADDITIONS
Throughout the document updated test methods (e.g., include molecular, bacterial testing for platelets).
MLS Entry Level Curriculum
Immunology

**Basic Concepts**

Define innate immunity 

Define adaptive immunity
  - Passive immunity
  - Active immunity

List major components of innate immune system and their functions
  - Physical barriers
  - Phagocytic cells
  - Innate lymphocytes and innate-like T/B cells
  - NK cells
  - pH
  - Lytic components
  - Inflammatory response
  - Soluble mediators (cytokines, complement, acute phase reactants)

Describe cellular and organ components of the immune system and their origins
  - Lymphoid organs (primary and secondary including GALT, MALT, Peyer’s patches)
  - Cells (e.g., T cells, B cells, macrophages)

Contrast primary and secondary immune responses

Discuss the features of an antigen molecule that determine immunogenicity
  - Molecular size and complexity
  - Foreignness
  - Epitopes
  - Dosage, timing, route of administration
  - Cross-reactivity

Compare the basic characteristics of T-cell dependent and T-cell independent antigens

Discuss the structure, function, properties, and formation of an antibody molecule
  - Class and subclass
  - Light and heavy chain
  - Regions
  - Fragments (Fab and Fc)
  - Gene rearrangement
Define the following and discuss the importance in the immune process
Isotype
Allotype
Idiotype

Cell-mediated immunity
Discuss the concepts of T cell plasticity and polarization

Describe T cell development

Differentiate the functions of T cell subsets
CD8+ (cytotoxic)
CD4+ (Th1, Th2, Th9, Th17, Tfh)
Treg (tTreg, pTreg)

Compare the response of T cells to intracellular vs. extracellular pathogens

Describe the process and interactions of antigen recognition and presentation for T cell subsets
Role of activation and antigen-presenting cells
MHC molecules involved
Restricted recognition
Co-receptors
Signaling
Cytokines stimulated or responded to
Cells stimulated

Discuss and compare the effector functions of each T-cell subset
Lysis
Apoptosis
Inflammation
Regulation
B cell activation

Discuss the characteristics, role, function and interactions of natural killer (NK) Cells
CD markers
Lack of MHC restriction
Cytokines stimulated
Expanded cell phenotyping using transcription factors, adhesion molecules
Cytokine response
Humoral immunity
Discuss the interaction of cells in the generation of antibody
  APC
  CD4+

Define isotype switching and describe how it occurs

List and describe the characteristics of memory cell populations
  Types of cells (B cell, T cells, ILC, NK, central, effector, resident tissue populations)
  Numbers of cells
  Titer of antibody
  Affinity of antibody

Compare antigen independent and antigen dependent B-cell differentiation
  Affinity maturation
  Class switching
  Gene rearrangement

Describe the process and interactions of mature B cell activation
  Stimulatory molecules
  Membrane bound Ig
  Secreted Ig
  Plasma cell

Cytokines
Discuss major cytokines involved in innate immunity (e.g., IL-1, IL-6, TNF-α)
  and compare major characteristics
  Cells that produce
  Functions
  Cells that are affected

Discuss major cytokines involved in adaptive immunity (e.g., IL-2, IL-4, IL-5, IL-10, IFN-γ)
  and compare major characteristics
  Cells that produce
  Functions
  Cells that are affected

Discuss soluble mediators affecting PMNs and macrophages (e.g., Chemotactic factor, migration inhibitory factor, GM-CSF)
  Cells that produce
  Functions
  Cells that are affected
Immunologic techniques used in the clinical immunology laboratory

Discuss and compare the basic immunoassay principles and techniques

- Particle (e.g., precipitation, agglutination, flocculation, diffusion)
- Competitive & non-competitive binding (e.g., EIA, Chemiluminescent, fluorescent polarization)
- Enzyme immunoassay (e.g., competitive and, non-competitive)
- Microparticle assay
- DNA

Compare sensitivity, specificity of methods, and their usefulness

- Particle (e.g., precipitation, agglutination, flocculation, diffusion)
- Competitive & non-competitive binding (e.g., EIA, Chemiluminescent, fluorescent polarization)
- Enzyme immunoassay (e.g., competitive and, non-competitive)
- Microparticle assay
- DNA

Evaluate specimen suitability

Prepare appropriate materials, reagents and equipment for performing test procedures

Perform procedures according to established laboratory protocols using controls and standards (if applicable) and report results

- Particle (e.g., precipitation, agglutination, flocculation, diffusion)
- Competitive & non-competitive binding (e.g., EIA, Chemiluminescent, fluorescent polarization)
- Enzyme immunoassay (e.g., competitive and, non-competitive)
- Microparticle assay
- DNA

Evaluate acceptability/reportability of results

Identify sources of error in procedures according to laboratory protocol

Perform and document quality control

Evaluate results of quality control and determine reportability or action to be taken

Perform and document routine preventive maintenance

Correlate immunology test results with other laboratory data and patient diagnosis
Immunologic Techniques used in Flow Cytometry – cross-referenced to hematology

Discuss basic concepts and operation of flow cell cytometry instrument Level 2
   Fluid system
   Optical system
   Signal detection system
   Data management system
   Sample preparation
   Light scatter (forward angle – FALS and side scatter – SS)
   Gating

Discuss the role of monoclonal antibodies in Fluorescence assisted cell sorting (FACS) Level 1
   Cell sorting
   Production
   Cluster designations (CD)
   Fluorescent labeling
   DNA probes

Discuss the clinical applications of flow cell cytometry in diagnosis and treatment Level 2
   Lymphocyte immunophenotyping
   Leukemia/lymphoma immunophenotyping
   DNA ploidy analysis
   Reticulocyte enumeration

Perform flow cytometry testing and report results Level 2

Interpret and evaluate flow cytometry results Level 3

Autoimmune Diseases
Define immune tolerance Level 1

Discuss and compare the proposed mechanisms for autoimmunity Level 2
   Release of sequestered antigen
   Escape of tolerance at the T cell level
   Molecular mimicry
   Diminished cell regulation and balance

Differentiate organ-specific and systemic autoimmune diseases Level 2

Discuss MHC/HLA structure and diversity Level 1

Describe the role of MHC/HLA antigens in autoimmune disease Level 1
Describe underlying mechanisms, clinical symptoms, characteristic autoantibody(ies) and correlate laboratory findings for classic autoimmune diseases:

Collagen vascular (systemic lupus erythematosus, rheumatoid arthritis, scleroderma, Sjögren’s syndrome)
Idiopathic thrombocytopenia purpura
Thyroid (Hashimoto’s thyroiditis and Graves’ disease)
Myasthenia gravis
Multiple sclerosis
Addison’s disease
Type 1 diabetes mellitus
Celiac disease
Goodpasture’s syndrome
Wegener’s granulomatosis (granulomatosis with polyangitis)

**Tumor Associated Antigens**

Discuss the purpose and function of the immunosurveillance system for tumor recognition

List and discuss the most common antigens associated with tumors /specific cancers

- Carcinoembryonic antigen (CEA)
- Alpha-1 antitrypsin (Cross listed with chemistry)
- Prostate specific antigen (PSA)
- Beta-2 microglobulin (Cross listed with chemistry)
- HCG (Cross listed with chemistry)
- CA 125, CA-19-9, CA 15-3, CA 27-29

Discuss the problems associated with use of tumor marker test results

**Primary Immunodeficiency Diseases**

Correlate the underlying defect(s), clinical symptoms, and laboratory findings for congenital/genetic B cell immunodeficiencies

- X-linked agammaglobulinemia (Bruton’s agammaglobulinemia)
- Selective common variable immunoglobulin deficiencies
- IgA deficiency
Correlate the underlying defect(s), clinical symptoms, and laboratory findings for congenital/genetic T cell immunodeficiencies
  Thymic aplasia (DiGeorge’s syndrome)

Correlate the underlying defect(s), clinical symptoms, and laboratory findings for combined congenital/genetic T cell and B cell immunodeficiencies
  Ataxia telangiectasia
  Severe combined immunodeficiency disease (SCID)
  Wiskott-Aldrich syndrome

Discuss therapeutic approaches for primary immunodeficiencies

**Complement system deficiencies**
Correlate the underlying defects and mechanisms, clinical symptoms, and/or disease and laboratory findings for individual complement component or regulatory molecule deficiencies

**Phagocyte deficiencies**
Correlate the underlying defects, clinical symptoms, and or/disease and laboratory findings for phagocyte deficiencies
  Leukocyte adhesion deficiency
  Chronic granulomatous disease (CGD)
  Chediak-Higashi syndrome

**Acquired immunodeficiencies**
List factors that may cause an acquired immunodeficiency

Correlate the underlying defect(s) or mechanism(s), clinical symptoms, and laboratory findings for a patient with an acquired immunodeficiency syndrome
  Tests for antigen and antibody and the characteristic reactions at different phases of HIV infection
  Classic infections associated with AIDS
**Infectious diseases**
Correlate the clinical symptoms, phases of infection and complications and laboratory findings (e.g., Characteristic patterns of markers at specific stages, Viral load tests and NAAT for specific infections)
- Epstein-Barr infection (infectious mononucleosis)
- Hepatitis (A, B, C, D, E)
- Rubella
- Syphilis
- Group A streptococcal infection
- Cytomegalovirus (CMV)
- Sepsis/SIRS

**Hypersensitivity**
Compare the causes, molecular mechanisms, mediators, and clinical manifestations associated with the 4 types of hypersensitivity
- Type I
- Type II
- Type III
- Type IV

Correlate each type of hypersensitivity reactions with representative clinical conditions

List the characteristic testing for each type

Correlate laboratory findings with the clinical condition
DELETIONS & ADDITIONS

DELETIONS:

- No significant deletions of sections
- However, did completely rearrange the basic immunology section to reflect components of immune system and newer cell types identified

ADDITIONS:

- Autoimmune disease:
  - Added additional diseases (e.g., celiac, autoimmune hepatitis)
  - Additional antibody tests
  - Role of HLA in autoimmune diseases

- Tumor markers:
  - Listed key tumor marker tests

- Cross referenced flow cytometry with hematology and tumor markers with chemistry.
A. **Basic principles**

1. Differentiate among microorganisms
   - **Level 3**
     a. Bacteria
     b. Yeasts, molds
     c. Viruses
     d. Parasites
     e. Prions

2. Describe the classification of bacteria
   - **Level 1**
     a. Taxonomy
     b. Nomenclature
     c. Identification

3. Describe the phenotypic characterization of bacteria
   - **Level 1**
     a. Cell growth and reproduction
     b. Metabolism and nutrition

4. Describe the staining characteristics of bacteria
   - **Level 1**
     a. Gram-positive, Gram-negative and Gram-variable
     b. Acid-fastness

5. Differentiate microscopic morphologies of bacteria
   - **Level 1**
     a. Cocci in chains, clusters, tetrads, pairs
     b. Diplococci and coccobacilli
     c. Bacilli/Rods
     d. Lancet
     e. Fusiform
     f. Pleomorphic
     g. Branching
     h. Palisading
     i. Endospores
     j. Capsules
     k. Flagella
     l. Spirochetes
     m. Intra- and extra-cellular

6. Apply the use of bio and molecular technologies to taxonomy and clinical microbiology  
   - **Level 2**
     a. Deoxyribonucleic acid (DNA) relatedness
     b. Nucleic acid probes/hybridization
     c. Amplification procedures including but not limited to polymerase chain reaction
     d. Maldi-TOF (general theory)

7. Demonstrate proper use of the microscope (also found in General Lab Practice)
   - a. Use
   - b. Maintenance
c Troubleshooting

B. Role of the Clinical Microbiology Laboratory
1. Pre-analytical Phase
   a. Communicate with health professionals to insure quality specimens for submission
   b. Recognize (Level 2) potential errors and resolve (Level 3) according to predetermined criteria
2. Analytical Phase
   a. Accurately perform appropriate and timely testing in a cost effective manner
3. Post-analytical Phase
   a. Provide accurate and timely results

C. Laboratory examination of specimens for bacterial culture
1. Properly identify specimen type
   a. CSF
   b. Blood and bone marrow
   c. Pleural
   d. Synovial
   e. Peritoneal
   f. Pericardial
   g. Amniotic
   h. Gastric
   i. Genital
   j. Eye/ear/throat
   k. Nasopharynx/sinuses
   l. Sputum/Bronchial
   m. Tissue, skin, and bone
   n. Catheter tips
   o. Urine
      i. Catheterized
      ii. Clean voided midstream
      iii. Suprapubic
   p. Wound
      i. Abscess aspiration/purulent material
      ii. Surgical
      iii. Soft tissue
   q. Gastrointestinal
   r. Autopsy
2. Provide proper accession of specimens
   a. Log in
   b. Request form information/Laboratory information system orders
3. Evaluate acceptability of the specimen  
   a. Collection method/site preparation/aseptic technique  
   b. Collection time  
   c. Container/sampling device  
   d. Transport system (temperature, atmosphere, media)  
   e. Time in transit  
   f. Patient therapy  
   g. Number  
   h. Quality/Rejection criteria  
   i. Quantity  
   j. Contamination/spillage  

4. Choose appropriate storage temperature/environment if delay in processing  

D. Growth and Media  

5. Choose appropriate growth media and tests  
   a. Choose proper routine primary isolation media  
      i. Enriched  
      ii. Selective (differential/enrichment)  
      iii. Nutrient/general purpose  
   b. Describe the purpose of each media  
      i. Nutrients/constituents/supplements  
      ii. Antibiotics  
      iii. pH  
      iv. Antibiotic removal  
      v. Environment  
   c. Select special isolation media  
   d. Select special stains/direct tests  

6. Prepare specimen for inoculation  
   a. Centrifugation  
   b. Homogenization  

7. Perform proper inoculation of media  
   a. Order of media for inoculation  
   b. Quantitative  
   c. Semi-quantitative  
   d. Standard inoculation and streaking techniques  
   e. Swab  
   f. Loop sterilization  
      i. Reusable metal  
      ii. Plastic/disposable  
      iii. Calibrated  
   g. Streaking for isolation
h. Stab
i. Pipette
j. Automated plater

8. Determine appropriate media and conditions  
   Level 2
   a. Choose appropriate atmosphere
      i. Aerobic-ambient
      ii. Capneic (3-5%, 5-10%, microaerophilic)
      iii. Anaerobic
   b. Choose appropriate temperature
      i. 4 C
      ii. 25 C
      iii. 30 C
      iv. 35 C
      v. 42 C
   c. Humidity
   d. Determine appropriate length of incubation

9. Prepare direct microscopic smears of specimen  
   Level 2
   a. Prepare smear (one cell thick, dry, fixed)
   b. Stain smear appropriately
      i. Saline Wet mounts
      ii. Stained Wet Mounts
         1) Iodine
         2) KOH
         3) Methylene Blue
      iii. Gram
      iv. Spore
      v. Acid-fast
         1) Ziehl-Neelsen
         2) Kinyoun
         3) Modified Kinyoun
      vi. Fluorescent
         1) Acridine orange
         2) Auramine-rhodamine
         3) Calcofluor white
         4) Fluorescein conjugated (FITC)

10. Evaluate and interpret direct microscopic smears of specimen  
    Level 2
    a. Wet mounts and Vaginal wet preps
       i. Saline
       ii. Iodine
       iii. KOH
    b. Gram
11. Evaluate and quantitate microscopically  
   a. Bacteria  
      i. Structures  
      ii. Capsule  
      iii. Spores  
   b. Yeasts and hyphal elements  
   c. White and red cells  
   d. Epithelial cells - columnar and squamous, i.e. Clue cells  
   e. Artifacts and background material  
12. Quantitate organisms and cells  
13. Evaluate quality of specimen and assess clinical significance of findings according to guidelines  
14. Differentiate normal flora from potentially pathogenic organisms based on body site and specimen type  

E. **Bacterial Culture Examination**  
1. Distinguish colony morphologies  
   a. Staphylococci  
   b. Streptococci and Enterococci  
   c. Gram-negative cocci  
   d. Enterobacteriaceae  
   e. Pseudomonads  
   f. Other non-fermentative Gram-negative rods  
   g. Fastidious and other miscellaneous Gram-negative rods  
   h. Non spore-forming Gram-positive rods  
   i. Spore-forming Gram-positive rods  
   j. Branching and filamentous Gram-positive rods  
   k. Mycobacteria  
2. Differentiate common growth characteristics  
   a. Blood Agar media  
      i. Hemolysis (alpha/beta/gamma)  
      1) Double beta  
      2) Subtle or narrow zone  
   b. Selective Gram Negative media (i.e., MacConkey)  
      i. Fermenter vs. non-fermenter  
      ii. Detection of Hydrogen Sulfide (H2S)  
      iii. Lysine decarboxylation  
   c. Chocolate media  
      i. Modified Thayer Martin (MTM)  
   d. Campy-blood agar (BA)  
      i. Cefoperazone
ii. Vancomycin
iii. Amphotericin B (CVA)
e. Modified CCDA Medium
f. Colistin-nalidixic acid (CNA) blood agar
   i. Phenylethyl alcohol (PEA)
   ii. Mannitol salt agar (MSA)
g. Anaerobic media
   i. Anaerobic blood agar
   ii. Kanamycin-vancomycin laked (KVL)
   iii. Other anaerobic media (i.e., BBE, etc.)
h. Other media
   i. Group B selective broths
   ii. Routine enrichment broths
   iii. Mueller-Hinton
   iv. Chromogenic agar

3. Select for significant uncommon organisms using selective media
   Level 1
   a. Enrichment media
   b. Buffered charcoal yeast extract (BCYE)
   c. Stool selective media
   d. Corynebacterium selective media

4. Evaluate growth on primary isolation media
   Level 3
   a. Correlation of direct gram stain results and culture results
   b. Correlation of clinical diagnosis and specimen source
   c. Variations in colony morphology
      i. Colony characteristics
         1) Size
         2) Shape
            a) Elevation
            b) Form
            c) Margin
               i) Umbilicated
               ii) Swarming, etc.
            d) Surface appearance
               i) Mucoid
               ii) Transparent
               iii) Opaque, etc.
            e) Pigmentation
            f) Changes in media
               i) Hemolysis
               ii) Pitting
               iii) Fermentation, etc.
         3) Correlation of growth on different media
         4) Normal flora vs. potential pathogens
5) Characteristic odors of selected organisms
6) Growth quantitation

E. Organism identification

1. Apply principles of identification
   a. Limitations and sources of errors
   b. Troubleshooting according to set guidelines
   c. Sensitivity and specificity
   d. Environmental requirements atmosphere, growth temperature, etc.

2. Evaluate confirmatory identification tests (including rapid tests)

3. Perform confirmatory identification tests (including rapid tests)
   a. Catalase
   b. Oxidase/DMSO modified
   c. Coagulase
   d. TSI and KIA slants
   e. Methyl Red
   f. Phenylalanine deaminase (PAD)
   g. Amino acid (ornithine, arginine and lysine) decarboxylase, i.e., lysine iron agar (LIA)
   h. Acid production from carbohydrates
      i. Fermentation/oxidation
      r. Indole
      i. Tube
      ii. Spot
   r. Porphyrin (Delta aminolevulinic acid) (ALA)
   s. Pyrrolidonyl arylamidase (PYR)
   t. Salt tolerance
   u. Esculin hydrolysis
      i. Rapid
      ii. Bile esculin slant
   v. Hippurate hydrolysis
   w. H2S production
   x. Nitrate reduction
   y. Citrate utilization
   z. Urease
   aa. Butyrate esterase
   bb. Voges-Proskauer
   cc. Bile solubility
   dd. Growth factor requirement (X, V and XV)

3. Perform Disk identification tests
   a. Novobiocin
   b. Optochin (ethylhydrocupreine hydrochloride)
c. Special potency disks

d. Bacitracin

e. Beta lactamase

f. Growth factors (X, V, and XV)

g. Colistin, Kanamycin, Vancomycin

4. Choose other testing

a. Satellitism, i.e., *Staphylococcus aureus* streak

b. Motility

c. Aerotolerance

d. Colony fluorescence

5. Identify basic concepts of commercial identification systems

a. Non-automated

i. Miniaturized

ii. Rapid

   3) Substrate based

   4) Spot tests

b. Automated

i. Nucleic acid detection

   1) Nonamplified

      a) Hybridization probes

   2) Amplified, including but not limited to real time polymerase chain reaction (PCR)

   3) Maldi-TOF

   4) Microarray

6. Identify basic concepts of serological identification

a. Coagglutination

b. Latex agglutination

c. Urine antigen detection

d. Toxin detection

e. Immunofluorescent assays (Direct-DFA/Indirect-IFA)

f. Enzyme linked immunoabsorbant assay (ELISA)

g. Serotype

7. Utilize established algorithms and databases to establish identification

F. Clinically Significant Organisms

6. Isolate organisms listed below at the following identification levels:

   **Level 1**

   Can recall it

   Can identify it

   Can assess significance of culture findings based on identification and specimen site

   **Level 3**

a. Staphylococci

   i. **Staphylococcus aureus** (Level 3)

   ii. Methicillin-resistant *Staphylococcus aureus* (MRSA) (Level 3)

   iii. Vancomycin-intermediate *S. aureus* (VISA) (Level 3)
iv. Vancomycin-resistant *S. aureus* (VRSA) (Level 3)  
v. *Staphylococcus epidermidis* (Level 1)  
vi. *Staphylococcus saprophyticus* (Level 2)  
vii. *Staphylococcus lugdunensis* (Level 1)  
viii. Other coagulase-negative Staphylococci (Level 2)  
b. Micrococcus species (Level 2)  
c. Streptococci  
i. *Streptococcus pyogenes* (Group A) (Level 3)  
ii. *Streptococcus agalactiae* (Group B) (Level 3)  
iii. Other beta-hemolytic Streptococci (Level 3)  
iv. *Streptococcus pneumoniae* (Level 3)  
v. Viridans group (Level 3)  
vi. Alpha and non-hemolytic Streptococci (Level 2)  
d. Enterococcus, VRE,  
i. *Enterococcus faecalis* (Level 3)  
ii. *Enterococcus faecium* (Level 3)  
iii. Vancomycin resistant *Enterococcus* (VRE) (Level 3)  
e. Group D Streptococcus i.e., *S. gallolyticus* (previously *S. bovis*) (Level 3)  
Nutritionally variant streptococci (NVS) (Level 2)/Abiotrophia (Level 2)  
f. Aerobic Gram-positive cocci  
i. Leuconostoc spp (Level 1)  
ii. Lactococcus spp. (Level 1)  
iii. Gemella spp (Level 1)  
iv. Stomatococcus spp (Level 1)  
v. Pediococcus spp (Level 1)  
vi. Aerococcus (Level 1)  
g. Aerobic Gram-negative cocci  
i. *Neisseria gonorrhoeae* (Level 3)  
ii. *Neisseria meningitidis* (Level 3)  
iii. *Moraxella catarrhalis* (Level 3)  
h. Enterobacteriaceae  
i. *Escherichia coli* (Level 3)  
1) Enterohemorrhagic *E. coli* due to Shiga toxin  
2) Other diarrheagenic *E. coli*  
ii. *Shigella* sp. (Level 3)  
iii. *Edwardsiella tarda* (Level 2)  
iv. *Klebsiella* sp. (Level 3)  
1) *K. pneumoniae*  
2) *K. oxytoca*  
iv. *Enterobacter* sp. (Level 3)  
1) *E. aerogenes*
2) *E. cloacae*

v. *Serratia sp. (Level 3)*

vi. *Hafnia alvei (Level 1)*

vii. *Citrobacter sp. (Level 3)*

viii. *Salmonella spp., i.e., Salmonella enterica biovar typhi (Level 3)*

ix. *Proteus sp. (Level 3)*

1) *P. mirabilis*

2) *P. vulgaris*

x. *Providencia sp. (Level 1)*

xi. *Morganella morganii (Level 1)*

xii. *Yersinia enterocolitica (Level 3)*

h. Other facultative Gram-negative rods

i. *Vibrio spp (Level 3)*

6) *V. cholera*

7) *V. alginolyticus*

8) *V. parahaemolyticus*

9) *V. vulnificus*

ii. *Aeromonas sp. (Level 3)*

iii. *Campylobacter jejuni (Level 3)*

iv. *Helicobacter sp. (Level 1)*

i. Glucose non-fermenting Gram-negative rods

i. *Pseudomonas aeruginosa (Level 3)*

ii. *Other Pseudomonas species (Level 3)*

iii. *Stenotrophomonas maltophilia (Level 2)*

iv. *Burkholderia spp (Level 2)*

v. *Acinetobacter spp (Level 2)*

vi. *Alcaligenes (Level 2)*

vii. *Elizabethkingia meningoseptica*

viii. *Moraxella sp. (Level 2)*

j. HACEK and other fastidious Gram-negative rods

i. *Aggregatibacter aphrophilus* (previously known as *Haemophilus aphrophilus/H. paraphrophilus*) *(Level 1)*

ii. *Aggregatibacter actinomycetemcomitans* (previously known as *Actinobacillus actinomycetemcomitans*) *(Level 1)*

iii. *Cardiobacterium hominis (Level 1)*

iv. *Eikinella corrodens (Level 1)*

v. *Kingella sp. (Level 1)*

k. Other delicate/fastidious Gram-negative coccobacilli

i. *Bartonella spp. (Level 1)*

ii. *Bordetella sp. (Level 1)*

iii. *Brucella sp. (Level 1)*
iv. *Francisella tularensis* (Level 1)

v. *Haemophilus influenzae* (Level 3)
   1) Serotypes b and non-b
   2) Biovar aegyptius

vi. Other *Haemophilus sp.* (Level 2)

vii. *Legionella pneumophila* (Level 1)

viii. *Pasteurella multocida* (Level 2)

ix. *Capnocytophaga* (Level 1)

x. *Steptobacillus monoliformis* (Level 1)

li. Aerobic Gram-positive rods

i. *Gardnerella vaginalis* (Level 1)

ii. *Corynebacterium diphtheriae* (Level 1)

iii. Other *Corynebacterium species* (Level 2)

iv. *Listeria monocytogenes* (Level 1)

v. *Bacillus anthracis* (Level 1)

vi. *Bacillus cereus* (Level 2)

vii. Other *Bacillus sp.* (Level 2)

viii. *Erysipelothrix rhusiopathiae* (Level 1)

ix. *Nocardia sp.* (Level 1)

x. *Rhodococcus sp.* (Level 1)

xi. *Arcanobacterium heamolyticum* (Level 1)

xii. *Streptomyces* (Level 1)

m. Anaerobic Gram-positive rods

i. *Clostridium perfringens* (Level 3)

ii. *Clostridium difficile* (Level 2)

i. *Other Clostridia* (Level 1)

ii. *Propionibacterium acnes* (Level 2)

iii. *Mobiluncus sp.* (Level 1)

iv. *Actinomyces sp.* (Level 2)

v. *Lactobacillus sp.* (Level 2)

n. Anaerobic Gram-positive cocci

i. *Peptococcus* (Level 1)

ii. *Peptostreptococcus sp.* (Level 2)

o. Anaerobic Gram-negative rods and cocci

i. *Bacteroides fragilis group* (Level 3)

ii. *Bacteroides sp.* (Level 2)

iii. *Fusobacterium sp.* (Level 2)

iv. *Prevotella sp.* (Level 2)

v. *Veillonella sp.* (Level 1)

vi. *Porphyromonas spp* (Level 2)
p. Miscellaneous bacteria and organisms
   i. Treponema pallidum (Level 1)
   ii. Borrelia spp. (Level 1)
   iii. Leptospira interoogens (Level 1)
   iv. Mycoplasma (Level 1)
   v. Ureaplasma (Level 1)
   vi. Chlamydia (Level 3)
   vii. Rickettsia spp (Level 1)
   viii. Orientia tsutsugamushi (Level 1)
   ix. Ehrlichia spp (Level 1)
   x. Anaplasma phagocytophilum (Level 1)
   xi. Coxiella burnetii (Level 1)
   xii. Spirillum sp. (Level 1)

10. Identify public health and reference laboratories for special tests
    Level 1
    a. Reference laboratory resource information
    b. Specimen handling
       i. Packaging and shipping regulations
       ii. Safety precautions
       iii. Transport conditions
    c. Requisition information
    d. Records/documentation/protocols
    e. Cost

F. Antimicrobials
   1. Describe the mechanism of action of commonly used antimicrobials Level 1
   2. Apply standard performance principles and quality control to antimicrobial susceptibility tests Level 2
      a. Principles
      b. Limitations and sources of errors
      c. Troubleshooting according to set guidelines
      d. Sensitivity and specificity
      e. Quality control
   2. Describe and perform appropriate disk diffusion (Kirby Bauer) and antimicrobial gradient method (E-test) Level 2
      a. Media
         i. Depth
         ii. Supplements
         iii. Storage
      b. Inoculum
         i. Organism
         ii. Standardized suspension
iii. Time limit for inoculation
iv. Pattern of inoculation
v. Time limit for application of disks
vi. Disk placement
c. Incubation
   i. Time
   ii. Temperature
   iii. Atmosphere
d. Disk potency and storage
e. Reading
f. Interpretation
   i. Qualitative
   ii. Quantitative
g. Reporting
h. Special techniques
   i. Error detection and resolution according to predetermined criteria
3. Interpret Beta-lactamase detection
   Level 2
4. Identify and correlate organisms using Minimum inhibitory concentration (MIC) – micro-broth and automated systems
   Level 2
   a. Inoculum
   b. Selection of appropriate organism for method
c. Incubation
d. Reading
e. Interpretation
f. Reporting
g. Supplements and special techniques
h. Error detection and resolution according to predetermined criteria
   i. Minimum bactericidal concentration (MBC)
5. Perform molecular detection of resistance Level 2
6. Utilize Clinical and Laboratory Standards Institute (CLSI) guidelines Level 2
7. Perform susceptibility testing and special resistance detection methods on appropriate organisms Level 2
   a. Oxacillin resistance for Staphylococcus spp.
   b. Inducible clindamycin resistance for Staphylococcus, beta-hemolytic Streptococcus spp. and Streptococcus pneumoniae
   c. Vancomycin resistance for Staphylococcus and Enterococcus spp.
   d. High level aminoglycoside resistance for Enterococcus spp.
   e. Penicillin resistance for Streptococcus pneumoniae
   f. Extended spectrum beta-lactamases (ESBL) for Enterobacteriaceae
   g. ampC enzymes for Gram-negative rods
8. Interpret and evaluate susceptibility testing results according to established guidelines
   **Level 3**
   a. Qualitative
   b. Quantitative

9. Review susceptibility data and recognize unusual antimicrobial profiles according to set guidelines
   **Level 2**

10. Recognize “predictor” antimicrobial agents used to detect specific resistance mechanisms
    **Level 2**

11. Recognize multidrug-resistant organisms (MDRO)
    **Level 2**

12. Report data according to established guidelines and utilizing cascade and selective reporting
    **Level 2**

13. Relate antimicrobial agents to mode of action and spectrum of activity
    **Level 1**

14. Explain the common mechanisms of bacterial resistance
    **Level 1**

15. Recognize antimicrobials within each major class and by generic and brand name
    **Level 1**

16. Describe the function of other professionals to select appropriate drugs for testing
    **Level 1**
    a. Antibiotic usage committee
    b. Pharmacy
    c. Infectious disease clinicians
    d. Hospital epidemiologist/infection control committee
    e. Antiogram data

G. **Results**

1. Prioritize reporting of direct smears
   **Level 3**

2. Prepare (Level 2) culture reports and assure (Level 3) quality of results based on predetermined criteria
   a. Culture correlation with
      i. Direct Gram stain
      ii. Body site/specimen type
      iii. Patient history/population
      iv. Identification testing results
      v. Susceptibility testing results
      vi. Clinical significance of organisms
      vii. Other significant information
   b. Selective reporting of antimicrobials

3. Report normal flora appropriately
   **Level 1**

4. Designate preliminary or finalized status
   **Level 1**

5. Recognize (Level 2) and resolve (Level 3) issues according to predetermined criteria
   **Level 1**

6. Report cultures concisely, clearly and in a timely fashion
   **Level 1**

7. Document work performed
   **Level 1**
A. Basic principles of Clinical Mycology

1. Describe characteristics of fungi
   a. Classification, Taxonomy
      i. Scientific Classification by sexual reproductive structures
      ii. Clinical Classification by anatomic site of infection
         1) Systemic
         2) Subcutaneous
         3) Cutaneous
         4) Superficial
   b. Eukaryotic cells
   c. Reproduction
   d. Growth requirements
   e. Morphologic structures
      i. Yeast cells/Hyphae/pseudohyphae/mycelia
      ii. Conidiophores/metulae/phialides/vesicles
      iii. Conidia/blastoconidia/arthroconidia/micro and macrconidia/chlamydoconidia
      iv. Cleistothecia/perithecia/ascocarps/asci/ascospores
      v. Stolons/rhizoids/sporangia/columellae/apophyses/sporangiospores/zygosporo
      vi. Chlamydospores
      vii. Cleistothecia
      viii. Columella

B. Laboratory examination of fungal specimens

1. Describe proper collection methods
2. Discuss appropriate transportation and storage of specimen
3. Determine acceptability of specimen
4. Select appropriate media for culture of fungal specimens
   a. Primary isolation media
   b. Without antibacterial or antifungal agents
   c. With antibacterial agents (chloramphenicol, ciprofloxacin, gentamicin, penicillin or streptomycin)
   d. With antibacterial agents and antifungal agents (cyclohexamide)
   e. Dermatophyte test medium (DTM)
   f. Mycosel or mycobiotic agar
   g. Selective and differential for yeast, e.g., CHROMagar Candida
   h. Medial for demonstration of reproductive structures of molds
5. Discuss the purpose of each media preparation
   a. pH
   b. Antibacterial agents
c. Antifungal agents

6. Inoculate media using
   a. Aspirates, tissue, bone
   b. Blood and bone marrow
   c. CSF and other body fluids
   d. Upper and lower respiratory specimens
   e. Urine
   f. Hair, skin, nails

7. Discuss the influence on incubation
   a. Temperature
   b. Atmosphere
   c. Length of incubation and examination schedule

8. Perform (Level 2) and interpret (Level 3) direct microscopic smears of fungal specimen according to set guidelines
   a. KOH
   b. India ink
   c. Gram stain
   d. Lactophenol cotton blue
   e. Calcofluor white
   f. Acid fast
   g. Giemsa

9. Differentiate common yeasts and molds from bacteria on routine mycology media

10. Describe procedures for microscopic observation of fungi
    a. Cornmeal/rice (chlamydospore agars)
    b. Scotch tape preparation with LPCB
    c. Slide cultures
    d. Tease preparations with lactophenol cotton blue

11. Correlate patient history and clinical symptoms with growth on media, colonial morphology and microscopic structures to assist in identification of fungi and assessment of clinical significance
    a. Yeasts
       i. Candida
          1) C. abicans
          2) C. glabrata
          3) C. tropicalis
          4) Other Candida sp.
       ii. Cryptococcus
          1) C. neoformans
          2) Other Cryptococcus sp.
       iii. Trichosporon sp.
       iv. Geotrichum sp.
v. Malassezia spp., i.e., *M. furfur*
vi. *Rhodotorula sp.*

vii. *Saccharomyces sp.*

b. Dimorphic moulds

i. *Blastomyces dermatitidis*

ii. *Coccidioides* sp., i.e., *C. immitis*

iii. *Histoplasma capsulatum*

iv. *Sporothrix schenckii*

v. *Paracoccidioides braziliensis*

vi. *Talaromyces marneffei*

c. Brightly colored/hyaline molds

i. *Aspergillus* spp.

1) *A. fumigatus*

2) *A. flavus*

3) *A. niger*

4) Other *Aspergillus* species

ii. *Penicillium* sp.

iii. *Fusarium* spp.

iv. *Scopulariopsis*

v. *Paecilomyces*

vi. *Pseudoallescheria boydii*

vii. *Acremonium* spp

viii. *Chrysosporium* spp

ix. *Sepedonium* spp

d. Dermatophytes

i. *Microsporum* species

1) *M. canis*

2) *M. gypseum*

3) *M. gudouinii*

4) Other *Microsporum* species

ii. *Trichophyton* species

1) *T. mentagrophytes*

2) *T. rubrum*

3) *T. tonsurans*

4) Other *Trichophyton* species

iii. *Epidermophyton floccosum*

e. Zygomycetes

i. *Rhizopus* spp.

ii. *Mucor* spp.

iii. *Absidia* spp.

iv. *Rhizomucor* spp
v. *Cunninghamella* spp  
vi. *Syncephalastrum* spp  
f. other fungi  
i. *Pneumocystis jiroveci*

12. Describe test methodologies for fungi identification    
   a. Principles  
   b. Limitation and sources of errors  
   c. Troubleshooting according to set guidelines  
   d. Sensitivity and specificity  
   e. Rapid and traditional testing methods  
      i. Assimilation/fermentation  
      ii. Temperature tolerance  
      iii. Mold/yeast conversion  
      iv. Wood’s lamp fluorescence  
      v. In-vitro hair perforation  
      vi. Germ tube production  
      vii. Antigen detection methods  
         1) Cryptococcal antigen  
      viii. Commercial methods  
     iii. Molecular methods

13. Utilize databases and reference materials in identification of fungi
Parasitology – MLS Entry Level Curriculum

A. Taxonomy and terminology for categories of parasites
   1. Describe the distinguishing characteristics of parasite categories
      Level 1
      a. Nematodes (roundworms)
         i. Tissue and blood
         ii. Intestinal
      b. Cestodes (tapeworms)
      c. Trematodes (flukes)
      d. Protozoan
      e. Amebae
      f. Flagellates
      g. Sporozoa
         i. Plasmodium spp.
         ii. Coccidia
      h. Ciliates
   2. Recognize characteristic structures of adults, larvae, ova, cysts, trophozoites, etc.
      Level 2

B. Define the stages and structures associated with parasite identification
   Level 1
   1. Trophozoite
   2. Cyst
   3. Egg
   4. Larvae
   5. Rhabditiform
   6. Filariform
   7. Microfilaria
   8. Sheath
   9. Rostellum
   10. Hermaphrodite
   11. Proglottids
   12. Intermediate host
   13. Definitive host
   14. Operculum
   15. Brood capsule
   16. Hydatid cyst or sand
   17. Schizont
   18. Schuffner’s dots/Maurer’s dots
   19. Merozoites
   20. Gametocyte
   21. Undulating membrane
   22. Parabasal body
23. Chromatoid body
24. Glycogen vacuole
25. Karyosome
26. Nucleus
27. Peripheral chromatin
28. Sporogony
29. Schizogony
30. Abopercular knob
31. Scolex
32. Uterine branches
33. Vector
34. Shoulder
35. Hexacanth larva
36. Corticate/mammilate
37. Axostyle
38. Kinetoplast
39. Axoneme
40. Cercaria
41. Coracidium
42. Miracidium
43. Flame cell

C. Specimen Collection and handling
1. Determine specimen acceptability in parasitic identification Level 3
   a. Collection method
   b. Collection time/receipt time
   c. Specimen storage
   d. Number of specimens
   e. Presence of interfering or contaminating substances
   f. Preservatives for parasitic specimen
      i. Polyvinyl alcohol (PVA)
      ii. 10% Formalin
      iii. Schaudinn solution (mercury free)
      iv. Sodium acetate-acetic acid-formalin (SAF)
      v. Less toxic single tube systems
   g. Rejection criteria

C. Examination of specimens
1. Examine the specimen macroscopically Level 2
   a. Color
   b. Presence of blood or mucous
   c. Consistency (watery/Loose,semisolid,formed)
d. Worm components (proglottids, adult, scoleces, etc)

2. Describe direct microscopic examination of specimen  
   a. Proper use of the microscope, objectives, and light source
   b. Use of ocular micrometer for measurement of size
      i. Calibration
   c. Use of direct wet mounts with saline and iodine preparations
   d. Systematic examination of prepared slide
   e. Detection of parasites

3. Select and perform appropriate concentration methods and stains  
   a. Principles
   b. Limitations and sources of errors
   c. Trouble-shooting according to set guidelines
   d. Sensitivity and specificity
   e. Quality control
   f. Concentration methods
      i. formalin-ethyl acetate
      ii. alternate solvents sedimentation
   g. Permanent stained smears
      i. trichrome/modified trichrome
      ii. iron-hematoxylin
      iii. modified Kinyoun (acid-fast)
      iv. Calcofluor white
      v. Auromine O
   h. Preparations of reagents and stains
      i. Preparation of malarial smears
         i. Thick smears
         ii. Thin smears

4. Explain the detection and differentiation of specific parasites  
   a. Immunoassays
   b. Nucleic acid assays

5. Detect and identify the following parasites at the following identification levels"
   Can recall it  
   Can identify/recognize it  
   **Level 2**
   a. Nematodes
      i. Intestinal
         1) *Ascaris lumbricoides* **(Level 2)**
         2) *Strongyloides stercoralis* **(Level 1)**
         3) Hookworm **(Level 2)**
            a) *Necator spp.*
            b) *Ancylostoma spp.*
4) *Trichuris trichiura* (Level 2)
5) *Enterobius vermicularis* (Level 2)

ii. Blood and tissue
1) *Trichinella spiralis* (Level 1)
2) *Wuchereria bancrofti* (Level 1)
3) *Brugia malayi* (Level 1)
4) *Loa loa* (Level 1)
5) Mansonella (Level 1)
6) *Onchocerca volvulus* (Level 1)
7) *Dracunculus medinensis* (Level 1)

b. Cestodes
i. *Taenia solium* (Level 2)
ii. *Taenia saginata* (Level 2)
iii. *Echinococcus granulosus* (Level 1)
iv. *Diphyllolothrium latum* (Level 2)
v. *Hymenolopis nana* (Level 2)
vi. *Hymenolopis diminuta* (Level 1)

iii. Flagellates
1) *Giardia lamblia/intestinalis* (Level 2)
2) *Trichomonas vaginalis* (Level 2)
3) *Dientamoeba fragilis* (Level 2)
4) *Chilomastix mesnili*

iii. *Trypanosoma spp.* **(Level 1)**

iv. *Leishmania spp.* **(Level 1)**

v. *Sporozoa* **(Level 2)**
   1) *Plasmodium spp.*
   2) *Babesia spp.*
   3) *Cryptosporidium parvum*
   4) *Cystoisospora belli*
   5) *Cyclospora*

e. Ciliates
   i. *Balantidium coli* **(Level 2)**

6 Correlate information in order to identify parasites according to set guidelines **(Level 3)**
   i. Diagnostic stage, i.e., characteristic structure(s) present
   ii. Knowledge of life cycle
   iii. Specimen of choice for detection
   iv. Detection methods available

7 Differentiate artifact from parasites **(Level 2)** and differentiate **(Level 3)** them from parasites
   i. White and red blood cells
   ii. Epithelial cells
   iii. Pollen granules
   iv. Vegetable fibers and cells
   v. Yeast cells
   vi. Charcot-Leyden crystals
   vii. Fungal spores (morels)
   viii. Diatoms
   ix. Hair

8 Examine specimens other than stool **(Level 1)**
   i. Cellophane tape/vaspar paddle preparation for *Enterobius vermicularis*
   ii. Wet mount/culture for *Trichomonas species*
   iii. Duodenal capsule or string technique (Entero-Test)
   iv. Thick and thin blood films
   v. Bone marrow and body fluids
   vi. Urine
   vii. Lower respiratory
   viii. Biopsy
Mycobacteriology – MLS Entry Level Curriculum

A. General Characteristics
1. Describe the general characteristics of mycobacteria Level 1
   a. Acid-fastness
   b. Growth requirements
   c. Rate of growth
   d. Atmosphere requirements
   e. Temperature

B. Specimen management
1. Identify the safety requirements for working with mycobacteria Level 1
   a. Biological safety cabinet (BSC/Biosafety level (BSL)
   b. Personal protective equipment
      i. Respirator
      ii. Gloves
      iii. Liquid impervious gowns
      iv. Centrifuges with safety carriers
      v. Germicides
   c. Equipment
   d. Negative pressure facility
   e. Annual tuberculin skin test
      i. Chest x-ray if skin test is positive
      ii. Effects of BCG vaccine
2. Discuss specimen collection and transportation procedures Level 1
   a. Pulmonary sites
      i. Sputum, expectorated and induced
      ii. Bronchial alveolar lavage (BAL), bronchoscopy, etc.
   b. Extrapulmonary sites
      i. Non-contaminated
         1) Blood and bone marrow
         2) Body fluids
         3) Tissue
      ii. Contaminated
         1) Urine
         2) Skin lesions, wound, abscesses
         3) Gastric lavage or aspirate
         4) Stool for Mycobacterium avium complex
      iii. Blood for interferon gamma release assay (QuantiFERON – TB test)
   c. Collection method/site preparation
      i. Container
ii. Collection time
iii. Number of specimens
iv. Quality
v. Optimum volume
vi. Rejection criteria

3. Describe (Level 1) and utilize (Level 2) specimen processing procedures
   i. Contaminated specimens
      1) Digestion and decontamination
         a) Liquefaction
         b) Decontamination
         c) Centrifugation
            i) Speed
            ii) Time
            iii) Equipment required
         d) Limitations and potential sources of errors
         e) Quality assurance, e.g., maintenance of a contamination rate of 3-5%
   ii. Non-contaminated specimens
      1) Centrifugation
      2) Direct inoculation

C. Smears and Stains
   1. Discuss the preparation, staining and screening of smears
      Level 1
      a. Specimen selection
         i. Smear preparation, standardization, fixation
            1) Direct
            2) Concentrated
            3) Cytocentrifugation with bleach
      b. Stains
         i. Reagent preparation
         ii. Acid-fast stain procedures
            1) Principle
            2) Acid-fast: fuchsin
               a) Ziehl-Neelsen
               b) Kinyoun
            3) Acid-fast: fluorochrome
               a) Auramine O
               b) Auramine-rhodamine
         iii. Quality control
         iv. Limitations and potential sources of errors
         v. Troubleshooting and according to set guidelines
         vi. Sensitivity and specificity
c. Microscopic evaluation
   i. Magnification
   ii. Scanning pattern
   iii. Organism morphology, e.g., serpentine cording
   iv. Specificity
   v. Sensitivity

2. Describe specimen processing Level 1
   a. Digestion
   b. Decontamination
   c. Concentration

3. Describe the interpretation and reporting of smear Level 1
   a. Sources of false positives
      i. Nocardia
      ii. Rhodococcus
      iii. Cryptosporidium, Cystoisospora and Cyclospora oocysts
      iv. M. gordonae from a tap water source
      v. Other
   b. Appearance of artifacts, debris, background
   c. Reporting scheme
   d. Internal review process for quality assurance

D. Culture medium
1. Describe the culture media most appropriate for primary cultures by specimen type Level 1
   a. Egg-based
      i. Lowenstein-Jensen
   b. Agar-based
      i. Middlebrook 7H10 and 7H11
   c. Liquid based
      i. Middlebrook 7H9, 7H12 and 7H13
   d. Commercial systems
   e. Other

2. Discuss the incubation of the primary media Level 2
   a. Describe optimal temperature to isolate mycobacteria
      i. 35 degrees C vs. 37 degrees C
      ii. 25-33 degrees C
   b. Describe the optimal atmospheres of incubation
   c. Describe the optimal length of incubation
   d. Reading schedule for inoculated media

E. Identification
1. Describe the identification of isolates using established algorithms and databases Level 1
a. Acid-fastness of the organism
b. Preferred temperature of growth
c. Rate of growth
   i. Rapid grower (< 7 days)
   ii. Slow grower (> 7 days)

2. Colony morphology
   i. Pigment
      1) Photochromogen
      2) Scotochromogen
      3) Non-chromogen

F. Discuss common testing
   Level 1
1. Biochemical testing
2. Other methods for organism identification
   a. Molecular diagnostics
   b. Amplification methods for direct detection of Mycobacterium tuberculosis
3. Describe mycobacteria based on key criteria
   a. Mycobacterium tuberculosis complex
   b. M. tuberculosis
   c. Mycobacterium avium-intracellulare complex (MAC or MAI)
   d. M. ulcerans
   e. M. xenopi
   f. M. kansasii
   g. M. marinum
   h. M. gordonae
   i. M. scrofulaceum
   j. M. chelonae
   k. M. abscessus
   l. M. leprae
4. Correlate the presence of organisms with the most common types of clinical infections and clinical significance according to set guidelines
   a. Routes of transmission
   b. Signs and symptoms

G. Reporting
1. Describe the turnaround time and reporting of direct smear, culture, and susceptibility results
   Level 1
A. Characteristics of viruses

1. Describe the basic structure/components of viral agents
   a. Virion
      i. Type of nucleic acid present (RNA or DNA)
      ii. Capsid
      iii. Envelope
      iv. Glycoprotein spikes

2. Differentiate viruses from bacteria
   a. Requirement for living cells
   b. Size
   c. Structure
   d. Replication
   e. Therapy

B. Classification of viruses

1. Outline the criteria for classifying or grouping viruses
   a. Nucleic acid type (RNA or DNA)
   b. Host
   c. Size and morphology
   d. Type of replication

2. Correlate agents of infections infection with disease or pathologic manifestations and route of transmission
   a. Hepatitis viruses
   b. Simplex virus, Herpesvirus 1 and 2
   c. Cytomegalovirus (CMV)
   d. Varicella-Zoster virus (VZV)
   e. Influenza virus A
      i. H1N1
      ii. H5N1
   f. Influenza virus B
   g. Respiratory syncytial virus (RSV)
   h. Coronavirus
      i. SARS related coronavirus
   j. Middle Eastern Respiratory Syndrome coronavirus (MERS)
   k. Human Papillomavirus (HPV)
   l. Eastern and Western equine encephalitis virus
   m. Arenavirus
      i. Lassa virus
n. Human T lymphocytic virus
o. Ebola
p. Enteroviruses
   i. Poliovirus
   ii. Coxsackievirus
   iii. Enterovirus
   iv. Rhinovirus
   v. Echovirus
q. Hantavirus
r. Parvovirus B19
s. Flaviviruses
   i. West Nile virus
   ii. St. Louis Encephalitis virus
   iii. Dengue virus
   iv. Yellow fever virus
   v. Zika virus
t. Parainfluenza virus
u. Adenovirus
v. Epstein-Barr virus (EBV)
w. Marburg virus
x. Rabies virus
y. Metapneumovirus
z. Measles virus
aa. Norwalk virus
bb. Rift Valley Fever virus
cc. Rotavirus
dd. Rubella virus
e. Mumps virus
ff. Smallpox
g. Vaccinia virus
hh. Human Immunodeficiency virus
ii. Polyomavirus

C. Specimen collection and processing
   1. Discuss important information for specimen collection and processing of specimens Level 1
      a. Selection of body site/Specimen type
      b. Collection methods, devices and containers
c. Safety precautions  
d. Transport media  
e. Temperature  
f. Time  
2. Utilize proper specimen storage upon receipt in laboratory  
3. Utilize proper specimen shipment methods are used  
4. Utilize specimen processing algorithms based on most likely virus present  
   a. Rejection criteria  
   b. Specimen type/body site  
   c. Specimen preparation  
   d. Age of patient  
   e. Time of year/virus seasonality  
   f. Virus suspected  
   g. Immune status  

D. **Laboratory procedures**  
1. Describe laboratory procedures for detection of viral agents and particles  
   a. Principles  
   b. Limitations and sources of errors  
   c. Troubleshooting according to set guidelines  
   d. Sensitivity and specificity  
   e. Quality control  
   f. Direct detection methods  
      i. Immunodiagnostic  
         1) Direct and indirect immunofluorescent  
         2) Antibody methods  
         3) Enzyme immunoassay methods (EIA)(ELISA)  
      ii. Molecular methods  
      iii. Cell culture systems  
      iv. Serology
A. Disease transmission
1. Define terms associated with disease transmission Level 1
   a. Epidemiology
   b. Community acquired infections
c. Nosocomial infections
d. Epidemic
e. Endemic
f. Outbreak
g. Cluster
h. Surveillance
i. Morbidity
j. Mortality
2. Describe the origin and mode of spread Level 1
   a. Droplet
   b. Airborne
c. Fomite
d. Vector
e. Reservoir
f. Endogenous
g. Exogenous
3. Compare and contrast Level 2
   a. Colonization
   b. Infection
c. Carrier state

B. Infection prevention methods
1. Relate underlying patient condition/factors to acquisition of infection Level 1
   a. Medical devices (Catheters, respirator)
b. Immunocompromised
c. Immunosuppressive therapy
d. Antimicrobial therapy
e. Malignancy
f. Age
g. Occupation
h. Surgery
i. Prosthetic devices (pacemaker, artificial heart valve, shunt, joint)
2. Apply concepts of disease transmission to disease prevention Level 2
a. Education
   i. Health care professionals
   ii. Patients
   iii. Environmental services (housekeeping)
b. Precautions
   i. Standard Precautions
   ii. Transmission-based
      1) Direct and indirect contact
      2) Droplet
      3) Airborne
   iii. Immunizations
   iv. Treatment
      1) Antibiotics
      2) Antiviral
      3) Antifungal
      4) Antiparasitic

C. Role of clinical microbiology laboratory
   1. Culture microbial pathogens
      a. Common bacteria
      b. Multiple drug resistant organism (MDRO)
      c. Mycobacteria
      d. Fungi
      e. Unusual organisms
      f. Viruses
      g. Parasites
   2. Identify common bacteria through interpretation of culture, microscopic, or rapid testing
   3. Detect microbial organisms through microscopic or rapid testing
      a. Mycobacteria
      b. Fungi
      c. Unusual organisms
      d. Viruses
      e. Parasites
   4. Determine when to report relevant cultures/organisms to infection control personnel
   5. Assist medical laboratory scientists with surveillance of infectious diseases
      a. Environmental samples
      b. Personnel specimens
      c. Patient specimens
      d. Rapid diagnostic testing
e. Organism identification
f. Antimicrobial susceptibility testing
g. Epidemiologic analysis of microorganisms
   i. Phenotypic techniques
   ii. Genotypic techniques
6. Report communicable diseases/organisms to the appropriate public health agencies **Level 2**
7. Monitor for bioterrorism agents and emerging infections **Level 2**
   a. Centers for Disease Control (CDC) categories of organisms
   b. CDC laboratory response network
   c. Specimen packing and shipping
   d. Biosafety
   e. Protocols to rule in/rule out critical agents
8. Maintain adequate archival information **Level 2**
   a. Data
      i. Health Insurance Portability and Accountability Act of 1996 (HIPAA)
   b. Organisms
      i. Patient
      ii. Personnel
      iii. Surveillance/environmental
9. Handle and dispose of biohazard materials **Level 2**
   a. QC of autoclaves
   b. Identification of biological, pathological, and surgical infectious materials
   c. Cleaning, sterilization, disinfection
   d. Laboratory safety procedures manual
   e. Aseptic technique
A. **Quality management (Also covered in Laboratory Administration)**

1. Follow policies and procedures
   
2. Perform (Level 2) procedures and review (Level 3) results of standard quality control
   
   a. Media
   
   b. Stains
   
   c. Reagents/kits
   
   d. Equipment
   
   e. Physiological tests
   
   f. Antimicrobial testing
   
   g. Serological tests
   
   h. Stock organisms
   
   i. Inventory
   
   j. Automated systems
   
   k. Immunological test
   
   l. Microscope calibration

3. Recognize (Level 2) and resolve (Level 3) errors according to set guidelines

4. Participate in data collection for a quality management plan

5. Assist in the education and training of others

   a. Laboratory science students

   b. Healthcare personnel

   c. Co-workers

6. Maintain knowledge and skills through continuing education

B. **Laboratory Safety (Also covered in General Lab Practice)**

1. Describe (Level 1) and utilize (Level 2) accepted safety precautions to prevent laboratory acquired infections

   a. Standard Precautions
      
      i. Handwashing

      ii. Protective clothing/devices

   b. Engineering controls
      
      i. HEPA filtration

      ii. Ultraviolet germicidal irradiation

      iii. Negative pressure room

   c. Emergency action protocol

   d. Training

   e. Health care facilities
      
      i)     Emergency care
ii) Respiratory fit testing

iii) Treatment

f. Aseptic techniques
g. Handling and disposal of sharps
h. Use of biological safety cabinets
i. Center for Disease Control and Prevention (CDC)/biological safety level (BSL) classification
   i. Classifications of BSL requirements
   ii. Correlation of specific organisms and required BSL
j. Bio-hazardous materials discard
k. Decontamination, disinfection, sterilization
l. Emergency first aid, eye wash, showers
m. Immunizations
n. Employee health services

2. Take immediate and appropriate action when an incident occurs Level 3

3. Describe the procedures for prevention of aerosolization of microbial agents (mycobacteria and other bacteria, fungi, and viruses) Level 1
   a. Aseptic techniques
   b. Containment procedures
c. Decontamination, disinfection, sterilization
d. Centrifuge use
e. Bio-hazardous materials discard

4. Describe the collection and discard of infectious waste materials Level 1
   a. Environmental Protection Agency (EPA)/state regulations
   b. Definition of infectious waste

5. Discuss hazards of chemicals in the workplace Level 2
   a. Safety data sheets (SDS)
   b. Storage, labeling and use
      i. Physical hazards
         1) Flammable
         2) Oxidizer
         3) Corrosive
      ii. Health hazards
         1) Toxicity
         2) Carcinogenicity
      iii. Environmental hazards

6. Outline fire safety guidelines Level 2
   a. Fire protocol (RACE - rescue, alarm, contain, extinguish)
   b. Classes of fire extinguishers
   c. Fire evacuation plan
d. Fire extinguisher protocol (PASS - pull pin, aim, squeeze, sweep base of fire)
C. **Laboratory Information System (LIS)**

1. Describe data entry
   a. Automated/Manual

2. Describe the reporting of data

3. Discuss data retrieval to provide relevant information for microbiology
   a. Analysis
   b. Integration
   c. Antibiogram

4. Describe the retrieval of information by clinics/providers
   a. Results
   b. Services provided
   c. Specimen handling
   d. Education

D. **Administrative tasks**

1. Explain the responsibilities of laboratory management (also covered in Laboratory Administration)
   a. Personnel
      i. Safety
      ii. Training
      iii. Proficiency
      iv. Competency
   b. Physical facilities
   c. Communication
      i. Public health authorities
      ii. Infection prevention/epidemiology
      iii. Service providers/clinicians
      iv. Administration
      v. Education
      vi. HIPAA
      vii. Finance, i.e., cost containment
**Deletions - Microbiology**
CAMP
Perform confirmatory identification tests (including rapid tests)
- Hemolysis on Horse blood
- Beta-glucuronidase (MUG)

**Additions - Microbiology**
Prions
Staphylococcus lugdunensis
virdans Streptococci
Enterococcus faecalis; Enterococcus faecium; Vancomycin resistant Enterococcus (VRE)
Group D Streptococcus ie S. gallolyticus (previously S. bovis)
Abiotrophia
Moraxella catarrhalis
Edwardsiella tarda
Vibrio alginolyticus
Vibrio paraohamaolyticus
Vibrio vulnificus
Aggregatibacter aphrophilus (previously known as Haemophilus aphrophilus/H. paraphrophilus)
Aggregatibacter actinomycetemcomitans (previously known as Actinobacillus actinomycetemcomitans)
Capnocytophaga
Steptobacillus monoliformis
Eggerthella
Orientia tsutsugamushi
Anaplasma phagocytophilum
Coxiella burnetii
Spirillum spp

**Additions - Mycology**
Rhodotorula spp
Saccharomyces spp
Penicillium marneffei
Acremonium spp
Chrysosporium spp
Sepedonium spp
Rhizomucor spp
Cunninghamella spp
Syncephalastrum spp

**Additions - Parasitology**
Heterophyes heterophyes
Metagonimus yokagawai
Naegleria fowleri
Chilomastix mesnili
Trichinella spiralis
Wuchereria bancrofti
Brugia malayi
Loa loa
Mansonella
Onchocerca volvulus
Dracunculus medinensis

**Additions - Mycobacteria**
M. ulcerans
M. xenopi
M. kansasii
M. marinum
M. gordonae
M. scrofulaceum
M. chelonae
M. abscessus
M. leprae

**Additions - Viruses**
SARS related coronavirus
Poliovirus
Coxsackievirus
Enterovirus
Rhinovirus
Echovirus
Hantavirus
Parvovirus B19
Flaviviruses: West Nile virus, St. Louis Encephalitis virus, Dengue virus, Yellow fever virus
MERS
Rift Valley Fever virus
1. Basic Foundation Concepts
   a. Describe a brief history of the development of molecular diagnostics Level 1
   b. Discuss the impact molecular diagnostic will have on:
      i. Laboratory medicine Level 1
      ii. Diagnosis and management of diseases
      iii. Ethical implications
   c. Discuss the basic functions of DNA Level 1

2. Nucleic Acid Biochemistry
   a. Discuss/diagram RNA, DNA, and genome structure Level 1
      i. Pairing of nitrogen bases
         1. Chargaff rules
         2. Pyrimidine, purine
      ii. Complementary rule
      iii. Sugars found in DNA and RNA
   b. Explain semi-conservative DNA replication Level 1
      i. Origin or replication (eukaryote vs prokaryote)
      ii. Leading strand
      iii. Lagging strand
      iv. Primase
      v. Okazaki fragments
   c. Describe DNA Level 1
      i. Central dogma
      ii. Transcription
         1. Polarity (5’, 3’)
         2. Nucleosides, Nucleotides
         3. Template strand
      iii. Translation
         1. Codons/anticodons
         2. Ribosomes
         3. Genetic code
         4. Degeneration
         5. Wobble rule
      iv. Extrachromosomal (plasmid, mitochondrial transmission)
   d. Compare and contrast viral, bacterial, eukaryotic Level 2
      i. Complexity
      ii. Shape
      iii. Nucleic acid content

3. Genetics
   a. Describe chromosome morphology Level 1
   b. Define the various changes in chromosomal structure, such as inversion, duplication, deletion, translocation and isochromosome Level 1
   c. Explain the various changes in chromosomal number, such as: aneuploidy, monosomy, trisomy, nondisjunction and polyploidy Level 1
   d. Discuss Mendelian and non-Mendelian Genetics Level 1
   e. Define: carrier, penetrance, founder affect, incomplete dominance Level 1
   f. Determine disease carriage state using punnet squares Level 2
g. Describe inherited disease patterns, such as: autosomal dominant, autosomal recessive, X-linked Dominant, X-linked recessive Level 1

h. Provide specific examples of diseases that follow each type of inheritance pattern Level 1

i. Interpret a pedigree to determine the inheritance pattern Level 2

j. Compare and contrast single-gene disorders, polygenic disorders and chromosomal disorders Level 2

4. Molecular Methodologies
   a. Describe nucleic acid extraction/isolation/quantitation/purification techniques Level 1
      i. Purpose
      ii. Molecules that interfere
      iii. Conditions to consider when choosing method of extraction
      iv. Reagents and purpose
      v. Acceptable specimen types
      vi. Advantages and disadvantages of solid phase extraction vs. liquid phase

   Calculation of DNA and RNA concentration and yield and acceptability/contamination

   b. Discuss nucleic acid modifying enzymes Level 1
      i. Storage criteria
      ii. Nomenclature
      iii. Enzyme inactivation
      iv. Function of a restriction endonuclease and the two types of cuts
      v. Basic function of the following enzymes
         1. Endonucleases
         2. Exonucleases
         3. Ligases
         4. Polymerases
         5. Reverse transcriptases
         6. Phosphatases
         7. Kinases

   c. Discuss nucleic acid Electrophoresis Level 1
      i. Role of size, charge, and shape or conformation in migration/movement
      ii. Components, staining methods, safety consideration and waste disposal
         1. Ethidium bromide staining
         2. Other staining methods
      iii. Electrophoresis methods
         1. Agarose
         2. Polyacrylamide gel electrophoresis (PAGE)
         3. Pulse Field
         4. Capillary

   d. Compare and contrast blotting techniques
      1. Western, Northern, and Southern blotting
      2. Nucleic substance tested (DNA,RNA, protein)
      3. Consider the following variables when performing various blotting techniques
         a. Restriction fragment length polymorphism (RFLP)
         b. Stringency
         c. Hybridization
      4. Pros and Cons of each method
Molecular Diagnostics
Medical Laboratory Scientist: Entry Level Curriculum

e. Discuss amplification Techniques Level 1
   i. polymerase chain reaction (PCR).
      1. Amplification reaction
      2. Cycle (denature, anneal, extend)
         a. Thermocycler use
      3. Stringency
      4. Fluorescent resonance energy transfer (FRET)
      5. Melt-curve analysis and validity
         a. Melting temperature (Tm), including the calculation
      6. Components/concentration
         a. Primers
         b. Primer-dimers
         c. DNA template, bases, polymerase
         d. Buffer
     7. Probe assays
     8. Master mix
     9. Amplicons
   ii. Amplification assays Level 2
       1. Target amplifications
          a. Polymerase Chain Reaction (PCR)
          b. Differentiate PCR modification techniques (end-point vs real time)
             i. Real time PCR
             ii. Nested PCR
             iii. Multiplex PCR
             iv. Reverse transcription – PCR (RT-PCR)
          c. Transcription mediated amplification (TMA)
      2. Probe amplification
      3. Signal amplification

f. Explain the purpose of florescence in situ hybridization (FISH) Level 1

g. Explain DNA sequencing methods Level 1
   i. Sanger chain termination sequencing (level 2) and the role of ddNTPs
      1. Define:
         a. Deoxynucleosidetriphosphates (dNTP)
         b. Dideoxynucleosidetriphosphates (ddNTP)
      ii. Automatic fluorescent sequencing
      iii. Pyrosequencing
      iv. Array sequencing
      v. Next-generation sequencing (NGS)

h. Discuss microarray/Arrays Level 1
   i. General concept
   ii. Specific uses and clinical applications

5. Mutations and polymorphisms Level 1
   a. Define:
      i. Mutations
      ii. Polymorphisms
iii. Single nucleotide polymorphism (SNP)
iv. Short tandem repeats (STRs)
v. Variable numbers of tandem repeats (VNTRs)
b. Distinguish among DNA gene, chromosomal, and genome mutations  Level 2
c. Evaluate a small gel sequence result (visual representation)  Level 3
d. Define genotype versus phenotype  Level 1

6. Laboratory Operations, Quality Control and Quality Assurance in the molecular laboratory
   a. State variables of concern for pre-analytical  Level 1
      i. Test request
      ii. Acceptable specimen types
      iii. Specimen collection/handling
         1. DNA vs RNA
         2. Temperatures and timing
      iv. Informed consent
   b. State variables for the analytic phase  Level 1
      i. Specimen extraction and storage
      ii. Lab design
      iii. Contamination monitoring
      iv. Contamination prevention
         1. Unidirectional (clean to dirty) workflow in the molecular laboratory
         2. Function of RNases/DNases
      v. QC/preventive maintenance
   c. Define Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP)  Level 1
d. Discuss the importance of test validation  Level 1
e. Recognize the complexity of reporting patient results, including laboratory test regulations, as they pertain to:  Level 1
      i. Analyte specific reagent (ASR)
      ii. Research use only (RUO)
      iii. In vitro diagnostics (IVD)
      iv. Lab developed test (LDT)
      v. Personnel training and competency
   f. State concerns for the post-analytical phase  Level 1
      i. Reporting of results
      ii. Follow-up recommendations
      iii. Confidentiality
   g. Evaluate controls and patient results for acceptability  Level 3
      i.
h. Troubleshoot questionable or invalid results  Level 2
      i. Specimen issues
      ii. Procedural issues
      iii. Instrumentation problems
i. Compare and contrast: Level 2
   i. Clinical sensitivity
   ii. Clinical specificity
   iii. Accuracy
   iv. Precision

j. Discuss the clinical applications and impact of molecular testing on the following: Level 1
   ii. Oncology/hematopathology
   iii. Solid tumors
   iv. Forensics
   v. Infectious disease
      a. Detection monitoring
      b. Qualitative vs quantitative viral load
      c. Genotyping of virus/resistance
      d. Time results
      e. Commonly tested/examples – usually nucleic acid amplification PCR methods
   vi. Blood Bank
   vii. HLA typing
   viii. Inherited diseases
      i. Define
         1. Allele
         2. Chimerism
         3. Diploid
         4. Haploid
         5. Methylation in terms of gene expression
         6. transformation

k. Discuss the inheritance and mutations involved in inherited diseases, such as: Level 1
   i. Cystic fibrosis
   ii. Fragile X
   iii. Huntington’s disease
   iv. Prader-Wille/Angelmann disorder
   v. Thalassemias (alpha and beta)
   vi. Sickle cell anemia
   vii. Other inherited disorders

ix. Epigenetics
x. Bacteriology
   i. Antibiotic resistance
   ii. Epidemiology
xi. HLA typing
   i. Transplantation
   ii. Parentage/kinship

xii. Define Pharmacogenetics/genomics
   i. Cytochrome p450

xiii. Role in evidence based medicine
xiv. Consider the various ethical implications of molecular methodologies
   i. Discrimination
   ii. Confidentiality
   iii. Informed consent
MLS Entry Level Curriculum
Phlebotomy

The Health Care System and Services
Demonstrate a knowledge and proficiency in the use of computers as related to job duties and responsibilities Level 2

Define and utilize health professions/medical terminology pertinent to phlebotomy, laboratory testing, and patient care Level 2

Patient and laboratory safety
List and discuss precautions, practices and procedures to assure patient safety  Level 1
  o Correct identification of patients
  o Communication and its applications to patient safety
  o Use of proper equipment and procedures for specimen/sample collection
  o Identification and avoidance of safety risks including but limited to nerve damage.
  o Preventing errors in specimen/sample collection
  o Preventing errors in point-of-care testing
  o Relevance of specimen/sample collection to preventing errors in testing procedures
  o Identification of improper specimens/samples and the impact on testing, e.g., hemolysis, insufficient blood collected in tubes with anti-coagulant, improper draws, etc.

Identify and/or perform emergency procedures necessary for survival of patients/clients in the health care setting limited to scope of training and practice  Level 2
  o Cardiopulmonary resuscitation (CPR)
  o First aid techniques to prevent bleeding
  o Managing adverse reactions

Demonstrate an understanding of safety hazards and precautions and identify symbols  Level 1
  o Biological hazard
  o Electrical safety
  o Chemical safety
  o Radiation safety
  o Fire safety
  o Mechanical safety
  o Biosafety
  o Biosecurity

Discuss and apply the Occupational Safety and Health Administration (OSHA) Standards and compliance with OSHA in phlebotomy and clinical laboratory practice  Level 2

Discuss institutional safety procedures and practices Level 1
  o Biological and physical safety of oneself and others in the workplace
  o Proper labeling of biohazardous specimens/samples
  o Handling biological specimens/samples routinely
  o Handling biological specimens/samples collection in cases of bioterrorism and other emergency response situations
  o Hazardous materials
Natural disasters including weather emergencies
Fire and electrical safety
Cleaning protocols including cleaning phlebotomy trays and equipment, cleaning up of specimen/sample spills, and other biohazardous spills
Waste disposal

Comply with federal and state mandates and regulations and organizational requirements regarding safety practices Level 2

Develop and evaluate safety equipment for use in phlebotomy and related services Level 3

Select and evaluate safety equipment for use in phlebotomy and related services Level 3

Infection Prevention
List and explain the principles of infection control Level 1
  - sources of infection
  - modes of disease transmission
  - hosts
  - susceptibility to infection
  - healthcare-associated infections (HAI)

State the elements of the chain of infection and mechanisms to break the chain Level 1

Discuss and demonstrate sterile techniques related to the scope of practice Level 2

Discuss and apply standard precautions, workplace practices, and engineering controls and the application to phlebotomy and related services: Level 2
  - Use of isolation procedures
  - Use of personal protective equipment – gloves, gowns, masks, and face shields
  - Hand washing and hand antisepsis
  - Sterile technique
  - Environmental controls including use of approved surface disinfectants
  - Needle and other sharps disposal
  - Other

Discuss and apply the isolation procedure and personal protective equipment requirements in accordance with standard precautions and identify example disease conditions associated with each isolation procedure Level 2
  - Airborne or droplet precaution (respiratory isolation)
  - Contact precautions
  - Protective precautions
  - Body substance isolation

Relate the types of isolation associated with specific inpatient or clinical treatment units Level 2
  - Burn unit
  - Dialysis
  - Intensive care unit
  - Nursery
  - Oncology Unit
  - Infectious diseases/Select Agents

Level 2
Discuss and evaluate protocols for exposure to blood and other body fluids including accidental sticks with contaminated needles  Level 3

Discuss and evaluate proper hand washing procedure and hand asepsis  Level 3

Develop and evaluate a system including protocols for ensuring proper infection control in phlebotomy and related services  Level 3

**Human Anatomy and Physiology**

Describe terminology related to direction, anatomic positions, body planes and body cavities  Level 1

Identify body systems by discussing:
- Major organs
- Components and structures
- Primary functions
- Common disorders and clinical laboratory tests/results

State specimen requirements and laboratory commonly performed for evaluation of each body system  Level 1

Discuss the circulatory system  Level 1
- Characteristics of blood and its components- cellular and non-cellular
- Blood vessels and sites used for arterial, capillary and venipuncture
- Properties of arterial blood, capillary blood, and venous blood, and
- Differences related to collection, handling, and appropriate use for laboratory testing
- Process of coagulation and fibrinolysis as it relates to phlebotomy

Discuss the proximity of nerves to arteries and veins and the impact on phlebotomy  Level 2

Discuss the vascular system in the skin and how it applies to phlebotomy and phlebotomy practice  Level 2
- Sites for skin puncture for capillary blood collection in infants, children, and adults
- Limitations and precautions related to skin puncture and capillary blood collection

**Specimens/samples**

Define the term specimen/sample  Level 1

Identify types of specimens/samples tested within the clinical laboratory  Level 1

Discuss requirements that ensure the integrity of each type of specimen/sample type  Level 1

Discuss specimen/sample collection including order of draw, preservation, processing and analysis of the integrity of each specimen/sample  Level 1

State the components of blood  Level 1

Explain the differences between serum and plasma  Level 1

State and discuss pre-analytical factors that affect basal state of specimens/samples
- Age
- Altitude
- Dehydration
- Diet
- Diurnal variation
- Hemoconcentration
- Hemolysis
- Exercise
- Intravenous therapy
- Lipemia
- Obesity
- Posture
- Smoking
- Stress
- Tourniquet applications
- Use of improper collection devices

Describe the procedures and discuss the rationale for handling urine specimens Level 1
- Collection
- Preservation
- Transporting
- Handling
- Processing

State factors that compromise the integrity of specimens/samples as related to the accuracy of clinical laboratory testing - Level 1
- Timing of collection, transport and testing
- Order of draw during specimen/sample collection
- Light
- Temperature
- Medications/drugs

Evaluate specimens/samples and determine the integrity and appropriateness for specific tests requested Level 3

State the types of additives used for blood collection in phlebotomy Level 1
- EDTA (citrate, potassium and disodium forms)
- Heparin
- Sodium fluoride
- Oxalate
- Antiglycolytic agents
- Clot activators
- Thixotropic gel, polymer gel
- Preservatives

Discuss the modes of action and appropriate use of each additive used for blood Collection Level 1

Match the blood collection tube stopper colors with the additive routinely associated with each colored stopper (e.g., tubes with lavender) Level 1

State, select, and evaluate appropriate equipment and supplies to be used for skin puncture and venipuncture for a variety of patient types Level 3

List specimens/samples used for commonly ordered clinical tests Level 1
State the laboratory section in which these tests are generally performed Level 1
Equipment and Supplies

Name, select and evaluate equipment and supplies used for phlebotomy and discuss proper use of each-

Level 3
- Evacuated tube system
- Syringes
- Winged and non-winged infusion sets
- Micro collection containers
- Skin puncture devices
- Arterial blood collection equipment
- Blood culture collection equipment
- Micro pipette dilution systems
- Tourniquets
- Antiseptics
- Disinfectants
- Puncture resistant containers
- Phlebotomy trays and carts
- General supplies (gauze, bandages, etc)
- Newborn screening testing kits
- POCT tests kits

Name, select and evaluate appropriate protective wear to be used during blood collection, transport, and handling- Level 3

Use equipment and supplies appropriately such that specimens/samples of quality and high integrity are obtained and efficient services of high quality are realized Level 2

Appropriately store equipment and supplies Level 2

Appropriately dispose of used/contaminated equipment and supplies Level 2

Specimen/sample collection

Instruct the patient on specimen/sample collection Level 2

Evaluate patient readiness for quality specimen/sample collection including adherence to diet, medication, etc. by interviewing/communicating with patients Level 3

Prepare and organize equipment and supplies prior to performing phlebotomy and related services Level 2

Name and select the appropriate collection site for arterial puncture, skin puncture, and venipuncture after considering factors that affect site selection- Level 2
- Intravenous fluid lines
- Transfusion
- Presence of burns
- Broken skin
- Scars
- Mastectomy
- Other

Collect blood via appropriate collection site and standard venipuncture techniques - Level 2
  - Syringe system
  - Winged and non-winged infusion set system
  - Evacuated tube system using correct order of draw

Collect blood via appropriate collection site using standard skin puncture techniques on various patient types- Level 2
  - Adults
  - Infants
  - Children

Evaluate specimen/sample integrity by proper patient preparation for tests ordered- Level 3
  - Accurate patient identification
  - Use of proper collection site and supplies, devices and procedures including order of draw
  - Accurate labeling, transport and handling of specimens/samples collected

Discuss and appropriately use special precautions when collecting blood specimens/samples- Level 2
  - Decontaminating the skin for routine collection
  - Aseptic technique for blood cultures
  - Warming devices
  - Collecting appropriate Sample size
  - Suitability of site for collection
  - Implementing, monitoring, and evaluating quality assurance methods relevant to the scope of practice

Discuss the purpose of performing arterial punctures Level 2

Discuss blood donor screening, donor blood collection procedures, and precautions, blood products, expiration dates, and storage requirements Level 2 (Cross Reference in Immunohematology)

Discuss patient factors and adverse complications that affect phlebotomy specimen/sample collection Level 1
  - Vein damage
  - Collapsed veins
  - Scar tissue
  - Infections
  - Difficult veins
  - Pain
  - Petechiae
  - Excessive bleeding
  - Syncope
  - Seizures
  - Nausea
  - Vomiting
  - Insulin shock
  - Tatoes
Discuss methods to prevent or address technical and physiological complications in phlebotomy Level 1

Define and discuss the prevention of phlebotomy complications Level 1
  - Hematoma
  - Hemoconcentration
  - Hemolysis

Describe and demonstrate appropriate technique in preparation of acceptable peripheral blood smears Level 2

Label specimens/samples collected with appropriate information as defined by standard protocol Level 2

Identify and label biohazard specimens/samples Level 1

Prepare specimens/samples for transport or mailing to reference laboratories or other off site laboratories for testing using appropriate standard protocol Level 2

Describe and demonstrate proper disposal of contaminated equipment, supplies, and discard specimens/samples Level 2

**Point of Care Testing (POCT)**

State tests commonly performed at the patients' bed side or chair side- point of care Level 1

Name practitioners who are qualified to perform point of care tests Level 1

Discuss qualifications of practitioners who may perform point of care tests Level 1

Discuss the purpose of each POCT test Level 1
  - Sample/specimen requirements
  - Precautions
  - Limitations
  - Sources of error
  - Reference values
  - Quality assurance

State critical values and follow established criteria for reporting such values Level 1

**Quality Assurance/Quality Control**

Define and distinguish among the terms quality control, quality assurance and quality improvement Level 3

Discuss quality assurance in phlebotomy and related services Level 1
  - Requisitioning
  - Patient preparation
  - Phlebotomy procedures
  - Aspects of post phlebotomy care
  - Specimen labeling, transport, handling and procurement
  - Point of Care testing

Implement and evaluate a quality assurance system for phlebotomy Level 3

Discuss methods of improving phlebotomy services and related patient outcomes Level 1
Discuss and demonstrate proper documentation of procedure and quality assurance using established standards
 Level 2
   - Specimen logs
   - Tracking specimens manually and with the computer system

Evaluate specimens/samples for acceptability for tests requested
 Level 3
   - Labeling discrepancies or absence of labels
   - Hemolysis
   - Specimen collection using the Wrong additive
   - Use of outdated supplies
   - Improper storage or transport

Discuss the volume of blood that can be taken from a patient with regard to age and standard practice- Level 1
Discuss standard practices related to the number of time a patient can be punctured by the same phlebotomist-
Level 1

Human communication definitions and application to practice

Discuss effective human communication in phlebotomy and related services- Level 1
   - Definitions
   - Theories
   - Key components

Discuss and demonstrate the application of communication theories in practice as a means of assuming the role
of listener, speaker, and ultimately, effective communicator as a phlebotomist and patient care provider- Level 2
Demonstrate effective communication in providing patients with instructions for preparing for phlebotomy
procedures- Level 2
   - Fasting specimens/samples
   - Glucose tolerance tests
   - Urine collection
   - Occult blood test

Demonstrate proper communication skills in interviewing a patient/client as related to phlebotomy and
phlebotomy services- Level 2
Demonstrate proper greeting of patients/clients, visitors, peers, and other health care professionals- Level 2
Discuss and demonstrate effective communications with diverse clients encountered including pediatric and
geriatric patients- Level 2
Describe factors that influence effective communications between patient/client and phlebotomists, medical
laboratory technician (MLT) or medical laboratory scientist (MLS), the health care professional and their
colleagues/other health care professionals, the health care professional, and patients’ families and guests- Level
2
   - Cultural sensitivity
   - Language barriers
   - Technical jargon
   - Disabilities
   - Age
   - Stress
   - Medication
   - Other
Professionalism, legal, and Ethical aspects

Discuss professionalism and behaviors associated with professionals practicing phlebotomy- Level 1
Demonstrate professional appearance by proper grooming and wearing professional attire- Level 2
Discuss basic theories of ethics and application to persons practicing phlebotomy- Level 1
Discuss the Patients' Bill of Rights and its application to phlebotomy and related services- Level 1
Discuss the importance of patient confidentiality and demonstrate maintenance of patient confidentiality and how it related to HIPPA- Level 1
Discuss the legal and ethical implications associated with breach of patient confidentiality- Level 1
Discuss and apply laws that impact upon phlebotomy and related services- Level 2
- Clinical Laboratory Improvement Amendments of 1988
- Occupational Safety and Health Administration regulations
- Health Insurance Portability & Accountability Act (HIPPA)
- Patient Self-Determination Act of 1990
- Affordable Care Act (2010)
- Other
Discuss and apply the ethical and legal responsibilities of the Patient's Bill of Rights especially as they relate to phlebotomy and phlebotomy service- Level 2
- HIPPA
- The Patient Self-Determination Act of 1990
- Confidentiality
- Right to refuse treatment
- Informed consent
- Privacy
- Other
Discuss the United States legal system as it relates to Phlebotomists, MLTs, MLSs participating in duties related to phlebotomy- Level 1
Discuss the importance of standard of care and legal implications associated with standards of care- Level 1
Discuss the importance of labeling specimens/samples and the legal ramifications associated with improper specimen labeling- Level 1
Discuss the legal ramifications of testing specimens/samples that lack integrity- Level 1
Discuss the interrelationship of ethics, morals, professional and personal values, and legal aspects of care in performing phlebotomy- Level 1
Discuss stress and the effects of stress on professionals performing phlebotomy and related services- Level 1
State methods of handling stress or eliminating stress in the work place- Level 1
Discuss measures that can be taken to avoid or reduce risks and liability in performing phlebotomy and related duties- Level 1
The Health Care System and Services
Identify components of the health care delivery system and the services each provides

Point of Care Testing (POCT)
bleeding time

Added items

Patient and laboratory safety
Discuss and evaluate safety equipment for use in phlebotomy and related services

Infection control
Relate the types of isolation associated with specific inpatient or clinical treatment units - Oncology unit
Develop and evaluate a system including protocols for ensuring proper infection control in phlebotomy and related services

Specimens/Samples
Match the blood collection tube stopper colors with the additive routinely associated with each colored stopper (e.g., tubes with lavender)

Equipment and Processing for phlebotomy and processing
Select and evaluate equipment and supplies used for phlebotomy and discuss proper use of each
- Winged and non-winged blood collection sets
- Triple Packaging System/Transfer devices
- Dried Blood Spot and filter paper collections

Specimen/Sample collection
Discuss precautions when collecting blood specimens/samples
Discuss technical complications associated with blood collection and methods of correction for each - include needle insertion and loss of vacuum in evacuated tubes
State and discuss patient factors and adverse complications that affect phlebotomy specimen/sample collection - mastectomy, stroke, double IV
Renal Anatomy and the Urinary System

Describe the anatomy of the kidney Level 1

Shape
Size
Placement in the abdominal cavity

Describe the function of each structure Level 1

Cortex
Medulla
Pyramids
Papilla
Calyces
Pelvis

Diagram each portion of the nephron Level 1

Bowman’s capsule
Proximal convoluted tubule
Ascending and descending limbs of Loop of Henle
Distal convoluted tubule (macula densa)
Collecting duct

Describe the function of each portion of the nephron Level 1

Explain the function of each component of the glomerulus Level 1

Capillary endothelium
Basement membrane
Podocytes (epithelium)

Explain role of renal blood circulation related to renal function Level 1

Describe the renal blood circulation Level 1

Afferent and efferent arterioles
Glomerulus
Peritubular capillaries
Vasa recta

Describe the ureters Level 1
Anatomical structure and location
Epithelium
Mechanism of action

Describe the bladder Level 1
Anatomical structure
Epithelium
Mechanism of action

Describe the urethra for male and female Level 1
Anatomical structure
Epithelium
Mechanism of action

Renal Physiology
Describe the process of glomerular filtration Level 1
Hydrostatic and oncotic forces
Glomerular filtration barrier (GFB)
Capillary endothelium
Basement membrane
Podocyte filtration diaphragms
“Shield of negativity”

Describe how glomerular filtration rate is calculated Level 1
Creatinine clearance
eGFR

Describe the process of urine formation Level 1
Tubular reabsorption and secretion
Active and passive transport
List the solutes that are reabsorbed by the nephron Level 1
List the solutes that are secreted by the nephron Level 1
Identify the nephron location and mechanism of reabsorption or secretion for each solute Level 1
Explain changes in solute composition as ultrafiltrate passes through the nephron Level 1
Explain changes in osmolality as the ultrafiltrate passes through the nephron Level 1
Explain tubular transport capacity (Tm) in relation to renal threshold level Level 1
Describe secretory mechanisms that regulate acid-base balance Level 1
   Hydrogen ion secretion to recover bicarbonate
   Hydrogen ion secretion to form acids
   Hydrogen ion secretion to form ammonium ions
Discuss the mechanisms that maintain hypertonicity/osmotic gradient of renal medulla physiology Level 1
   Countercurrent multiplier mechanism
   Countercurrent exchange mechanism
   Urea cycle
   Role in urine formation and concentration
Explain changes in urine volume and solute composition Level 1
   Volume and composition of normal urine
   Role of ADH/vasopressin in water reabsorption
Describe the renin-angiotensin-aldosterone system Level 1
Describe physiologic factors involved in determining the volume of urine excreted Level 1
   Anuria
   Oliguria
   Polyuria

**Renal Disease**
Describe the pathogenesis and clinical features associated with glomerular disease/damage Level 1
State the clinical features of nephrotic syndrome and state diseases that are associated with this syndrome Level 1

Compare and contrast typical urinalysis findings in glomerular diseases Level 2

- Acute glomerulonephritis
- Chronic glomerulonephritis
- Nephrotic syndrome

Compare and contrast the mechanism of tubular dysfunction and typical urinalysis findings Level 2

- Acute tubular necrosis (ATN)
- Cystinosis and cystinuria
- Renal glycosuria
- Renal tubular acidosis (RTA)

Describe the clinical features of Fanconi Syndrome and identify diseases associated with this syndrome Level 1

Compare and contrast etiology, clinical features and typical urinalysis findings in tubulointerstitial disease and urinary tract infections Level 2

- Acute pyelonephritis
- Acute interstitial nephritis (AIN)
- Lower urinary tract infections (e.g., cystitis)

Explain the presence of non-bacterial organisms (e.g., yeast, trichomonads, giardia, etc.) found in urine despite no evidence of urinary tract infection or involvement Level 1

Describe the etiology of renal vascular disease Level 1

Discuss effect of renal vascular disease on renal function Level 2

Compare and contrast acute and chronic renal failure Level 2

- Etiology
- Clinical features
- Typical urinalysis results
- Renal function tests

Define and describe formation of renal calculi Level 1

Discuss factors that influence calculi formation Level 1
Extrarenal Diseases
Describe physiologic mechanisms, clinical features and typical urinalysis findings of amino acid disorders  Level 1
  Cystinuria and cystinosis
  Alkaptonuria
  Maple Syrup Urine Disease
  Phenylketonuria
  Tyrosinuria and melanuria

Describe physiologic mechanisms, clinical symptoms and typical urinalysis findings of carbohydrate disorders  Level 1
  Glycosuria
  Diabetes Mellitus
  Galactosuria

Describe physiologic mechanisms, clinical features and typical urinalysis findings of metabolic disorders  Level 1
  Diabetes Insipidus
  Porphyrin disorders

Urinalysis
Instruct others in proper collection of urine specimen types  Level 2
Describe urine specimen collection techniques/procedures  Level 1
  Random void
  Midstream clean void
  Catheterization
  Suprapubic aspiration
  Pediatric collection bags
  Timed collection

Describe characteristics of urine specimen types  Level 1
  Random void
  First morning void
  Timed
Evaluate acceptability of urine specimens  Level 3
   Labeling and patient information
   Sufficient volume

Determine if time of collection, handling and transport conditions are appropriate  Level 3
   Time elapsed since specimen collection
   Timed test intervals
   Storage (light, temperature, preservatives)
   Visual evidence of contamination
   Collection technique and specimen container is appropriate

Storage parameters for testing
   Refrigerate or freeze
   Room temperature
   Light protection
   Preservative requirements

Communicate to health care provider’s criteria for specimen rejection  Level 2

Document unacceptable specimens and action taken  Level 2

Verify acceptability of work area, equipment and supplies  Level 2

Determine and record temperatures in work area  Level 2
   Room
   Refrigerator
   Freezer

Examine reagents for correct storage conditions  Level 2
   Tightly sealed in properly labeled container
   Temperature
   Protected from light if necessary
   Expiration date not exceeded

Prepare calibration and quality control materials  Level 2
   Reagent strip controls
Refractometer calibrators and controls (If applicable)
Microscopic controls
Other chemical test controls
Perform and record calibration checks, quality control checks and equipment maintenance
Level 2
Refractometer (If applicable)
Centrifuge
Microscope
Osmometer
Automated instrument
Recognize, take corrective action and document when calibration or quality control check fails or equipment malfunctions Level 2
Evaluate quality control values to determine analytical errors and implement corrective action Level 3
Perform and record troubleshooting on equipment Level 2
Discuss evaluation and selection of methodology Level 3
Prepare specimens for analysis Level 2
Mix specimen
Aliquot for macroscopic and microscopic
Prepare dilutions as necessary
Centrifuge and remove supernatant
Resuspend sediment and stain if necessary
Prepare sediment for microscopic analysis (stain or standardized slide)
Ensure appropriate conditions for macroscopic evaluation Level 2
Adequate room illumination
Homogenous specimen
Temperature
Observe and record specimen color using established terminology Level 2
Correlate color with specimen concentration Level 2
Correlate color with patient medication Level 2
Correlate color and substances that produce them with clinical significance  Level 2
Observe and record specimen clarity using established terminology  Level 2
Correlate clarity with microscopic examination  Level 2
State substances that affect urine clarity and indicate those that are clinically significant  Level 1
Determine specimen concentration  Level 2
  Perform specific gravity measurements  Level 2
    Refractometer
    Reagent strip
    Automated technology
Perform osmolality measurements  Level 2
Compare and contrast principles employed in each method of concentration measurement  Level 2
  Osmolality
  Refractometry
  Reagent strip specific gravity
Correlate urine concentration with clinical significance  Level 2
Observe and comment on abnormal urine odor, if applicable  Level 2
  Distinguish between normal urine odor and that associated with old, unpreserved urine  Level 2
  Describe abnormal urine odor and clinical significance  Level 2
Perform (manually or using instrument) and record qualitative/semi-quantitative reagent strip chemical tests  Level 2
  Dip and remove strips in urine appropriately and correctly, time and read, and interpret reactions  Level 2
  State limitations of various chemical techniques (false positive/negative)  Level 1
Apply criteria for results that require confirmatory testing and/or dilutions
Compare and contrast principles and limitations of various chemical tests on urine  Level 2
  pH
  Blood and myoglobin
Leukocyte esterase
Nitrite
Protein
Carbohydrates
Ketones
Bilirubin
Urobilinogen
Ascorbic acid
Albuminuria (microalbumin) by reagent strip
Creatinine by reagent strip

Discuss principles and limitations of confirmatory and qualitative metabolic screening tests  
Level 1
Identify qualitative results as positive or negative for substance of interest  
Level 2
Identify substances detected and correlate with possible metabolic disease  
Level 2
Branched chain amino acids
Cystine
Homocystine
Homogentisic acid
Melanin
Phenylpyruvate and metabolites
Porphobilinogen
Tyrosine

Use established terminology to report chemical examination results  
Level 2
Correlate chemical examination results for acceptability and clinical significance  
Level 2
Detect errors, discrepant and/or contradictory results and action to be taken before reporting results  
Level 2
Preanalytical errors
improper timing
improper preservative
exposure to light
mislabeled specimens

Analytical errors
interfering substances present in urine
deteriorating reagents
instrument malfunction

Post-analytical errors

Correlate results of macroscopic examination with microscopic examination  Level 2
Apply protocol for initiation of microscopic examination based on macroscopic examination  Level 2

Explain purpose of macroscopic tests to health care personnel  Level 2

Prepare microscope for optimal viewing  Level 2  (See microscope section in MLS General Practice)

Clean ocular and objective lenses
Adjust light source for proper illumination
Place filters in light path
Protect microscope from dust

Select type of microscopy and adjust for optimum viewing (Koehler illumination)  Level 2
Optimize condenser position for height and centration
Adjust field iris and condenser aperture diaphragms

Describe and utilize various microscopic techniques  Level 2
Brightfield
Phase contrast (if available)
Polarizing (if available)

Compare and contrast viewing differences and advantages for each type of microscopy  Level 2

Check and perform phase ring alignment for phase microscopy  Level 2
Place polarizing filters in light path for polarizing microscopy  Level 2

Place, focus and scan mounted specimen on microscope
Secure microscope slide on mechanical stage
Check and perform interpupillary and diopter adjustments
Use course and fine adjustments
Use mechanical stage adjustments to scan specimen

Distinguish and quantitate cellular elements Level 2
Red blood cells (typical, ghost and crenated forms) using high power magnification (400x)
White blood cells using high power magnification (400X)
  Typical white blood cells (neutrophils, lymphs, macrophages)
  Atypical white blood cells (degenerative forms)

Special stains (eosinophils, lymphocytes, etc.)
Epithelial cells – Squamous (100x), transitional & renal tubular (400X)
Oval Fat Bodies
Abnormal and/or atypical cells
Distinguish, quantitate, and determine the type of casts Level 2
Hyaline
Waxy
Cellular inclusions (RBC, WBC, renal epithelial, mixed)
Inclusions (finely and coarsely granular, fatty, crystals, hemosiderin)
Pigmented (hemoglobin, bilirubin)

Distinguish acidic, neutral, and alkaline crystals Level 2
Associate with pathology/disease state
Derived iatrogenically

Distinguish miscellaneous formed elements Level 2
Bacteria
Fat globules
Hemosiderin
Mucus
Parasites
Spermatozoa
Yeast
Contaminants (starch, fibers, fecal material, clue cells, etc)

Record microscopic examination results using established protocol and terminology
Level 2

Correlate microscopic with macroscopic and chemical examination
Level 2

Correlate microscopic results with stated/possible conditions
Level 2

Use protocol to identify specimens that require confirmatory testing before reporting results
Level 2

Check for pre-analytical and post-analytical errors

Perform additional testing to resolve conflicting results

Explain purpose of microscopic tests to health care personnel
Level 2

Describe viewing differences and advantages for each type of microscopy
Level 2

Determine acceptability of quality control results and take necessary corrective action

Ensure results are recorded in established format and terminology
Level 2

Utilize reference intervals to determine clinical significance
Level 2

Evaluate and correlate results with other tests results on same patient
Level 3

Compare current results with previous results on same patient
Level 2

Utilize protocol for identifying and reporting "critical values"
Level 2

Utilize protocol to communicate results via computer, verbal or written
Level 2

Respond to inquiries from health care personnel concerning test results, reference intervals, specimens

Renal Function Tests
Discuss the advantages and disadvantages of substances for determination of renal clearance
Level 2
Creatinine
Inulin
Cystatin C

Discuss factors that can influence creatinine clearance results (timing, complete collection, body size) Level 1

Use protocol for performing creatinine clearance tests Level 2

Calculate creatinine clearance results using body surface area normalization Level 2

Differentiate eGFR and GFR Level 2

Recognize and identify factors that can influence eGFR results (age, muscle mass, pregnancy, ethnicity, race) Level 2

Interpret and report results Level 2

Evaluate acceptability of quality control results and take necessary corrective action

Evaluate acceptability of patient specimens Level 3

Evaluate results for completeness

Intercept questionable and/or contradictory results and verify appropriate action is taken and documented

Ensure results are recorded in established format and terminology Level 2

Utilize reference intervals to determine clinical significance Level 2

Correlate results with stated/possible condition Level 2

Correlate results with other tests results on same patient Level 2

Compare current results with previous results on same patient Level 2

Utilize protocol to communicate results via computer, verbal or written Level 2

Respond to inquiries from health care personnel concerning test results, reference intervals, specimens Level 2

Explain purpose of each renal function test to health care personnel Level 2

**Renal Calculi**

List and discuss factors that can influence calculi formation (increase in chemical salts, change in pH, urinary stasis, foreign body seed) Level 1

Describe the chemical composition of most renal calculi Level 1

Recognize modes of prevention and treatment Level 1
Body Fluids

Explain basic concepts relating to the clinical significance of body fluids   Level 1
Discuss types of body fluids (production, source, function) used in analysis  Level 1
Cerebral spinal fluid (CSF)
Pleural
Peritoneal
Pericardial
BAL
Synovial
Amniotic
Seminal
Define terminology associated with body fluid analysis    Level 1
Paracentesis
Thoracentesis
Arthrocentesis
Ascites
Effusion (transudate/ exudate)
Xanthochromia
Chylous
Pseudochylous
Traumatic tap
Perform processing of specimens according to established laboratory protocol Level 2
Storage conditions
Specimen transport
Perform body fluid analysis according to laboratory protocol for CSF, Serous, Synovial, BAL Level 2
Physical exam
Color/ clarity
Chemical exam
Glucose
Protein
Oligoclonal bands and IgG Index (CSF)
Hematologic exam
Cell counts
Cytospin differential
Crystal identification (synovial)
Microbiologic exam
Gram stain
Culture
Viscosity, if applicable (synovial)
Perform body fluid analysis according to laboratory protocol for amniotic fluid Level 2
Physical exam – color, turbidity
Chemical
fetal lung maturity
lecithin/sphingomyelin (L/S) ratio
phosphatidylglycerol/phosphatidylinositol
lamellar body counts

Perform body fluid analysis according to laboratory protocol for seminal fluid (Level 2)

- Physical appearance
- Volume
- Viscosity

Microscopic
- Motility
- Morphology
- Viability
- Agglutination
- Count
- Cells

Chemical (pH/fructose/zinc/citric acid/acid phosphatase/alpha-glucosidase)

Perform body fluid analysis according to laboratory protocol for fecal samples

- Fat
- Blood
- White cell count

Evaluate acceptability of body fluid results (Level 3)
Report results according to laboratory protocol (Level 2)
Perform, document, and evaluate quality control (Level 2)
Correlate patient results with disease state or disorder (Level 2)
MLS- Urinalysis and Body Fluids

Deleted items

Explain the function of the mesangium of the glomerulus

Diagram renal blood circulation

Identify characteristics of fasting urine specimen types

Assemble worksheets and other documenting materials

Observe and record temperatures of heating blocks and water baths

Dispense standardized volume of sediment to glass microscope slide and apply appropriate coverslip

Perform and record confirmatory tests - Sulfosalicylic acid for protein & Watson-Schwartz for urobilinogen/porphobilinogen, clinistest, acetest, icotest

For qualitative metabolic screening tests Select most appropriate chemical method for clinical situation

For qualitative metabolic screening tests - Apply criteria for results that require confirmatory testing and/or dilutions

Qualitative metabolic screening tests: Hoesch test for porphobilinogen, Watson-Schwartz for urobilinogen/porphobilinogen, Ferric chloride test for ketones, Ammoniacal silver nitrate test for homogentisic acid, Nitroprusside test for ketones

Describe and utilize various microscopic techniques - Interference contrast microscopy

Maintain daily and cumulative QC documentation

Retain result documentation as required for accreditation

Participate in continuing education programs; Enhance pertinent knowledge; Annually document competency (not needed for entry level)

Renal calculi – locate chemical tests to determine chemical composition

Quality Management in the Urinalysis Laboratory (covered in management section)

Body Fluids

Amniotic – bilirubin (Δ 450), microviscosity
**Added items**

Describe the process of glomerular filtration – including shield of negativity

State the clinical features of nephrotic syndrome and state diseases that are associated with this syndrome

Describe Specimen Collection technique - Timed collection

Specimen preparation - mix specimen

Observe and comment on abnormal urine odor, if applicable

Distinguish between normal urine odor and that associated with old, unpreserved urine

Dip and remove strips in urine appropriately and correctly, time and read, and interpret reactions

Apply criteria for results that require confirmatory testing and/or dilutions

Albuminuria by reagent strip

Creatinine by reagent strip

Discuss the advantage and disadvantages of Cystatin C for determination of renal clearance

Differentiate eGFR and GFR

Recognize and identify factors that can influence eGFR results (age, muscle mass, pregnancy, ethnicity, race)

Describe the chemical composition of most renal calculi

**Body Fluids**

BAL
MLT Entry Level Curriculum - Immunohematology

**Whole blood donation -- principles of donor selection**
Review donor information (testing and interview responses) and determine if the donor is suitable for his/her category of donor
- Routine allogeneic
- Double RBC
- Therapeutic
- Autologous
- Apheresis (platelet, plasma)

Maintain donor records Level 1

Respond to questions regarding donor suitability – consulting with medical director as appropriate Level 1

**Blood collection**
List the different anticoagulant/preservative solution used in blood collection/storage bags Level 1

Describe the process for correcting the amount of solution according to body weight of donor Level 1

Perform the appropriate pre-donation testing (e.g., platelet count for plateletpheresis)
- Platelet count for plateletpheresis Level 2

Maintain produce sterility and integrity Level 2

**Donor reactions**
Describe the signs and symptoms of adverse donor reactions Level 1

**Processing donor blood**
Discuss the required standard of care tests and deferral criteria for infectious disease
- Hepatitis B and C antibody and NAT
- Syphilis
- HIV 1 / 2 (antibody and NAT)
- HTLV I/II
- CMV (as necessary)
- Chaga’s disease
- Bacterial testing of platelets

Determine ABO group and Rh type and record results Level 2
Determine reportability of results Level 2
Perform antibody screen and if positive identify Level 2
Store according to product requirements Level 1

**Autologous donors**
Discuss advantages and disadvantages of autologous and allogeneic donation and transfusion Level 1
Discuss and compare criteria for collection with that of random allogeneic donor Level 2
Test and label blood as required for autologous units Level 2
Dispose of unused autologous units as indicated Level 1

**Preparation of cellular and plasma components from donor units**
Describe the processes for separating units of whole blood and preparing components Level 1
- Packed red blood cells (PRBC)
- Leukocyte-poor PRB
- Washed PRBC
- Frozen, deglycerolized PRBC
- Irradiated PRBC
- Platelet concentrate

Discuss the preparation of single donor platelets by plateletpheresis Level 1
Store each component within required parameters Level 1
Prepare components according to protocol Level 2
- fresh frozen plasma (FFP)
- cryoprecipitate (CRYO) from fresh frozen plasma
- single donor plasma from whole blood

Discuss the principle of pathogen inactivation for platelets and plasma products Level 1
Label units/component with required information Level 2
- Name of component
- Expiration date
- Amount of product
- Storage temperature
- Results of tests

List quality control standards for methods used in component preparation Level 1
Test components to determine if they meet the QC requirements Level 2

Document and review QC results Level 2

**Storage of blood components**
List the biochemical changes that take place in stored blood units and relate to the specific anticoagulant used, time and temperature of storage Level 1

Monitor equipment Level 2
- Document temperatures for refrigerators and freezers at required intervals
- Check temperature sensors at required intervals
- Document corrective action when temperatures vary beyond limits

Package and ship components Level 1
Select units for shipping to fill routine and emergency orders
- Prepare transfer records
- Package components for shipping to maintain required conditions
- Maintain inventory

**Blood group serology**
Evaluate suitability of specimen Level 2
- List rejection criteria
- Ascertain that specimen has been correctly collected and labeled
- Discuss possible sources of error in testing that may result

Discuss how specific factors may affect reactions Level 1
- Incubation time/temperature
- Class of antibody
- Antigen/antibody ratio
- Centrifugation time/speed
- Suspending media (e.g., pH, saline, high protein, low ionic strength)

Prepare suspension of red blood cells using required equipment and reagents Level 2
- Choose appropriate reaction tubes and prepare saline cell concentrations
- Dispense cells and reagents without contamination
- Balance and use a serological centrifuge
- Wash cells manually and using a cell washer

Perform testing (e.g., tube, gel and solid phase) and record results Level 2
- Shake out tube tests without dispersing true agglutination
- Read and grade hemolysis and agglutination
- Interpret positive and negative reactions when an acceptable procedure has been followed
- Identify any factors that may have affected reactions and/or interpretation of reactions
**Antiglobulin tests**
Discuss the principle of the direct antiglobulin test Level 1
Discuss the principle of the indirect antiglobulin test (antibody screen) Level 1
Describe the principle and purpose of IgG sensitized cells Level 1
Use and interpret appropriate controls including autocontrol Level 2
Perform the antiglobulin test according to protocol and interpret results Level 2
Choose polyspecific and monospecific antiserum for the appropriate test specimen Level 2
Investigate and false positive and/or false negative results and determine methods for resolution Level 2

**Special methods**
Describe criteria and/or situations for use of specific elution techniques Level 1
Lui freeze-thaw
Chemical
Describe the principle of selected special methods (e.g., enzymes, pre-warmed, neutralization, elution) Level 1
Perform special methods (e.g., enzyme, pre-warmed, neutralization, elution) and record results Level 2
Select appropriate cells, reagents, controls and/or cell preparation methods for special techniques Level 1
Interpret results of special tests Level 2
Perform antigen typing (e.g. using tube, gel, and/or solid phase Level 2
Perform (tube, gel and solid phase) testing for antibody screening & identification and document results Level 2
Apply knowledge of limitations of test procedure to test results and interpretation Level 2
Principles for recognition or differentiation of blood group antigens and antibodies

For the more common blood group systems list and compare characteristics of red cell antigens with their specific antibody Level 2
- Enzyme enhancement or inhibition
- Dosage
- Complement binding
- Other optimal conditions or reaction (e.g., pH, temperature, enhancement media)

Identify and use a source of information to identify characteristics reactions of rare unexpected antibodies Level 1

Apply characteristics of blood group antigens to interpret an antibody screen and correlate clinical significance of antibodies identified, and safety of blood components for transfusion Level 2
- Specificity and immunogenicity
- Variable expression of antigens
- Dosage
- Number and location of antigen sites
- Modes of inheritance
- Antigen development including changes from newborn through adult to aged
- Disease-related antigen changes
- RBC blood group antigens present on other tissue

Discuss properties of antibodies directed toward blood cell antigens that are used in evaluating antibody screens Level 1
- Primary vs. secondary response
- Non-red cell vs. red cell stimulation
- Expected (e.g., A, B, H) vs. unexpected
- Avidity
- Titer
- Effects of patient age, specimen age, disease
- Clinical significance
- Immunoglobulin class
- Phase of reactivity (in vivo vs. in vitro)

Identify properties related to immunoglobulin class Level 1
- Form of stimulation
- Clinical significance
Describe the effect of complement on hemagglutination reactions
- Aid in enhancing anti-Jk reactions
- Interference in immediate spin crossmatches

**Pre-transfusion testing**
Determine acceptability of recipient specimen based on specified criteria

Check records for previous ABO group and Rh type antibody problems, and transfusion history of patient

Perform required tests on recipient blood sample and document results
- ABO forward and reverse typing
- Rh typing including weak D when appropriate
- Antibody screen and identification
- Perform typing for special antigens as necessary employing negative and weakly-reacting positive control cells
- Perform antigen typing

Identify discrepancies of ABO typing results and perform
tests to resolve using appropriate methods (e.g., lectins, saline replacement, and reverse grouping with A2 and O cells)

Correlate results with potential causes of discrepant ABO results
- Subgroups of A and B
- Missing antibody in newborn, elderly or immunosuppressed
- Unexpected alloantibody
- Autoantibody
- rouleaux
- Transplantation of non-ABO–identical bone marrow/stem cells

Perform antibody screening and identification for antibodies that can be resolved using routine procedure
- Perform and interpret antibody screening including antiglobulin phase
- Perform and identify using routine antibody identification panels on serum or eluate

Confirm antibody identification
- Perform and interpret antigen typing of patient cells
- Select perform and interpret a cell panel using a 95% probability level of cells (3 cells positive and 3 cells negative) for the antigen against which a suspected antibody is directed

Evaluate clinical and/or laboratory data to determine when each specific technique is appropriate
Alter reaction conditions to include appropriate controls and interpretation of results

- Increased serum volume
- pH adjustment
- Neutralization techniques
- Pre-warm technique
- Saline replacement technique
- Special antigen typings

### Compatibility of recipient and donor

Discuss the need for compatibility testing depending on component required and nature of request

- Type and screen with negative screen results vs. positive screen results
- Routine transfusion
- Emergency transfusion
- Massive transfusion
- Intrauterine and neonatal transfusion

List the blood types that are compatible with each ABO blood group

select the appropriate blood for compatibility when
- group specific blood is available,
- is not available,
- if the patient has been recently transfused with non-group specific blood

Prepare donor sample from attached sealed segment or segment with number matching it to donor sample

Perform crossmatch and document results

- Immediate spin to detect ABO incompatibility
- Routine antiglobulin crossmatch
- Computer crossmatch

Release compatible units for transfusion and complete appropriate records

Retain specimen from donor and recipient for appropriate length of time

Select blood for compatibility testing that is negative for the antigen against which clinically significant recipient antibody(ies) is/have been detected
Correlate results of compatibility testing with causes for incompatible results
   Atypical antibody(ies)
   Rouleaux
   Autoantibody(ies)
   Positive DAT on donor cells

Apply appropriate labels/tags to units including cases of incompatibility, emergency release of non-crossmatched units, least incompatible, etc.

**Testing for disease states associated with the direct antiglobulin test**

Explain the principle of the direct antiglobulin test (DAT)

Perform DAT including use of IgG sensitized cells and record results

Determine reportability of results

Investigate patient history and test results for consistency with a positive DAT

**Hemolytic disease of the fetus and newborn**

Describe the immune process which causes hemolytic disease of the fetus and newborn (HDFN)

List the common antibodies responsible for HDFN and compare their characteristics with antibodies that do not cause HDFN

Perform prenatal testing and record results
   ABO & Rh typing
   Antibody screen on maternal sample
   Identify antibody if screen is positive

Perform testing on fetal blood samples and report results

Procure safe blood for intrauterine transfusion
   Select fresh blood of appropriate ABO and Rh type
   Select or prepare leukocyte-reduced, irradiated, washed, hemoglobin S negative and CMV negative units as necessary

Perform and record compatibility testing using maternal serum, eluate or fetal serum (when available) through umbilical cord sampling

Determine if results can be reported or if follow-up testing is required
Perform neonatal testing and record results
   ABO (forward typing only) and Rh typing
direct antiglobulin test
elution and antibody identification where indicated
ABO and Rh typi and antibody screen
   on maternal postnatal specimen
Identify antibody(ies) if present

Perform testing for exchange transfusion
   Select blood for transfusion that is appropriate to the clinical needs
   of the recipient
   Perform and interpret compatibility test using appropriate samples

Perform testing to determine necessity of administration of RhIg
to prevent of HDFN
   Review patient history for evidence of antenatal administration of RhIg
   Perform D and weak D tests on maternal and newborn samples
   Perform antibody screen on maternal serum

Determine appropriate dosage of RhIg
   Perform test to identify and quantitate fetal maternal hemorrhage
   Rosette
   Kleihauer-Betke

Calculate dosage of RhIg based on test results

Issue product and complete records

Issuing of blood and blood components
Discuss the clinical necessity, and effects of transfusion

Prepare blood and blood components for transfusion
   Maintain adequate supply of appropriate blood and blood components
   Inspect blood and components for date of expiration and evidence
   of contamination or deterioration
   Perform confirmatory verification of ABO group and Rh type on
   donor units as specified
   Verify patient identification and perform comparison checks on ABO
   and Rh of patient and complete records

Discuss bacterial testing for platelet units
Prepare products for transfusion

- Wash cells
- Irradiate product according to protocol
- Pool platelets or cryoprecipitate
- Thaw fresh frozen plasma and cryoprecipitate
- Prepare red blood cells to specified hematocrit or small volume for pediatric patients

Control return of unused blood or components

- Note time and estimate conditions under which blood components were maintained when out of the laboratory
- Inspect for evidence of improper storage
- Determine whether blood components can be reissued, complete appropriate records and store as required
- Appropriately dispose of blood components that cannot be reissued and complete paperwork

**Investigation of suspected adverse outcome to transfusion**

Perform required preliminary investigation to determine whether a hemolytic reaction has occurred

- Obtain and review completed transfusion report
- Check identification of pre-transfusion sample of donor and patient and of blood container
- Confirm correctness of interpretation of pre-transfusion test results
- Compare plasma of pre-transfusion and post-transfusion specimens for evidence of hemoglobin
- Perform and interpret a direct antiglobulin test (DAT) and ABO/Rh typing on post-transfusion sample and compare with pre-transfusion sample

Perform additional testing where appropriate to determine if a hemolytic reaction is the result of an alloantibody

- Repeat ABO, Rh, compatibility testing and antibody screening on patient pre-transfusion and post-transfusion samples and donor unit
- Identify unexpected alloantibody found in patient serum
- Type donor cells for antigen corresponding to the recipient antibody identified
- When DAT on patient cells is positive with anti-IgG prepare and test a red cell eluate for unexpected alloantibody
- Separate transfused from autologous cells by capillary centrifugation and perform appropriate testing on separated cells
**Human leukocyte antigens (HLA)**
Describe the genetic origin, biological functions, and cell distribution of the major human leukocyte antigens  
Level 1

Discuss the clinical importance for identifying HLA antigens or antibodies and matching HLA antigens  
Disease association  
Transplantation  
Platelet transfusion  
Level 1

**Quality assurance**
Follow good manufacturing practices for environment within the facility  
Adequate space  
Ventilation  
Sanitation and trash disposal  
Temperature control  
Water systems  
Level 1

Maintain/follow a Standard Operating Procedure (SOP) manual for all procedures  
Level 2

Participate in laboratory quality assessment  
Level 2

Discuss competency assessment  
Level 1

Discuss process improvement indicators  
Level 1

Participate in personnel QA  
Provide and/or participate in continuing education programs  
Participate in proficiency testing  
Level 2

Perform calibration and preventive maintenance at required intervals, trouble shooting and complete appropriate records  
Centrifuge  
Refrigerators/freezers/platelet chambers  
Timers  
Automated cell washers  
Automated blood grouping or antibody screening instrumentation  
Level 2

Perform and record appropriate quality control (QC) on reagents  
Typing sera and cells  
Antibody screening and panel cells  
Antiglobulin sera and IgG sensitized control cells  
Level 2
Perform positive and negative control testing as required in tandem with patient tests when tests are not performed daily  
Lectins  
Special antigen typing  

Monitor results of quality control procedures for reagents  

List the criteria for adequate recovery of prepared component  
Test an appropriate percentage of blood units or components and interpret results for acceptability  
Packed red blood cells for volume and hematocrit  
Number of platelets and volume  
Number of units of Factor VII in cryoprecipitate  

Maintain inventory records  
Have the records available for: ABO, Rh testing performed in the last 12 months and difficulties encountered in transfusion testing according to state and federal requirements  
Store and retrieve testing results and other information from a database  

Record errors or adverse outcomes in patients and notify supervisor  

Agencies regulating blood banks  
Identify major regulatory agencies
MLT – ELC Immunohematology

Deletions & Additions

DELETIONS

Whole blood donation -- principles of donor selection
higher levels such as, Select, Identify, Perform, etc.

Blood collection
higher levels such as, Select, Identify, Perform, etc.

Donor reactions
higher levels such as, Use

Processing donor blood
higher level of, Perform tests

Autologous donors
some higher levels such as, Select, Adapt, Collect

Preparation of cellular and plasma components from donor units
some higher levels such as, Prepare (some)

Hemolytic disease of the fetus and newborn
Predict risk…..

Additions

Whole blood donation -- principles of donor selection
Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities
Added Resolve questions……

Blood collection
Updates – Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities

Donor reactions
Updates – Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities

Processing donor blood
Updates – Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities
Added more currents tests
**Autologous donors**
Updates – Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities

**Preparation of cellular and plasma components from donor units**
Updates – Modified to reflect level 1 knowledge, since actual collections are performed by blood donor facilities
- Added Prepare (several)
- Added QC

**Blood group serology**
Updates – Re-ordered sequence of subtopics
- Changed Drop to Dispense
- Added Perform and Interpret

**Antiglobulin tests**
Updates – added this section and reorganized appropriate test/concepts under it, etc

**Special methods**
Updates – added this section and reorganized appropriate test/concepts under it, etc

**Pre-transfusion testing**
Updates – Added Determine…, Analyze…

**Hemolytic disease of the fetus and newborn**
Updates – Added Perform testing…

**Human leukocyte antigens (HLA)**
Changed heading from Major to Human
MLT Entry Level Curriculum – Immunology

**Basic Concepts**

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<thead>
<tr>
<th>Define innate immunity</th>
<th>Level 1</th>
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<td>Define adaptive immunity</td>
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<td>Active immunity</td>
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<tr>
<td>State major components and function of innate immune system</td>
<td>Level 1</td>
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<tr>
<td>Physical barrier</td>
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<td>Phagocytic cells</td>
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<td>pH</td>
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<td>Lytic components</td>
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<td>Inflammatory response</td>
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<tr>
<td>Soluble mediators (cytokines, complement, acute phase reactants)</td>
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</tbody>
</table>

| Describe the cellular & organ components of the immune system & their origins | Level 1 |
| Lymphoid organs (primary & secondary)                             |         |
| Cells (B, T, macrophage)                                         |         |

| Contrast primary & secondary immune responses                  | Level 1 |

| Discuss and differentiate the features of an antigen molecule that determine immunogenicity | Level 2 |
| Molecular size & complexity                                    |         |
| Foreignness                                                   |         |
| Epitopes                                                      |         |
| Dosage, timing & route of administration                      |         |
| Cross-reactivity                                              |         |

| Discuss and compare the structure, function, properties and formation of an antibody molecule | Level 2 |
| Classes, subclasses                                           |         |
| Light & heavy chain regions                                   |         |
| Fragments (Fab, Fc)                                           |         |

| Define the following and discuss their importance in immune process | Level 1 |
| isotype                                                          |         |
| allotype                                                         |         |
| idiotype                                                         |         |
Cell-mediated Immunity

Describe T cell development Level 1

Differentiate the functions of subsets of T cells Level 2
- CD8+ (cytotoxic)
- CD4+ (Th1, Th2, Th17)
- Treg

Response to intracellular vs. extracellular pathogens

Describe and compare the process of antigen recognition/presentation for T-cell subsets Level 2
- Role of activation & antigen presenting cells
- MHC molecules involved and restricted recognition
- Co-receptors, signaling, cytokines stimulated or responded to
- Cells stimulated

Discuss and differentiate the effector functions of each T-cell subset Level 2
- Lysis
- apoptosis
- Inflammation
- B cell activation

Discuss the characteristics, role, and function of Natural Killer cells Level 2
- Lack of MHC restriction
- Lack of CD markers
- Cytokines stimulated

Humoral Immunity

Discuss the interaction of cells in the generation of antibody Level 2
- CD4+
- APC

Define isotype switching and describe how it occurs Level 1

List and describe characteristics of B cell memory Level 1
- Numbers of cells
- Titer of antibody
- Affinity of antibody

Compare antigen independent and antigen dependent B cell differentiation Level 2
- Affinity maturation
- Class switching

Describe the process of mature B cell activation Level 2
- Stimulatory molecules
- Membrane bound Ig $\rightarrow$ secreted immunoglobulin
- Plasma cell
Cytokines
Discuss and compare the characteristics and function of the major cytokines involved in innate immunity
(e.g., IL-1, IL-6, TNF-α) Level 2

Discuss and compare the characteristics and function of the major cytokines involved in adaptive immunity
(e.g., IL-2, IL-4, IL-5, IL-10, INFγ)
Cells that produce
Functions /cells affected

Discuss and compare the functions of soluble mediators affecting PMNs
and macrophages Level 2
Chemotactic factor
Migration inhibitory factor
GM-CSF

Immunological Techniques Used in the Clinical Immunology Laboratory

Discuss and describe basic immunoassay principles to include Level 1
characteristics such as complexity, methodology, phases, tags:
Visible (e.g., precipitation, agglutination, diffusion, flocculation, etc)
Competitive Binding:
(e.g., Radioimmunoassay, Enzyme immunoassay,
Chemiluminescent assays)
Non-Competitive Binding (Sandwich assays):
(e.g., Enzyme immunoassay, Chemiluminescent assays)

Discuss basic DNA techniques Level 1
(cross reference to molecular )

Discuss basic concepts of flow cytometry Level 1
(cross-reference to hematology)

Describe the operation of a flow cell cytometry instrument Level 1
(cross-referenced to hematology)

Prepare appropriate materials, reagents, and equipment for the performance of routine test procedures Level 2

Perform procedures according to established laboratory protocol Level 2

Determine acceptability of results and report according to laboratory protocol Level 2
Identify sources of error in test procedures according to laboratory protocol  
Level 2

Perform, document, and evaluate quality control  
Level 2

Perform and document routine preventive maintenance  
Level 2

**Autoimmune diseases**

Define tolerance  
Level 1

Describe proposed mechanisms for autoimmunity  
Level 1

Discuss characteristics of organ-specific and systemic autoimmune diseases  
Level 1

Describe the clinical symptoms and laboratory findings for classic autoimmune diseases  
Level 1
- collagen vascular (e.g., Systemic Lupus Erythematosus, Rheumatoid arthritis)
- Thyroid (e.g., Graves’ disease, Hashimoto’s thyroiditis)
- Addison’s Disease
- Type I Diabetes mellitus
- Celiac disease

**Tumor Associated Antigens**

Describe purpose and function of the immunosurveillance system for tumor recognition  
Level 1

List and describe antigens that are associated with human tumors  
Level 1
- Carcinoembryonic antigen (CEA)
- Alpha-fetoprotein (AFP)
- Prostate-specific antigen (PSA)
- Beta-2-microglobulin
- HCG
- Others, as applicable (e.g., CA 125, CA 19-9)

**Immunodeficiency Disorders**

Discuss the characteristics of congenital/genetic B cell immunodeficiencies  
Level 1
- X-linked hypogammaglobulinemia  
  (Bruton’s agammaglobulinemia)
- Selective immunoglobulin deficiencies (e.g., IgA)

Discuss the characteristics of congenital/genetic T cell immunodeficiencies  
Level 1
- Thymic aplasia (DiGeorge’s syndrome)
Discuss the characteristics of combined B cell and T cell immunodeficiencies  
Severe combined immunodeficiency disease (SCID)  
Wiskott-Aldrich syndrome

Complement System Deficiencies  
Describe the characteristics of common complement component deficiencies

Phagocyte Deficiencies  
Describe the clinical symptoms and laboratory findings  
Chronic granulomatous disease (CGD)  
Chédiak-Higashi syndrome  
Job’s syndrome

Acquired Immunodeficiencies  
Describe the clinical and laboratory findings in a patient with acquired B cell deficiency including secondary infections  
HIV/AIDS

Infectious Diseases  
(cross-referenced to microbiology)  
Describe the clinical and laboratory findings in various infectious diseases  
Epstein-Barr infection (infectious mononucleosis)  
Hepatitis (e.g., A, B, C)  
Group A streptococcal infection  
Syphilis  
Rubella  
CMV

Prepare appropriate materials, reagents, and equipment for the performance of test procedures

Perform procedures according to established laboratory protocol and report results

Determine acceptability of results

Identify sources of error in test procedures according to laboratory protocol

Perform, document, and evaluate quality control
Hypersensitivity

List the types of hypersensitivity and give examples of representative conditions Level 1

Types I-IV

Discuss the immunological mechanisms unique to each type of hypersensitivity Level 1
MLT Entry level curriculum
Immunology

Deletions & Additions

**Deletions**

**Humoral Immunity**
Deleted – Gene re-arrangement

**Immunodeficiency Disorders**
Deleted – Chronic mucocutaneous candidiasis
Ataxia telangiectasia

**Additions**

**Infectious Diseases**
Updates – Changed name from “Viral Infections” to be more inclusive of others such as bacterial
Added cross-reference to microbiology for this section
Added other infectious diseases – Strep, MMR, Syphilis, Rubella, CMV
Perform – modified to match “Immunological Techniques” section

**Hypersensitivity**
Same
Health care reform environment
Describe the forces affecting changes in the health care environment Level 1
State changes occurring in laboratories related to health care changes Level 1

Federal regulations, government organizations/agencies and national organizations
Describe the forces affecting changes in the health care environment Level 1
Identify and define the functions and impact on laboratory practice of the following: Level 1
- Health and Human Services (HHS)—Lab Reimbursement/Fee Schedule
- Center for Medicare and Medicaid Services (CMS)
- Centers for Disease Control and Prevention (CDC)
- Federal Drug Administration (FDA)
- Department of Transportation (DOT)
- Occupational Safety and Health Administration (OSHA)
- Bureau of Biologics (BOB)
- Clinical Laboratory Standards Institute (CLSI)
- Office of Inspector General (OIG)
- Clinical Lab Improvement Amendments (CLIA) regulations and accreditation requirements
- International Standards Organization (ISO)

Identify the governmental laws and regulations that affect the laboratory and describe their impact Level 1
- Hill-Burton Act
- Medicare Act
- Clinical Laboratory Act (CLIA) ‘67
- Balanced Budget Act 1997 (BBA)
- CLIA ‘88
- Health Insurance Portability and Accountability Act (HIPPA)
- Federal and state bioterrorism statutes
Identify the following organizations and agencies and describe their roles in laboratory accreditation

- The Joint Commission (TJC)
- College of American Pathologists (CAP)
- State Health Departments
- Commission on Office Laboratory Accreditation (COLA)
- Substance Abuse and Mental Health Service Administration (SAMHSA)
- American Association of Blood Banks (AABB)

**General Management Theory**

- Define management, leadership, and administration
- Recognize the features of a good decision and explain the steps to make a sound decision
- Identify the positive influences as well as the major barriers to effective communications

**Financial Management**

- State the principles of third party payment using insurance coding and reimbursement parameters
- Explain the difference between operational and capital budgets
- Explain the difference between supply expenses and other budget items
- Explain the process of material management and inventory control
- Record inventory levels

**Information Systems**

- Demonstrate general information technology literacy
- Use software
- Use Laboratory Information Systems
- Use RFID Technology
- Use internet applications
- State the characteristics and activities of an information system
- Recognize the features and purpose of networks
Define information technology terms and explain the use of information technology in the laboratory Level 1
Use medical informatics Level 2
Explain use of bar codes Level 1
Define the goals and objectives of a laboratory information system Level 1
State IT system security Level 1
Use email and required privacy rule(s), encryption Level 3
Identify required mobile device security Level 1
Discuss electronic health records (EHR) and explain the laboratory role Level 1

**Human Resources**
Identify by name and function the professional organizations associated with the medical laboratory profession Level 1

- American Association of Blood Banks (AABB)
- American Association of Clinical Chemists (AACC)
- American Medical Technologists (AMT)
- American Society for Clinical Laboratory Science (ASCLS)
- American Society for Clinical Pathology (ASCP)
- American Society for Microbiology (ASM)
- Clinical Laboratory Managers Association (CLMA)

List, define, compare and contrast associated credentialing mechanisms Level 2

- Certification
- Licensure
- Accreditation

List and compare the certification levels offered and the appropriate initials offered for two, four year, and doctorally educated laboratorians and the level at which each certification level functions in a clinical laboratory Level 1

- Board of Certification (BOC)
- American Medical Technology (AMT)
- American Association of Bioanalysis (AAB)

Prepare a resume or curriculum vitae Level 2
Recognize situations of unethical professional performance Level 2
State appropriate action to correct unethical or unprofessional situations Level 1
Describe CLIA personnel qualifications and responsibilities Level 1
  Laboratory director
  Technical consultant
  Clinical consultant
  General supervisor
  Testing personnel
Review career ladders Level 1

Operations Management
Describe elements of a Continuous Quality Improvement (CQI) plan Level 1
Apply Clinical and Laboratory Standards Institute (CLSI) standards for technical procedures Level 3
Describe standards for quality assessment Level 1
State the purpose of a proficiency testing (PT) program Level 1
State personnel standards including required competency assessment Level 3

General healthcare
Explain medical laboratory science’s impact on other healthcare providers and patients Level 1
Discuss the use of clinical laboratory data in the diagnosis and treatment of patients Level 1
Explain model hospital/facility organization Level 1
  Typical hierarchy
  Typical committee structure, laboratory role
Describe how laboratory services impacts the delivery of care Level 1

Professionalism: Performance standards, roles, philosophy, communication, & ethics
Exemplify concepts and practice of professional standards Level 3
Discuss and apply confidentiality and legal requirements Level 3
Demonstrate ethical and professional standards Level 2
Explain and promote professionalism and professional development impact on laboratory operations Level 2
Explain impact of professionalism on profession and healthcare delivery Level 2
Communicate to other healthcare professionals in an effective manner Level 2
Personnel Safety

Apply OSHA standards Level 3
Apply ergonomic practices to laboratory tasks Level 3
Follow policies and procedures to address bioterrorism or other public health issues Level 1
Follow a disaster preparedness program Level 1

Patient Safety and Testing

Define patient safety and health care quality using the Institute of Medicine (IOM) definitions Level 1
Describe the total testing process including pre-analytic, analytic, and post-analytic processes Level 1
Describe components of health care quality as defined by IOM Level 1

Safe: Avoiding injuries to patients from the care that is intended to help them
Effective: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit by avoiding underuse and overuse
Patient-centered: Providing care that is respectful of and responsive to individual preferences, needs, and value and ensuring that patient values guide all clinical decisions
Timely: Reducing waits and sometimes harmful delays for both those who receive and those who give care
Efficient: Avoiding waste, including waste of equipment, supplies, ideas, and energy
Equitable: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status

Follow protocols for communicating current standards of laboratory practice for laboratory testing related to specific diagnosis or condition Level 2
Explain to other the how and why of laboratory testing process Level 2
Identify and use methods to evaluate the impact of patient turnaround time on other aspects of healthcare delivery Level 2
Document Changes

Addition:
Describe the forces affecting changes in the health care environment

Editorial note:
Removed Healthcare Finance Administration and added Center for Medicare and Medicaid Services AND NCCLS changed to CLSI AND changed JCHAO to TJC to reflect current names

Additions:
ISO added to both as an agency students must know about

The following acts were added for students to know about: Balanced budget act, HIPPA, Federal and State bioterrorism statutes

Deletion:
TERFA was removed as an agency students needed to know about

Editorial Change:
Students need to know about accreditation process as a whole and not simply CAP. Furthermore, they should be able to identify the component a site survey may wish to view.

Deletions with no replacements:

Explain the differences between management of health care organizations and other businesses

List and explain the major managerial “functions”

Additions:

Recognize the features of a good decision and explain the steps to make a sound decision (Level 2)

Identify the role human behavior plays and its influence in the decision-making process (Level 1)

Identify the decision-making techniques to resolve the problems and decisions faced by the laboratory (Level 1)

Identify the sources of conflict and resistance to change and discuss the change process and incorporation of the change process in the overall operations of the laboratory (Level 1)

Define leadership within the functions of management (Level 3)

Recognize the factors that determine leadership success (Level 1)

List and compare the concepts and advantages of major leadership models (Level 2)

Explain leadership principles to the management of organizations (Level 2)
Explain the differences between management of health care organizations and other businesses (Level 2)

List and explain the major managerial “functions” (Level 2)

- Financial management
- Human resource management
- Test system management
- Operations management
- Information systems/informatics management

Addition:

Students should understand Quality Management Systems instead of continuous quality improvement.

Describe current and future reimbursement for clinical laboratory services from government agencies, insurers, and managed care groups, e.g., third party payment (Level 1)

Define medical necessity, advanced beneficiary notices, Medicare secondary payor documents, and diagnosis coding impact on laboratory reimbursement (Level 2)


Define National Coverage Determination (NCD) and Local Coverage Determination (LCD) lists (Level 2)

Explain the difference between operational and capital budgets (Level 2)

Explain the difference between supply expenses and other budget items (Level 2)

Explain the process of material management and inventory control (Level 1)

Record inventory levels (Level 1)

Deletions:

Define computer terms and explain their use in the laboratory (Level 1)

- Laboratory information systems (LIS)
- Central processing unit (CPU)
- Medical informatics
- Bar codes

Removed interviewing from ELC for management since that skill is not entry level

Additions:

Describe the key elements of a performance appraisal system (Level 1)
Explain the role of human resource management in the operation and functions of the management process (Level 2)

Describe CLIA personnel qualifications and responsibilities (Level 1)

Laboratory director
Technical consultant
Clinical consultant
General supervisor
Testing personnel

State principles of delegation and, given criteria, determine what and to whom to delegate (Level 1)

State various techniques to motivate employees (Level 1)

Identify incentives for professional development (Level 1)

Describe workflow productivity (Level 2)

Review career ladders (Level 1)

Operations Management

Write effective policies and procedures (Level 2)

Describe elements of a Continuous Quality Improvement (CQI) plan (Level 1)

Apply Clinical and Laboratory Standards Institute (CLSI) standards for technical procedures (Level 3)

Maintain an effective quality systems assessment program (Level 3)

Define Use Six Sigma (Level 2)

Use Lean Six Sigma (Level 2)

Use other quality models (Level 2)

Describe standards for quality assessment (Level 1)

Use an effective quality control system (Level 3)

State the purpose of a proficiency testing (PT) program (Level 1)

State personnel standards including required competency assessment (Level 3)

Utilize method evaluation and validation (Level 2)

Utilize process improvement and problem identification (Level 2)

Explain data gathering, data process, and use of information systems for data comparisons, storage, transformation, and retrieval (Level 2)
General healthcare

Explain medical laboratory science’s impact on other healthcare providers and patients (Level 2)

Discuss the use of clinical laboratory data in the diagnosis and treatment of patients (Level 2)

Explain model hospital/facility organization (Level 2)

Discuss typical hierarchy (Level 2)

Discuss typical committee structure, laboratory role (Level 2)

Discuss clinical pathway development, laboratory role (Level 2)

Discuss expanded or other roles for administrative MLS (Level 2)

a) Technical consultant

b) Infection control professional

c) Information technology professional

d) Marketing or client relations

e) Compliance officer

Describe how laboratory services impacts the delivery of care (Level 1)

Apply CLIA pre-analytical, analytical, and post-analytical aspects (Level 3)

Professionalism: Performance standards, roles, philosophy, communication, and ethics

Exemplify concepts and practice of professional standards (Level 3)

Discuss and apply confidentiality and legal requirements (Level 3)

Demonstrate ethical and professional standards (Level 2)

Explain and promote professionalism and professional development impact on laboratory operations (Level 2)

Explain impact of professionalism on profession and healthcare delivery (Level 2)

Communicate to other healthcare professionals in an effective manner (Level 2)

Safety

Implement a laboratory safety program (Level 2)

Use Globally Harmonized System (GHS) of classification and labeling of chemicals (Level 2)

Apply OSHA standards (Level 3)

Apply ergonomic practices to laboratory tasks (Level 3)
Follow policies and procedures to address bioterrorism or other public health issues (Level 2)

Follow a disaster preparedness program (Level 2)

Patient safety and testing

Define patient safety and health care quality using the Institute of Medicine (IOM) definitions (Level 1)

Describe the total testing process including pre-analytic, analytic, and post-analytic processes (Level 1)

Describe components of health care quality as defined by IOM (Level 1)

Safe: Avoiding injuries to patients from the care that is intended to help them

Effective: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit by avoiding underuse and overuse

Patient-centered: Providing care that is respectful of and responsive to individual preferences, needs, and value and ensuring that patient values guide all clinical decisions

Timely: Reducing waits and sometimes harmful delays for both those who receive and those who give care

Efficient: Avoiding waste, including waste of equipment, supplies, ideas, and energy

Equitable: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status

Identify methods to measure the effectiveness of laboratory testing (Level 2)

Testing performed for screening purposes

Testing performed to monitor progress of chronic diseases

Testing performed to monitor rates of disease diagnosis using measurements of positive and negative predictive values

Follow an effective patient safety program (Level 3)

Describe and apply changes in public health policy and oversight of healthcare delivery system that fosters and improves patient safety (Level 3)

Use facts and trends in sentinel event investigation (Level 2)

Explain overuse, underuse, and misuse of laboratory testing (Level 2)

Identify appropriate laboratory tests to order using evidence-based methods (Level 1)

Testing performed to screen for conditions and diseases

Testing performed for diagnosis of conditions and diseases

Testing performed to monitor prognosis after diagnoses of conditions and diseases

Testing performed to monitor therapy implemented to treat conditions and diseases
Identify appropriate protocols to monitor utilization of blood products in transfusion services (Level 1)

Follow protocols for communicating current standards of laboratory practice for laboratory testing related to specific diagnosis or condition (Level 2)

Identify methods to provide patient-centered laboratory services (Level 1)

Pre-analytic phase of laboratory total testing process

Cultural differences

Patient preferences

Explain to other the how and why of laboratory testing process (Level 3)

Identify and use methods to evaluate the impact of patient turnaround time on other aspects of healthcare delivery (Level 2)

Identify and use methods to quantify inefficiencies in the pre-analytic, analytic, and post-analytic phases of the total testing process, i.e., quantify savings due to improvement of efficiencies (Level 2)

Technical consultant

List the CLIA qualifications for a technical consultant (TC) (Level 1)

List the CLIA TC responsibilities (Level 1)
MLT Entry Level Curriculum – Clinical Chemistry

Mathematics and Chemical Calculations
- Perform basic calculations
- Exponents
- Molarity
- Percentage
- Ratios and proportions
- Unit conversions (concentration relationships)
- Percent to molarity; molarity to percent
- Standard solutions
- Define Dilutions (Serial and Ratio)
- Calculate and Perform Dilutions (Serial and Ratio)
- Define units of systems of measurement
  - Metric
  - International system of units (SI units)
- Define conversions between and among systems of measurement
  - Metric to SI
  - SI to metric
- Perform temperature conversions
  - Fahrenheit to Celsius
  - Celsius to Fahrenheit
- Define statistical data for quality control and statistical analyses
- Calculate and utilize statistical data for quality control and statistical analyses
  - Refer to General Lab Document page 5
  - Mean, Median, Mode
  - Standard deviation
  - Coefficient of variation
  - Confidence limits

Instrumentation: Spectrometry
- Identify basic concepts of spectrophotometry
  - Principles of light absorption
  - Wavelength
  - Spectrum
  - Beer’s law
  - Complementary spectra
- Identify spectrophotometer components
  - Light source
  - Monochromator
  - Cuvets
  - Light detectors
  - Read-out systems
- Describe the operation of a spectrophotometer
  - Function controls
  - Standard curves
- Explain maintenance/quality assurance of instrumentation
  - Stray light

Commented [MB1]: This is also in General Lab document
Commented [MB2]: This is also in General Lab document
Sensitivity
Linearity
Wavelength calibration

Perform test procedures on standards, controls, and unknowns Level 2
Calculate, if necessary, and record quality control (QC) data
Evaluate quality control data (QC)
Accept/reject results
Take appropriate corrective action, if necessary
Report results, if acceptable

Perform routine maintenance checks on all spectrophotometers Level 2
Correlate test results with other laboratory test and patient diagnosis Level 2

**Instrumentation: Turbidimetry and Nephelometry**
- State basic concepts of turbidimetry and nephelometry Level 1
  - Principles of absorption and light scatter
  - Reflectance

**Instrumentation: Atomic Absorption Spectrophotometry**
- State basic concepts of atomic absorption spectrophotometry Level 1
  - Principles of light absorption
  - Generation of atoms from molecules

**Instrumentation: Fluorometry**
- State basic concepts of fluorometry Level 1
  - Principles of light absorption and emission by molecules
  - Absorption and emission spectrum

**Instrumentation: Luminescence**
- State basic concepts of luminescence Level 1

**Instrumentation: Osmometry**
- Describe unique components relative to Osmometry Level 1
  - Principles of osmolality (colligative properties)
  - Definition
  - Calculations

**Instrumentation: Electrochemistry**
- Explain basic concepts of electrochemistry Level 1
  - Principles of electrochemistry
  - Potentiometry
  - Electrodes
- Describe the basic components of electrochemistry Level 1
  - Reference electrode
  - Indicator electrode
  - Salt bridge
- Describe the basic concepts of ion-selective electrodes Level 1
  - Glass
Solid state
Liquid membrane

State the difference between a direct and indirect ISE  Level 1
Correct malfunction according to manufacturer’s protocol   Level 2
Perform test procedures on standards, controls, and unknowns Level 2
Evaluate quality control data (QC)
Accept/reject results
Take appropriate corrective action, if necessary
Report results, if acceptable

Correlate test results with other laboratory tests and patient diagnosis  Level 2

Instrumentation: Blood Gas Analyzers
State basic concepts of blood gas analyzers   Level 1
Describe basic components of blood gas analyzers Level 1
  pCO2 electrode
  pO2 electrode
  pH electrode
  ISE electrode (if applicable; see electrochemistry section)
Cooximetry
Sample chamber
Describe operation of blood gas analyzers Level 1
  Function controls
  Sample handling
Perform routine maintenance/quality assurance of blood gas analyzers (if available) Level 2
  Standard gases
  Electrode and membrane care
  Interference
Perform test procedures on standards, controls, and unknowns Level 2
  Evaluate quality control data (QC)
  Accept/reject results
  Take appropriate corrective action, if necessary
  Report results, if acceptable

Correlate test results with other laboratory tests and patient diagnosis  Level 2

Instrumentation: Balances
Describe basic mechanisms and types of balances Level 1
Define balancing terminology Level 1
  Capacity
  Sensitivity
  Precision
  Readability
  Tare
Operate balances Level 2
  Leveling
  Handling weights
  Pan and/or beam arrest
Weighing paper or boats
Cleanliness
Temperature
Elimination of drafts, vibrations, etc.

Calibrate balances following established laboratory procedure  Level 2

Perform routine maintenance checks on all balances  Level 2

Instrumentation: Centrifuges
- Explain basic concepts of centrifugation Level 1
- Principles of centrifugal force
- Tachometer
- Relative centrifugal force

Identify basic components of a centrifuge  Level 1
- Head (rtor)
- Bowl and cover (chassis)
- Shields, cups
- Brushes
- Cushion

Describe operation of centrifuge  Level 1
- Function controls
- Balancing

Operate centrifuges  Level 2
- Load and balance
- Lock head
- Select appropriate speed (temperature, if applicable)
- Follow safety precautions

Perform routine maintenance checks on all centrifuges  Level 2

Instrumentation: Heating Units

Perform routine maintenance on heating units following established laboratory procedure  Level 1

Check/calibrate temperature setting of heating units  Level 2
Correct malfunction according to manufacturer's manual  Level 2

Instrumentation: Electrophoresis

State basic concepts of electrophoresis  Level 1
- Principles of electrophoresis
- Voltage, current
- pH
- Ionic strength
- Buffers
- Temperature

Describe the basic components of electrophoresis  Level 1
- Support media: cellulose acetate/gel/agarose
- Chamber
- Buffer
- Electrodes
Power supply
Densitometer

Describe the operation of electrophoresis Level 1
Sample application
Time
Temperature
Voltage, current
Stains

Perform analyses according to laboratory procedure (if available) Level 2
Accept/reject results
Evaluate and record quality control data
Report results, if acceptable
Correlate results with disease/diagnosis Level 2

Instrumentation: Chromatography
State basic concepts of chromatography Level 1
Separation mechanisms (partition, absorption)
Define basic chromatography techniques Level 1
Column
Thin layer (TLC)
Liquid (HPLC)
Gas (GLC)
Describe the basic components of a chromatography system Level 1
Flow regulation
Mobile phase
Stationary phase
Column
Detectors

Instrumentation: Mass spectrophotometer
State basic concepts of mass spectrophotometry Level 1

Instrumentation: Automation
State basic concepts of automated analyzers Level 1
Discrete sample systems, self-contained and special purpose (POC)
Describe operations and principles of the automated systems Level 1
Describe the basic components of an automated system Level 1
Sample/reagent pick-up/dilution
Transfer module/mechanism
Spectrophotometer module
Control/calibration module
Readout/recorder
Operation/calibration
Maintenance/quality assurance
Troubleshooting
General Clinical Chemistry

Evaluate quality control data  Level 3
Select control materials for use
Analyze data for acceptability
If data unacceptable, identify problems or causes
Follow corrective action to resolve problem and document
Verify or establish reference intervals ("Normal ranges")  Level 3
List reference intervals for major analytes  Level 1
Correlate all patient test data for acceptability  Level 2
Review normal physiology and function (liver, cardiac, kidney, etc.)
Interpret patient test results using reference intervals and previous patient data
Recognize pathophysiology of “abnormal” results
Assess pre-analytic and analytic factors that can affect patient results Level 3
Sample integrity, draw time, preservation or storage
Age, gender, ethnicity
Diet, nutritional status, fasting, post prandial
Exercise, position or posture
Sample processing and identification
Method interfering substances/sources of error
Recording of results
Report results according to laboratory protocol  Level 2
Routine
STAT
Action limits (critical values)

General Clinical Chemistry:
Carbohydrates

Define the following terms Level 1
Monosaccharide
Disaccharide
Polysaccharide
Glycosidic linkage
Aldose
Ketose
Hexose
Pentose
Isomer

State the components of the disaccharides Level 1
Lactose
Maltose
Sucrose

State the composition and function of each of the following polysaccharides Level 1
Starch
Glycogen

Discuss carbohydrate metabolism Level 1
State the purpose of digestion and absorption of dietary carbohydrates
State how glucose is transported in the blood
State the main physiologic functions of carbohydrates
State the purpose of the following glucose pathways
   - Glycolysis
   - Gluconeogenesis
   - Glycogenesis
   - Glycogenolysis
State whether the following hormones increase or decrease blood glucose levels Level 1
   - Insulin
   - Glucagon
   - Cortisol
   - Adrenocorticotropic hormone (ACTH)
   - Epinephrine
   - Thyroxine
   - Growth hormone (GH)
   - Human placental lactogen (HPL)
Discuss the maintenance of blood glucose levels in the “fed state” (parenteral) and the “fasting state” Level 1
List disease states and disorders associated with carbohydrate metabolism Level 1
Explain etiology, symptoms, and effects of hyperglycemia Level 1
   - Type 1, Type 2, and gestational diabetes mellitus (GDM)
   - Cushing’s syndrome
   - Hyperthyroidism
   - Hyperpituitarism
   - Other diseases/conditions
Explain the diagnostic criteria for Type 1, 2 (impaired glucose tolerance and provisional diabetes mellitus), and GDM Level 1
Explain etiology, symptoms, and effects of hypoglycemia Level 1
   - Induced
   - Fasting
   - Reactive
State the general cause and resulting disorder(s) for inborn errors of metabolism Level 1
   - Galactosemia
   - Glycogen storage disorders
   - Lactose intolerance
Explain methodologies for carbohydrate determinations Level 1
   State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness of each Level 1
   - Glucose oxidase
   - Hexokinase
   - Glycated hemoglobin (A1C)
Explain the usefulness of, patient preparation, and the procedure for a glucose tolerance
test; include normal and diagnostic levels Level 1
State the qualitative or quantitative method used for detection Level 1
Other reducing substances
Ketones
Urinary sugars
Cerebrospinal fluid (CSF) glucose

Explain the usefulness of Level 1
Insulin and C-peptide

Perform carbohydrate analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3

Correlate all patient results and patient outcomes with disease state or disorder Level 2
State the usefulness of bedside or at-home glucose monitoring devices; compare results to non-POC analyzer results Level 1

General Chemistry:
Lipids

Define the lipid associated terminology Level 1
Lipid / Lipase
Simple /Complex lipid
Lipemia
Lecithin
Sphingomyelin
Glycolipid
Lipoprotein
Aipoprotein
Esterification
Saturated/Unsaturated

State structural characteristics of lipids Level 1
Cholesterol
Fatty Acids
Triglycerides
Phospholipids

Compare the lipoproteins using the difference in lipid and protein composition Level 2
Chylomicron
Very low density lipoproteins (VLDL)
Low density lipoproteins (LDL)
High density lipoproteins (HDL)

Discuss lipid metabolism Level 1
State the main transport route of dietary lipids Level 1
State the main physiologic functions of lipids Level 1
State the origin, main function of each lipoprotein; include apoprotein(s) required for normal function Level 1
Explain the lipid pathways; include exogenous, endogenous, reverse Level 1
For the following pre-analytical variations, identify, and explain the effects of each on serum
lipid levels Level 1
Intra-individual variation
Variation due to age, gender, and race
Lifestyle/behavior variations
Correlate disease states and disorders associated with hyperlipidemias Level 2
Hyperglycemia/ Hypoglycemia
List the lipid levels associated with hereditary disorders Level 1
abetalipoproteinemia
hypobetalipoproteinemia
Tangier disease
State the disorders/conditions associated with lipid imbalances Level 1
Atherosclerosis
Malabsorption states
Biliary obstruction
Pregnancy
Postmenopause
Ketosis
Fatty liver
Lipid storage diseases
Hyaline membrane disease/Respiratory Distress Syndrome
List methodologies for lipid determinations
State the principle of the chemical reaction, reference interval, most common interfering substances/sources of error, and the usefulness Level 1
Cholesterol
Triglycerides
LDL
HDL
Explain the calculation for LDL
List the usefulness of apolipoprotein measurements
Explain recommended patient preparation protocol, specimen requirements, and abnormal serum appearance when collecting or handling specimens for lipid analysis Level 1
Perform lipid analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

General Chemistry:
Proteins

Define protein-associated terminology Level 1
Isoelectric point
Amino acid
Peptide bond
Complex or conjugated protein
State protein structures and classifications Level 1
Contrast protein structures Level 2
Primary
Secondary
Tertiary
Quaternary

State protein metabolism Level 1
State the main transport route of dietary amino acids Level 1
Discuss synthesis Level 1

Non-essential amino acids
Cellular proteins; include DNA and RNA

State the main physiologic functions of plasma proteins Level 1
State the main site of synthesis for plasma proteins Level 1
State the electrophoretic fraction in which each is located, the normal function, and disease states associated with abnormal levels Level 1

Albumin
Alpha-1-antitrypsin
Fetal fibronectin
Alpha-2-macroglobulin
Haptoglobin
Ceruloplasmin
Transferrin
Fibrinogen
C-reactive protein
Immunoglobulins

List the cause for elevated urine levels Level 1
Albumin (microalbumin)
Immunoglobulin
Immunoglobulin light chains (Bence-Jones protein)
Beta-2-microglobulin

Explain the role of fetal fibronectin in preterm delivery Level 1

State the reference range for serum total protein and albumin Level 1
Correlate disease states and disorders associated with total protein levels and other test results Level 2
Dehydration
Multiple myeloma
Nephrotic syndrome
Malabsorption
Liver disease
Hemolytic anemia
Acute phase reaction
Hypogammaglobulinemia
Congestive heart failure (beta-natriuretic peptide)

Correlate the serum protein electrophoresis pattern with disorders Level 2
Nephrotic syndrome
Monoclonal gammopathy
Hypogammaglobulinemia
Liver cirrhosis
Acute phase reaction
Polyclonal gammopathy/inflammation

Discuss methodologies for protein determinations Level 1
State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness Level 1
- Biuret
- Turbidimetry/nephelometry
- Dye binding

Protein electrophoresis
State the property of proteins that allows separation or classification Level 1
- Electrophoresis
- Isoelectric focusing
- Ion exchange chromatography
- Ultracentrifugation

Imunochemical assay

Perform protein analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3

General Chemistry:
Enzymes
Define enzyme-associated terminology Level 1
- Enzyme
- Catalyst
- Cofactor
- Apoenzyme
- Coenzyme
- Prosthetic Group
- Active Site
- Substrate
- Product
- Inhibitor
- Kinetic
- International Unit
- Isoenzyme
- Vmax
- Km
- Activation Energy
- Michaelis-Menten Constant
- First Order Reaction
- Zero Order Reaction

State enzyme classification, nomenclature, and structure Level 1
State the chemical composition of an enzyme Level 1
State the most common physiologic functions of enzymes Level 1
Explain theories of substrate binding by enzymes Level 1
- Lock and key
Induced fit

List factors affecting enzyme reaction rates Level 1
- Temperature
- Substrate concentration
- pH
- Enzyme concentration
- Time
- Isoenzymes
- Substrate specificity

List types of activators Level 1
List types of inhibitors (reversible/irreversible) Level 1
List clinically significant enzymes Level 1
- Lactate dehydrogenase (LD)
- Creatine kinase (CK), CK-MB, CK isoforms
- Aspartate amino transferase (AST)
- Alanine amino transferase (ALT)
- Gamma glutamyl transferase (GGT)
- Alkaline phosphatase (ALP)
- Amylase (AMY)
- Lipase (LIP)
- Cholinesterase/pseudeocholinesterase

Discuss the usefulness of measuring enzymes Level 1
State the primary tissue source(s) of clinically significant enzymes Level 1
Explain the significance of abnormal serum levels and correlate with specific disease states or disorders Level 2
- Myocardial infarction
- Liver disease
- Muscle disease
- Bone disease
- Malignancy
- Hematological disorders
- Pancreatitis

State the kinetic measurement (first order, zero order) that is preferred for use in an analytical method Level 1
Contrast endpoint and continuous monitoring kinetic methods Level 2
List examples of the use of enzymes as analytical reagents Level 1
State the chemical principle and reaction of the most commonly used methods for determining levels of the clinically significant enzymes Level 1
- Method of quantitation (kinetic, endpoint, immunoassay, etc.)
- Specimen required, special preservation, sample treatment
- Most common interfering substances/sources of error
- Reference interval and units

Perform enzyme analyses according to established laboratory protocol Level 2
- Determine acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
Chemistry: Disease Markers

State the origin and the usefulness in the detection of and risk assessment for an MI
Level 1
CK/MB
Myoglobin
Troponin
hs-CRP
Lp(a)
Homocysteine

Chemistry: Non-protein
Nitrogen

List disease states and disorders associated with urea measurement Level 1
Pre-renal causes
Renal causes
Post-renal causes
Decreased formation (liver disease)
Over-hydration; dilution
End stage renal disease
List methodologies for urea nitrogen Level 1
State the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error, and the usefulness Level 1
Perform urea nitrogen analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

State the usefulness of creatinine measurement Level 1
Explain creatinine synthesis and mode of excretion Level 1
Discuss disease states and disorders associated with creatinine measurement Level 1
Renal disease
Muscle wasting disease
List methodologies for creatinine Level 1
For the most common methods, state the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error Level 1
Perform creatinine analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2
Calculate creatinine clearance results using body surface area normalization Level 2
Differentiate eGFR and GFR Level 2

Commented [MB3]: Cross reference to Urinalysis
State the reference range and explain the usefulness of the BUN/creatinine ratio Level 1
State the usefulness of uric acid measurement Level 1
Explain uric acid synthesis of and mode of excretion Level 1
List disease states and disorders associated with uric acid measurement Level 1
Renal disease
Gout
Increased cell turnover (Leukemia, Chemotherapy)
List methodologies for uric acid Level 1
Perform uric acid analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2
List disease states and disorders associated with uric acid measurement Level 1
Renal disease
Liver disease
Inborn errors of metabolism

State the usefulness of ammonia measurement Level 1
Explain ammonia synthesis and mode of excretion Level 1
List methodologies for ammonia Level 1
For the most common methods, state the principle of the chemical reaction, sample types required, reference interval, most common interfering substances/sources of error Level 1
Perform ammonia analyses (if available) according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

General Chemistry: Electrolytes and Trace Elements
Define electrolyte-associated terminology Level 1
Electrolyte
Anion
Cation
Intracellular/extracellular
Anion Gap
Trace element
Discuss electrolyte metabolism Level 1
State the physiologic function and distribution of the following electrolytes Level 1
Sodium
Potassium
Chloride
Bicarbonate
Calcium
Magnesium
State the regulation of Sodium
Dietary intake
Aldosterone
Renin
Kidney function

State the regulation of Potassium
Dietary intake
Blood pH
Kidney function

State the regulation of Chloride
Follows sodium
Blood pH

State the regulation of Bicarbonate
Blood pH

State the regulation of Calcium
Parathyroid hormone (PTH)
Calcitonin
Protein affects total calcium
Blood pH
Vitamin D

State the regulation of Magnesium
Aldosterone
PTH

State the regulation of Phosphate
PTH
Calcitonin
Vitamin D

State the physiologic function and distribution
Iron
Copper

State the regulation of Iron
Iron
Intestinal absorption
Transferrin
Serum iron
Ferritin

State the regulation of Copper
Absorption
Ceruloplasmin

Explain water movement and metabolism
Intracellular
Extracellular
Osmosis
Maintenance of electrical equilibrium
Effect of macromolecules

Describe water regulation Level 1
- Anti-diuretic hormone (ADH) (vasopressin)
- Renin-angiotensin-aldosterone system
- Thirst center

State the basic concepts in the measurement of osmolality Level 1
- Definition
- Colligative properties of solutions

State the significance of results Level 1
- Reflection of electrolyte-fluid balance
- Assessment of renal concentrating ability

State the difference between a direct and indirect ISE Level 1

State electrolyte specimen requirements and most common sources of error

Perform electrolyte and trace elements analyses according to established laboratory protocol Level 2
- Determine acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
- Correlate patient results with disease state or disorder Level 2

Discuss disease states and disorders associated with electrolyte metabolism Level 3

State reference intervals and critical values Level 1
- Sodium
- Potassium
- Chloride
- Bicarbonate
- Calcium
- Magnesium
- Phosphate

Define by including the diagnostic level and list causes and symptoms Level 1
- Hyponatremia
- Hypernatremia
- Hypokalemia
- Hyperkalemia
- Hypochloremia
- Hyperchloremia
- Increased levels of bicarbonate
- Decreased levels of bicarbonate
- Hypocalcemia
- Hypercalcemia
- Hypomagnesemia
- Hypermagnesemia
- Hypophosphatemia
- Hyperphosphatemia
Define and explain the usefulness of the Anion Gap  Level 1
Given electrolyte data, calculate the Anion gap  Level 2
Correlate an increased or decreased Anion gap with specific disorders or conditions  Level 2
Utilize the Anion gap as a quality control measure when performing electrolyte analyses  Level 2

General Chemistry: Acid-Base and Blood Gas Studies

Define blood gas analysis terminology Level 1
   Acid, acidosis, acidemia
   Base, alkalosis, alkalalemia, base excess
   Buffer
   pH
   Partial pressure
   Oxygen saturation, PSO2, oxygen capacity
   Hypoxia, hypoxemia
   Henderson-Hasselbalch equation

Explain the application of the Henderson-Hasselbalch equation  Level 1

List blood buffer systems  Level 1
   Bicarbonate/carbonic acid
   Proteins
State the plasma buffering systems  Level 1
State the RBC/hemoglobin buffering mechanism  Level 1
State regulation of acid-base balance  Level 1

List the mechanisms of bicarbonate reabsorption by the renal tubules Level 1
   Sodium-hydrogen exchange/H+ secretion
   Sodium-potassium exchange/secretion of K+
   Secretion of ammonia

State the mechanisms of carbon dioxide excretion via the lungs  Level 1
   Mechanism for expiration of CO2
   Factors affecting pCO2 or H2CO3

Explain compensatory mechanisms  Level 1
   Pulmonary compensation with primary metabolic change (change in HCO3)
   Hypoventilation if bicarbonate increased (increased pCO2 if increased HCO3)
   Hyperventilation if bicarbonate decreased (decreased pCO2 if decreased HCO3)
   Renal compensation with primary respiratory change (change in CO2)
   Retention of bicarbonate, if CO2 is retained
   Excretion of bicarbonate, if CO2 is blown off

List causes for metabolic acidosis = bicarbonate deficit
List causes for metabolic alkalosis = bicarbonate excess
List causes for respiratory alkalosis = decreased carbonic acid
List causes for respiratory acidosis = increased carbonic acid

Evaluate blood gas results to determine defect  Level 3
Discuss oxygen metabolism Level 1

Define hemoglobin oxygen saturation
List factors that affect oxygen dissociation from hemoglobin 2,3-diphosphoglycerate (DPG) Level 1
- pH
- Temperature
- Carbon monoxide (CO)
State causes for a shift to the left Level 1
State causes for a shift to the right Level 1
Discuss blood gas analysis Level 1
State the components of cooximetry methodology Level 1 (refer to instrumentation)

Explain arterial blood gas specimen collection and handling requirements Level 1
Explain most common sources of error Level 1
If available, perform blood gas analyses according to established laboratory protocol Level 2
- Determine acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

General Chemistry: Therapeutic Drug Monitoring (TDM) and Toxicology

Define the TDM-associated terminology Level 1
- Therapeutic drug monitoring
- Toxicology
- Steady State
- Half life (t1/2)
- Therapeutic range
- Peak and trough
- Drugs of abuse
- Emergency toxicology
- Chronic poisoning
List factors that influence toxicity Level 1
Explain and demonstrate proper specimen collection Level 2
- Time of blood draw relative to last dose
- Requirements for legal samples
- Requirements for forensic samples
Explain the usefulness of screening methods Level 1
Perform drug analyses (if available) according to established laboratory protocol Level 2
- Determine acceptability of results Level 3
- Report results according to laboratory protocol Level 2
- Perform, document, and evaluate quality control Level 3
General Chemistry: Vitamins, Provitamins, Derivatives
Correlate disease states with vitamin deficiencies Level 2

General Chemistry: Hemoglobin

State basic concepts relating to the significance of bilirubin Level 1
Heme catabolism
Bilirubin conjugation
List diseases associated with bilirubin metabolism Level 1
Prehepatic jaundice (neonatal/hemolytic anemia)
Dubin-Johnson syndrome
Rotor’s
Crigler-Najjar
Hepatitis
Cirrhosis
Posthepatic jaundice

State methods of analysis for total/direct bilirubin Level 1
Perform bilirubin analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

Chemistry: Endocrinology

Define endocrinology associated terminology — Level 1
Hormone
Endocrine
Releasing factor/hormone
Tropic hormone
Effector hormone
Glucocorticoid Mineralcorticoid
Diurnal variation

State the source and intended effect of protein hormones Level 1
Growth hormone
Adrenocorticotropic hormone (ACTH)
Thyroid stimulating hormone (TSH)
Follicle stimulating hormone (FSH)
Luteinizing hormone (LH)
Prolactin (PRL)
Antidiuretic hormone (ADH)/vasopressin
Calcitonin
Parathyroid hormone (PTH)
Insulin
Glucagon
Human chorionic gonadotropin (HCG)

State the source and intended effect of steroid hormones Level 1
- Cortisol
- Aldosterone
- Androgens
- Testosterone
- Dehydroepiandrosterone (DHEA)
- Dehydroepiandrosterone-sulfate (DHEA-S)
- Progesterone
- Estrogens/estradiol/estriol

State the source and intended effect of amine hormones Level 1
- Catecholamines
- Thyroxine (T4)
- Triiodothyronine (T3)
- Serotonin/5-hydroxyindolacetic acid (5-HIAA)

List disease states and disorders associated with endocrine metabolism Level 1
State the difference between primary, secondary, and tertiary disorders Level 1
State the cause and symptoms associated with each disorder Level 1
State the most common screening and diagnostic testing for hypothyroid disorders Level 1
- Hashimoto’s thyroiditis
- Myxedema
- Congenital
State the most common screening and diagnostic testing for hyperthyroid disorders Level 1
- Grave’s disease

List factors that affect hormone levels other than endocrine diseases Level 1
- Emotional stress
- Time of day
- Menstrual cycle
- Menopause
- Food intake/diet
- Hormone therapy
- Drugs

List relevant hormone and/or metabolite determinations in Thyroid Testing Level 1
- TSH
- Free T4
- free T3
- reverse T3
- TBG
- Antithyroid antibodies

List relevant hormone and/or metabolite determinations in Adrenal Testing Level 1
- Cortisol
- Urinary/primary free cortisol
ACTH
DHEA-S
Aldosterone
Renin
Catecholamines
Vanillylmandelic acid (VMA) and metanephrines

List relevant hormone and/or metabolite determinations in Metastatic carcinoid tumor analysis Level 1
Serotonin

List relevant hormone and/or metabolite determinations in Infertility Testing Level 1
FSH
LH
Testosterone
Progesterone
Estrogens

Perform hormone analyses according to established laboratory protocol Level 2
Determine acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 3
Correlate patient results with disease state or disorder Level 2

**Genetic Disorders**
Define genetic disease Level 1
Categorize and list examples of genetic diseases Level 1
Chromosomal aberration
Inborn errors of metabolism
ELC – Chemistry MLT Deleted Items

**Math and Instrumentation:**

- Calculations: Logarithms, Hydrates, Specific gravity
- Non-metric units of measurement
- Instrumentation: Electronics
- Spectrophotometer calibration and maintenance
- AAS basic components
- Blood gas analyzer temperature maintenance and readout systems, electrode balance and slope adjustment with standard gases
- Balance maintenance
- RCF calculations
- Centrifuge maintenance
- Densitometer calibration
- ELP maintenance
- Establishment of lab procedures
- Chromatography calculations and maintenance
- Coulometric Amperometry

**Carbohydrates:**

- Fructosuria
- Hereditary fructose intolerance
- Glucose dehydrogenase
- Glycated serum protein/fructosamine
- Lactic acid methodology
- Insulin antibodies
- Lactose tolerance
- D xylose
- Discuss recent advances
**Lipids:**
- Steroids
- Terpenes
- Prostaglandins
- Carotenoids
- Fat-Soluble Vitamins
- Detailed Lipid Pathway information
- Urine fat methods (included in UA)
- Fecal Fat analysis patient prep and procedure
- Compare lipid results to non POC analyzer results
- Discuss recent advances

**Proteins:**
- Zwirterion
- Protein targeting
- Regulatory hormones
- Transamination, oxidative deamination, ketogenic and glycogenic amino acids
- AFP (in Immunology-tumor markers)
- Cause for elevated urine protein (in UA document)
- Recent advances

**Enzymes:**
- Metabolism
- Enzyme calculations
- Synthesis, catabolism and regulation
- Plasma vs. non-plasma specific enzymes
- Recent advances

**Disease Markers:**
- Methods: CK-MB, Myoglobin, Troponin, hs CRP
- Ischemia modified albumin (IMA)
NPN:
Creatinine chemical structure

Electrolytes and Trace Elements:
Zinc
Manganese
Chromium
Recent advances

Acid-Base:
Imidazole group of histidine
Disease states associated with ABG imbalance

TDM and Toxicology:
Pharmacokinetics
Metabolism, biotransformation, elimination
Toxicology terms
Mechanisms of toxicity
Toxicology analytic methods
Recent advances

Vitamins:
Deleted all EXCEPT correlation of disease states with vitamin deficiencies

Hemoglobin:
Heme synthesis (covered in Hematology)
Porphyrin disease states
Porphyrin analysis

Body Fluids:
Amniotic Fluid
Seminal Fluid (EXCEPT post-vasectomy)

Endocrinology:
Hormone structure and classification
Hormone synthesis, metabolism and mechanism of action
Non-thyroid illness causes of abnormal thyroid tests
Total T3, Total T4, T3 Uptake and FTE/FTI
Dexamethasone Supression Test
Metyrapone Test
ACTH Stimulation Test

**PENDING:**
SPELP patterns correlated with disease
Basic components of chromatography
IEM etiology and lab testing

**ELC – Chemistry MLT Added Items**

**Instrumentation:**
- Turbidimetry and Nephelometry – basic concepts
- AAS-basic concepts
- Luminometer-basic concepts
- Mass Spec-basic concepts

**Carbohydrates:**
- Disaccharide components
- Composition and function of starch and glycogen
- Diagnostic criteria for Type 1, 2 (impaired glucose tolerance and provisional diabetes mellitus), and GDM

**Lipids:**
- Lipemia
- Saturated / Unsaturated fats
- Atherosclerosis

**Proteins:**
- Fetal fibronectin
- Congestive heart failure (BNP)

**Disease Markers:**
- Hs-CRP
- Lp(a)
- Homocysteine

**TDM & Toxicology:**
- Drugs of abuse
Emergency toxicology
Chronic poisoning
Factors that influence toxicity

**Hemoglobin:**
Dubin-Johnson syndrome
Rotor’s
Crigler-Najjar
Education
MLT Entry Level Curriculum

Compare and contrast competency and proficiency  Level 2
Describe the characteristics and qualities of an effective instructor  Level 1
Define basic educational terms  Level 1

Competence or competency

Objectives
Curriculum (as it applies to laboratory science programs)
Articulation (as it applies to laboratory science programs)
Continuing education unit (CEU)
Accreditation
Certification
Licensure
Evaluation
Reciprocity

Explain the purpose and use of the three domains of learning  Level 1

Cognitive
Psychomotor
Affective

Explain the purpose and use of the three modified taxonomy levels for the cognitive domain  Level 1
Level 1: Recall of information (knowledge)
Level 2: Understand information and applying it to other material or new situations (comprehension/application)
Level 3: Problem solving (analysis/synthesis/evaluation)

Explain the purposes and uses of objectives  Level 1
DOCUMENT CHANGES
Registration removed as term to define and reciprocity was inserted

Addition:

Compare and contrast competency and proficiency

Given an example of an objective, identify the domain, and if in the cognitive domain, identify the correct taxonomic level

Given an example of an objective, identify the domain

Given an example of an objective, identify the domain, and if in the cognitive domain, identify the correct taxonomic level

Given an example of a learning activity, identify the domain

Editorial Comment:

Distance-based methods was replaced by a more granular level of differentiation (hybrid, online, simulation, etc).

Establish staff development programs, continuing education (formal and informal)

Discuss the importance of staff development programs and continuing education

Deletion with no replacement:

Establish in-service education programs.
General
MLT Entry Level Curriculum

Laboratory Safety
Identify the following safety equipment and explain their use Level 1

- Fire extinguishers, blankets
- Fume hood
- Eye wash
- Safety shower

Personal Protective Equipment

- Splash guards
- Vented storage cabinets
- Acid storage cabinets
- Flammable storage cabinets
- Broken glass/sharps containers
- Spill kits
- Biological safety cabinet
- Engineering controls

Inspect and maintain safety equipment Level 2

- Follow procedures and techniques for maintenance, inspection and use of safety equipment
- Determine location of safety of safety equipment
- Monitor inspection, maintenance and documentation of safety equipment
- Maintain safety data sheets (SDS)

Recognize and report hazardous situations Level 1

- Identify potential sources of lab hazards
  - Fire
Electrical

Chemical

Biological/bioterrorism

Document laboratory accidents and unsafe procedures  Level 1

Utilize appropriate safety equipment and procedures according to established laboratory protocol  Level 1

Stock and maintain emergency medical supplies  Level 1

Follow laboratory protocol for disposal of contaminated materials  Level 2

Properly decontaminate work surfaces  Level 2

**General Laboratory Supplies and Equipment**

Identify attributes, advantages, advantages and disadvantages of specific type of glassware  Level 1

Select appropriate labware for specific procedures  Level 2

**Nonvolumetric**

Beakers

Flasks

Cuvettes

Pipettes

**Volumetric**

Flasks

Pipettes

**Automated Pipets**

Correctly use labware  Level 2

Correctly dispose of used labware  Level 2

Correctly clean Nondisposable labware  Level 2

Perform calibration of automatic pipets  Level 1
Select appropriate method of water purification Level 2

- Distilled
- Deionized
- Reverse Osmosis

Explain types of (CLSI) reagent grade water Level 1

**Chemicals**

Identify grades of purity Level 1

- Commercial or technical
- Commercially pure
- Reagent grade
- United States Pharmacopeia certified (USP)

Perform solution preparation Level 2

- Select correct chemical
- Perform necessary calculations
- Weigh/measure concentrates
- Label and store
- Observe safety requirements

**Standards/Controls**

Identify types of standards Level 1

- Primary
- Secondary

Identify types, uses and limitations of controls Level 1

- Assayed
- Unassayed

**Microscopes**

Prepare microscope for optimized viewing Level 2
Clean microscope components using appropriate care Level 2
Adjust light source for proper illumination level Level 3
Place filters (e.g., neutral density) in light path appropriately Level 2
Protect microscope from dust when not in use, i.e., dust cover Level 2
Select type of microscopy and adjust appropriately for optimum viewing (brightfield, phase contrast, polarizing, interference contrast, red compensating filters) Level 3
Optimize condenser position Level 3
  Height
  Centration
Adjust diaphragms appropriately for optimum viewing Level 3
  Field iris
  Condenser aperture
Check and perform phase ring alignment for phase microscopy Level 2
Place polarizing filters in light path correctly for polarizing microscopy Level 2
Operate microscope, i.e., place, focus, and scan mounted specimen Level 3
Secure microscope slide on mechanical stage Level 2
Check and perform interpupillary and diopter adjustments Level 3
Select and interchange objectives Level 3
Use coarse and fine adjustments Level 2
Use mechanical stage adjustment knobs to scan mounted specimen Level 2

**Information Technology**
Perform basic operation of computer systems Level 2
  Enter data
  Transmit
  Retrieve data
  Present data/information
Quality Assurance/quality control

Define quality control statistics Level 1
  Mean
  Mode
  Median
  Standard deviation
  Coefficient of variation
  Reference intervals
  Variance
  Linear regression
  Correlation coefficient
  Gaussian distribution
  Scales, graphs, charts
  Levey-Jennings charts
  Westgard Multirule system

Define type of laboratory errors and biases Level 1
  Preanalytical
  Analytical
    Random
    Systematic
  Postanalytical

Locate sources of lab error Level 1

Monitor and prevent laboratory errors Level 1

Perform maintenance, calibration and storage of laboratory supplies and equipment Level 1

Document quality assurance schedules Level 1

Maintain and troubleshoot quality control logs Level 2
Identify quality control programs    Level 1
  Internal
  External
Interpret statistical data    Level 2
Identify patterns    Level 2
  Shifts
  Trends
Perform all quality control procedures according to established protocol    Level 2
  Collect data and perform statistical analyses
Monitor and interpret quality control data    Level 2
  Recognize shifts, trends and other deviations
  Identify sources of error
  Verify laboratory proficiency
  Implement corrective action

**Point of Care Testing**
Explain the value of point of care testing to patient care    Level 1
Discuss the advantages and disadvantages of point of care testing    Level 1
Identify healthcare professionals who may be responsible for point of care testing    Level 1
Use good educational principles to train non-laboratory healthcare professionals on appropriate use of point of care testing devices    Level 1
DOCUMENT CHANGES

Microcomputers section changed to Information Technology

Deleted section regarding basic elements of a computer

Deleted:

Identify types and uses of plasticware in the lab

Correctly dispose of used plasticware

Microscope section added
Normal Hematopoietic System

Define hematopoiesis Level 1
- Theory of pluripotent stem cell development
- Stem cell kinetics: Generative cell cycle
- Regulatory growth factors and inhibitors

Identify phases and site of origin for cellular development of active hematopoietic tissue in Embryo and fetus Level 1
- Mesoblastic phase
- Hepatic phase (extramedullary)
- Medullary/myeloid phase

Identify phases and site of origin for cellular development of active hematopoietic tissue in Infant and young child Level 1
- All red marrow spaces (all cell lines)
- Thymus fully developed (T lymphs)
- Secondary lymphoid tissue (T and B lymphs)

Identify phases and site of origin for cellular development of active hematopoietic tissue in Adults Level 1
- Red marrow (axial skeleton and proximal ends of long bones)
- Primary and secondary lymphoid tissue (T and B lymphs)

Explain the role of other organ systems in hematopoiesis Level 1
- Mononuclear phagocyte system
- Spleen (structure, blood flow, function)
- Liver (structure, blood flow, function)
- Lymph nodes (structure, blood flow, function)
- Thymus (structure, blood flow, function)

State the physical findings commonly present in hematologic disease Level 1
- Splenomegaly
- Hypersplenism
- Hepatosplenomegaly
- Lymphadenopathy

Bone marrow tissue

Describe bone marrow collection techniques Level 1
- Aspiration
- Core biopsy

Describe the preparation of bone marrow smears and stains used Level 1
- Romanowsky polychrome stain
- Prussian Blue (iron) Stain

Describe key terms used to assess bone marrow structure and function Level 1
- Myeloid to erythroid ratio (M:E)/erythroid to granulocyte ratio (E:G)
- Erythropoiesis
- Granulopoiesis
- Megakaryopoiesis
- Non-hematopoietic cells
- Cellularity: fat (yellow marrow) to cell (red marrow) ratio
- Aplastic marrow
- Hypo/Hyperplastic marrow
Peripheral Blood Examination

Perform differential cell count on normal specimens  Level 2
Distinguish between normal and abnormal hematopoietic elements found within the peripheral blood  Level 2
Correlate complete blood count findings with peripheral blood smear evaluation  Level 2
Prepare peripheral blood for routine hematologic procedure and smear analysis
  Determine specimen acceptability  Level 2
  List appropriate anticoagulants  Level 1
  Identify acceptable ratio of anticoagulant to blood for specimens obtained from venipuncture and skin puncture  Level 1
  List reasons for rejecting specimens  Level 1
Stain smears using Romanowsky dyes and techniques according to established procedures
  Manual  Level 2
  Automated  Level 2
List and define components of commonly used stains  Level 1
Judge the acceptability of blood smears through microscopic evaluation and established criteria
  Random distribution of cells
  Acceptable stain quality
  Absence of artifact
  Troubleshoot staining problems  Level 3

Erythropoiesis

Describe the distinctive features used to characterize developing cells  Level 1
  Overall cell size
  Cell Nucleus
  Shape
  Relative size
  Staining reaction
  Chromatin pattern
  Presence or absence of nucleoli
  Staining reaction and size of cytoplasm
List the maturation sequence of developing erythrocytes  Level 1
Distinguish nucleated erythrocyte precursors from other hematopoietic elements  Level 2
Categorize red cells  Level 2
  Shape
  Color
  Inclusions
  Distribution patterns
List nutritional and regulatory factors with associated with erythropoiesis  Level 2
  Erythropoietin (EPO)
  Iron
  Vitamins (B12/ folate)
  Intrinsic factor
Discuss components of the mature red cell that are essential for survival and function

- Membrane composition and function
- Lipids/Proteins
- Maintain RBC shape, deformability, and permeability
- Support system for surface antigens
- Transport and exchange of gases and ions (cationic pumps)

Describe the purpose of the metabolic pathways used by erythrocytes

- Embden-Meyerhof
- Hexose monophosphate shunt
- Methemoglobin reductase
- Luebering-Rapoport

**Erythrocytic Hemoglobin**

Summarize the mechanisms by which normal hemoglobin is structured and synthesized in the developing red cell

- Iron transport, uptake, and supply
- Protoporphyrin IX (heme) formation
- Globin synthesis and genetic control
- Chromosome 11 and 16
- Embryonic hemoglobins (Gower 1, 11, Portland)
- Adult hemoglobins (Hb A, Hb A2, Hb F)

Describe normal hemoglobin-oxygen function using the oxygen dissociation curve (ODC)

Identify the effect various conditions can have on an oxygen disassociation curve

- pH (Bohr effect)
- Temperature
- CO2
- 2,3-DPG
- Hb F and other variants

Interpret the effect of various factors on the concentration of hemoglobin

- Age and gender
- Altitude
- Smoking
- Associated disease
- Altered hemoglobin derivatives (carboxyhemoglobin/sulfhemoglobin/methemoglobin)

**Erythrocytic Catabolism**

Explain the mechanism by which red cells are catabolized

Identify phased (extra/intravascular)

Trace the basic steps associated with each phase

Define terms associated with red cell destruction

- Biliverdin
- Bilirubin (conjugated/unconjugated)
- Urobilinogen
- Urobilin
- Hemoglobin dimers
- Haptoglobin
Erythrocyte Evaluation

Describe procedures to evaluate erythrocytes using patient blood and quality control samples  Level 1

Perform procedures to evaluate erythrocytes using patient blood and quality control samples  Level 2

State the clinical utility of histogram review in erythrocyte evaluation  Level 1

Determine if results are in accordance with prescribed criteria for accuracy and precision  Level 2

Discuss the automated hemogram parameters used for erythrocyte evaluation  Level 1

Hemoglobin
Hematocrit
mean cell volume (MCV)
Mean cell hemoglobin (MCH)
Mean cell hemoglobin concentration (MCHC)
Red cell distribution width (RDW)

Calculate red blood cell indices when provided appropriate data  Level 2

Perform erythrocyte sedimentation rates  Level 2

Wintrobe
Westergren and its modifications
Automated

Perform standard reticulocyte assays  Level 2

Supravital smear method with Miller disc
Supravital smear method without Miller disc
Automated flow cytometry methods

Perform calculations associated with reticulocyte assays  Level 1

Corrected
Absolute
Production index (RPI)

Determine the appropriate area of a peripheral blood smear to evaluate red blood cell morphology  Level 2

Distinguish between normal and abnormal red blood cell morphology  Level 1

List red blood cell count and indices reference values that account for variations in gender and age  Level 1

Correlate automated hemogram parameters with each other and with peripheral smear exam results  Level 3

Calibrate and perform preventive maintenance on instruments used to evaluate erythrocytes and their physical properties  Level 1
Take corrective action to resolve unexpected results and/or events on instruments used to evaluate erythrocytes

**Leukopoiesis**

State reference values that reflect variations in gender and age for the leukocyte counts in peripheral blood

- Total leukocyte count
- Absolute lymphocyte count
- Absolute neutrophil count

List common factors that alter leukocyte values

- Physiologic variation
- Cellular abnormalities

Enumerate and/or calculate absolute and relative leukocyte counts

- Relative values
- Absolute values

List morphologic features used to differentiate developing leukocytes

- Overall cell size
- Nucleus
- Shape
- Nuclear to cytoplasmic ratio (N:C)
- Staining reaction
- Chromatin pattern
- Presence or absence of nucleoli
- Relative amount of cytoplasm
- Cytoplasmic staining reaction
- Presence or absence of granules and staining reaction in cytoplasm

**Leukopoiesis: Granulocytes**

- List the maturation sequence of neutrophils, eosinophils, and basophils
- Differentiate band neutrophils, segmented neutrophils, eosinophils, and basophils
- Determine if a granulocyte is mature or immature
- Explain mechanisms that regulate and modulate granulopoiesis
  - Regulatory growth factors and inhibitors
  - Kinetics
  - Life span
  - Circulation
  - Granule content and surface membrane receptors
- Explain the functions associated with granulocytes
  - Phagocytosis and killing
  - Allergic response (eosinophils and basophils)
  - Host defense against parasites (eosinophils)
  - Hypersensitivity mediator (basophils and mast cells)
- Discuss the clinical utility of the absolute neutrophil count

**Leukopoiesis: Lymphocytes and Monocytes**

Summarize structural and functional features that characterize monocytes and macrophages
Summarize structural and functional features that characterize lymphocytes  
List the maturation sequence of monocytes and macrophages  
List the maturation sequence of lymphocytic cells  
Describe the use of monoclonal antibodies to differentiate lymphocytes by CD antigens  
B lymphs and subsets  
T lymphs and subsets  
Plasma cell (immunoglobulin antibody production)  
List the sites of formation and production of lymphocytes  
Bone marrow  
Thymus  
Lymph nodes and secondary lymphoid tissue  
Kinetics: Life span/ Migration  
Describe monocyte and macrophage function  
Describe lymphocyte function  
Humoral immunity (B lymphs and subsets)  
Cell mediated immunity (T lymphs and subsets)  
Natural killing and antibody dependent cellular cytotoxicity

**Leukocyte Evaluation**

Perform routine methods to assess leukocytes (e.g. manual and automated white blood cell counts and differentials)  
State the principles and clinical utility of histogram/scatterplot review  
Determine absolute and relative white cell counts on patient and control specimens using manual or automated methods in accord with prescribed criteria for accuracy and precision  
Calibrate and perform preventive maintenance on instruments used to evaluate white cells  
Examine white cell histograms and scatterplots for diagnostic and quality control purposes  
Identify and classify normal white blood cells on a properly stained Romanowsky blood smear  
Verify automated cell counts and differentials using established criteria  
Estimate the total white blood count from a smear  
Correct leukocyte counts for the presence of nucleated red cells

**Nonmalignant Leukocyte Disorders**

Explain the classification of nonmalignant leukocytic disorders  
Quantitative changes  
Qualitative changes  
Compare and contrast the utility of absolute values with relative values  
State common causes of alterations in absolute and relative cell counts for the mature myeloid cells  
Neutrophilia
Neutropenia
Eosinophilia
Eosinopenia
Basophilia

Associate quantitative and qualitative leukocyte disorders with expected results  
Bone marrow production and release
Rate of entry into peripheral circulating pools
Shifts between circulating and marginating pools
Rate of exit into tissues

Identify morphologic changes in neutrophils that may accompany nonmalignant neutrophilic disorders
Shift to the left
Toxic granulation
Dohle bodies
Vacuolization
Hyposegmentation
Hypersegmentation

State characteristic abnormalities and clinical features for the qualitative/functional disorders of neutrophils
Pelger-Huet anomaly
Alder-Reilly anomaly
Chediak-Higashi anomaly
May-Hegglin anomaly
Chronic granulomatous disease (CGD)
Myeloperoxidase deficiency

Describe qualitative and quantitative alterations of monocytes
Define monocytosis
State absolute monocyte reference values and relative reference values
State causes of monocytosis
Identify abnormal lipid accumulations within monocytes and macrophages
List causes of non-neoplastic disorders of lymphocytes and plasma cells
Define lymphopenia/ lymphocytosis
State lymphocyte absolute reference values with relative reference values
Compare and contrast morphologic features of reactive lymphocytes and normal lymphocytes
Size
Nucleus
Cytoplasm
Heterogeneity
Differentiate between reactive and resting lymphocytes on Romanowsky stained smears
List the causes of reactive lymphocytosis

Red Blood Cell Disorders: Anemia
Define anemia
State the clinical signs and symptoms of anemia
Hemoglobin
Hematocrit
RBC indices
Peripheral smear
Reticulocyte count
Bone marrow evaluation
Red blood cell distribution Width

List the categories used in a morphological classification of the anemias

Describe the expected laboratory results seen in the various pathophysiologic classifications of anemia

Decreased red cell production
Increased red cell destruction: Ineffective erythropoiesis/ Hemolytic processes
Loss of red cells

Explain sources of error of the red blood cell indices

Discuss the clinical utility of the RBC indices

Use the RBC indices as a quality control mechanism for assessing the validity of the erythrocyte count, hemoglobin, and hematocrit values

Define common words used to describe red cell morphology

Anisocytosis
Poikilo cytosis
Polychromatic
Rouleaux
Agglutination
Acanthocyte/Spur Cell
Codocyte/Target Cell/Leptocyte
Dacrocyte/Tear Drop Cell
Drepanocyte/Sickle Cell
Echinocyte/Burr Cell
Elliptocyte
Keratocyte
Schistocyte
Spherocyte
Stomatocyte
Basophilic stippling
Cabot rings
Heinz bodies
Howell-Jolly bodies
Malarial parasites
Pappenheimer bodies/siderotic granules
Hemoglobin crystals
Hemoglobin H

Differentiate between normal and abnormal RBC morphology

Associate a given red blood cell morphology with routinely encountered conditions

Iron deficiency/alterations in iron metabolism
Vitamin B12/Folate deficiency
Thalassemia
Sickle Cell Disease/Trait/otherhemoglobinopathies
Malaria
Hereditary membrane abnormalities (spherocytosis, elliptocytosis, ovalocytosis, etc)
RBC Enzyme abnormalities (G6PD and PK deficiencies)
Extracorpuscular (immune and non-immune) mediated RBC defects
Describe methods used to identify and/or confirm the composition of various red blood cell inclusions

Red Cell Disorders: Erythrocytosis (Polycythemia)
Define polycythemia Level 1
Differentiate between absolute polycythemia and relative polycythemia Level 2
Compare and contrast polycythemia rubra vera, secondary polycythemia, and relative erythrocytosis Level 2
Etiology
Clinical features
Laboratory findings
Describe changes in the bone marrow and peripheral blood with polycythemia Level 2

Red Cell Disorders: Hypochromic anemias
Define hypochromic anemia Level 1
List the causes of hypochromic anemias Level 1
Compare and contrast laboratory findings in hypochromic anemias Level 2
Serum ferritin
Serum iron
Transferrin/ Total Iron Binding Capacity (TIBC)
Percent transferrin saturation

Red Cell Disorders: Megaloblastic anemias
Discuss the absorption and metabolism of vitamin B12 and folate Level 1
Describe clinical features of megaloblastic anemia Level 1
State the hematologic abnormalities present in megaloblastic anemia Level 1
Peripheral blood changes
Bone marrow morphology
Compare and contrast causes and laboratory features of the megaloblastic anemias Level 2
Discuss tests methods commonly used to assess megaloblastic anemia Level 1
Mean cell volume (MCV)
Blood and bone marrow smear evaluation
Serum B12
Serum folate
Red cell folate
Anti-intrinsic factor antibodies
Anti-parietal cell antibodies
Differentiate nonmegaloblastic macrocytosis from megaloblastic anemia Level 2
Peripheral blood and bone marrow characteristics
Serum vitamin B12 level
Serum folate level
Red cell folate level
Red Cell Disorders: Hypoproliferative anemias: Congential and Acquired

- Define aplastic anemia Level 1
- Describe the clinical features of hypoproliferative anemias Level 1
- Describe the laboratory findings of hypoproliferative anemias Level 1
  - Peripheral blood changes
  - Bone Marrow Changes
- Define pure red cell aplasia Level 1
  - Describe the clinical features Level 1
  - Describe the laboratory findings Level 1

Red Cell Disorders: Hemolytic anemias

- Describe the clinical features and laboratory findings of red cell membrane defects Level 1
  - Hereditary spherocytosis
  - Hereditary elliptocytosis
  - Paroxysmal nocturnal hemoglobinuria (PNH)
  - Hereditary pyropoikilocytosis
- Discuss the principle of the Osmotic fragility test Level 1
  - Perform /observe the procedure Level 1
  - Apply appropriate quality control procedures Level 1
  - Correlate results Level 2
- Describe the utility of flow cytometry in assessing red cell membrane defects Level 1
- Describe the laboratory features of red cell enzyme abnormalities Level 1
  - Glucose-6-phosphate dehydrogenase (G6PD) deficiency
  - Pyruvate kinase (PK) deficiency
- Discuss the principles of G6PD assay, pyruvate kinase assay and staining for Heinz Bodies Level 1
  - Perform /observe the procedure Level 1
  - Apply appropriate quality control procedures Level 1
  - Correlate results Level 2
- Describe the hematologic findings associated with nonimmune hemolytic anemias Level 1
  - Malaria
  - Babesiosis
  - Thermal injury
  - Disseminated intravascular coagulation
- Identify mechanisms of immune-mediated hemolytic anemias Level 1
- Describe the clinical features and laboratory findings of Alloimmune hemolytic anemias Level 1
  - Acute hemolytic transfusion reaction
  - Delayed hemolytic transfusion reaction
  - Hemolytic disease of the newborn (HDN)
- Describe the clinical features and laboratory findings of autoimmune hemolytic anemias Level 1
  - Warm autoimmune hemolytic anemia (WAIHA)
  - Cold autoimmune hemolytic anemia idiopathic/secondary
  - Paroxysmal cold hemoglobinuria
- Discuss mechanisms of drug-induced immune hemolytic anemia Level 1
Hemoglobinopathies

Define hemoglobinopathy

Distinguish between qualitative and quantitative hemoglobin defects

Describe the clinical and laboratory findings of hemoglobinopathies

- Hb SS
- Hb AS
- Hb CC
- Hb SC

State the amino acid substitutions associated with sickle cell anemia and hemoglobin C disease

Describe the hemoglobin defect in thalassemia

List the characteristic clinical and laboratory findings associated with thalassemia

Describe the peripheral blood morphology associated with hetero and homozygous beta thalassemia

Describe the terminology associated with thalassemias

- Hb H
- Bart’s hemoglobin
- Hereditary persistence of fetal hemoglobin

Discuss the principle of the solubility test for sickling hemoglobin

Perform /observe the procedure

Apply appropriate quality control procedures

Correlate results

Discuss the principles of hemoglobin electrophoresis (cellulose acetate, alkaline pH vs. citrate agar, acid pH)

Perform /observe the procedure

Apply appropriate quality control procedures

Correlate results

Discuss the principles of hemoglobin quantification (HbA, HbA2, HbF)

Perform /observe the procedure

Apply appropriate quality control procedures

Correlate results

Identify the electrophoretic patterns when provide appropriate data

- Hb F
- Hb A
- Hb S
- Hb C
- Hb A2

Acute Blood Loss

Describe the etiology of anemia of acute blood loss

List the clinical symptoms of acute blood loss

List the laboratory findings of acute blood loss

Anemias associated with systemic disorders

Describe the laboratory findings associated with nonhematologic disorders

- Chronic disorders and inflammation
- Malignant diseases
- Renal disease
Neoplastic Disorders
Define and list categories associated with Neoplastic Disorders of Leukocytes Level 1
Leukemias
Myelodysplastic syndromes
Myeloproliferative disorders
Lymphoproliferative disorders
List major systems used to classify neoplastic disorders of leukocytes Level 1
French, American-British (FAB) Cooperative Group
World Health Organization (WHO)
Observe and/or perform procedures, apply appropriate quality control procedures, and interpret laboratory findings for laboratory procedures used in the identification, classification and differentiation of neoplastic disorders Level 1
Complete blood count
Hemograms
Scatterplots and histograms
Compare and contrast the principles of various cytochemical stains and the cell lineages they react with Level 2
Myeloperoxidase
Tartrate resistant acid phosphatase (TRAP)
Iron staining
Describe the use of various diagnostic techniques used to assess neoplastic disorders of blood and bone marrow cells Level 1
Cytochemical Stains
Immunophenotyping
Cytogenetics
Molecular genetics
Acute Leukemias
Describe general criteria to classify leukemias Level 1
Cell maturity (Acute/Chronic)
Cell lineage (Myeloid /nonlymphoid)
Lymphoid
List the clinical findings and laboratory results for acute leukemia Level 1
Contrast the FAB with the WHO acute myeloid leukemia subgroups Level 2
FAB classification
M0--acute myeloid leukemia with minimal differentiation
M1--acute myeloid leukemia without maturation
M2--acute myeloid leukemia with maturation
M3--acute promyelocytic leukemia
M4--acute myelomonocytic leukemia
M5--acute monoblastic leukemia
M6--acute erythroleukemia
M7--acute megakaryoblastic leukemia
WHO classification
AML with recurrent genetic abnormalities
AML with myelodysplasia-related changes
Therapy-related myeloid neoplasms
AML, not otherwise specified

Correlate diagnostic blood and bone marrow findings to various sub-types of acute myeloid leukemia

List the WHO acute lymphocytic leukemia subgroups

WHO classification:

- B lymphoblastic leukemia/lymphoma, not otherwise specified
- T lymphoblastic leukemia/lymphoma

**Myelodysplastic Syndromes (MDS)**

Define and describe cellular features that characterize the MDS

- Dyserythropoiesis
- Dysgranulopoiesis
- Dysmegakaryocytopenia

List subgroups recognized by the World Health Organization (WHO) Cooperative Groups for the MDS classification

**Chronic Myeloproliferative Neoplasms**

List the Chronic Myeloproliferative Neoplasms by cell type

- Granulocytes—Chronic myelogenous/granulocytic leukemia (CML/CGL)
- Erythrocytes—polycythemia vera (PV)
- Megakaryocytes—essential thrombocythemia (ET)

Discuss and compare features commonly shared by Chronic Myeloproliferative Neoplasms

- Clinical manifestations
- Pathophysiologic mechanisms
- Blood and bone marrow findings
- Transitional forms between stages
- Disease evolution with potential for blastic transformation

List the clinical and laboratory findings commonly found in MPD

- CML/CGL
  - Leukocytosis with absolute neutrophilia and left shift maturation
  - Absolute basophilia and eosinophilia
  - Thrombocytosis
  - Bone marrow hypercellularity with granulocytic proliferation
  - Leukocyte alkaline phosphatase (LAP) activity
  - Philadelphia chromosome
  - Cytogenetic (karyotype)
  - Molecular (DNA) techniques
- PV
  - Increased red blood cell (RBC) mass
  - Leukocytosis with mild left shift maturation and basophilia
  - Thrombocytosis
  - Bone marrow hypercellularity with all cell lines increased
  - LAP activity
  - Red cell morphology (initial phase/ “spent” phase)
- ET
Marked thrombocytosis with platelet aggregates and abnormal forms
Megakaryocytic hyperplasia of bone marrow
LAP activity
AMM
Leukoerythroblastosis with teardrop-shaped red cells
Leukocytosis with left shift maturation to occasional immature myeloid cell
Bone marrow fibrosis and relationship to megakaryocytic hyperplasia
LAP activity

**Chronic Lymphoproliferative Disorders**

Classify the chronic lymphoid leukemias by T and B cell lineage

- Chronic lymphocytic leukemia (CLL)
- Prolymphocytic leukemia (PLL)
- Hairy cell leukemia (HCL)

List diagnostic features of CLL

- Median age of onset
- Symptoms and clinical findings
- Blood and bone marrow findings of CLL
- Peripheral blood absolute lymphocytosis
- Leukemic cell line of mature, small lymphocytes with monotonous Morphology and smudge/basket cells
- Bone marrow lymphocytosis

List diagnostic features of PLL

- Median age of onset and gender
- Clinical finding of severe splenomegaly
- Blood and bone marrow findings of PLL
- Markedly elevated white count with absolute lymphocytosis
- White cell differential predominantly of prolymphocytes
- Immunophenotypic profile
- Survival rates

List diagnostic features of HCL

- Median age of onset and gender
- Clinical finding of severe splenomegaly
- Review blood and bone marrow findings of HCL
- Pancytopenia
- Leukemic cell line of “hairy” cells
- Tartrate resistant acid phosphatase (TRAP) stain reaction
- “Dry” tap; marrow fibrosis and infiltrates

List diagnostic features of Adult T-cell leukemia

- Human T-cell lymphotrophic virus-1 (HTLV-1)
- Endemic areas
- Blood and bone marrow findings of Adult T-cell leukemia
- Lymphoid cell line of small to large cells with cloverleaf/knotty nucleus

**Lymphoma**

Define lymphoma and generally classify using key terminology

- Hodgkin
- Reed-Sternberg cells
Outline the laboratory tests used to diagnose and stage Hodgkin’s lymphoma
- Complete blood count (CBC)
- Liver function tests
- Renal function tests

Review blood and bone marrow findings of Hodgkin’s lymphoma
- Radiologic studies
- Physical examination
- Lymph node biopsy

Recognize lymphoma cells

Plasma Cell Disorders
- Name disorders based on proliferation of plasma cells and abnormal production of immunoglobulins
- Discuss classification based on proliferation of plasma cells and abnormal production of immunoglobulins
  - Multiple myeloma
  - Waldenstrom’s macroglobulinemia
  - Plasma cell leukemia (PCL)
  - Heavy-chain disease
  - Monoclonal gammopathy of undetermined significance (MGUS)
- Compare the clinical findings and laboratory features of various plasma cell disorders
- Identify key morphologic features for plasma cell

Thrombopoiesis/megakaryopoiesis
- List the maturation sequence of platelets
- State reference values for absolute platelet counts in the peripheral blood
- Associate quantitative variations with clinical manifestations
  - Thrombocytopenia
  - Thrombocytosis
- Associate functional or qualitative variations with clinical manifestations
- Perform absolute platelet counts on patient and control specimens using manual and automated methods in accord with prescribed criteria for accuracy and precision
- State the principles of method analysis and histogram review
- Compare absolute count with those estimated from smear exam
- Identify and recognize factors that may alter platelet values
  - Platelet satellitism
  - Platelet aggregates
  - Giant platelets
  - Cell fragments
  - Extreme microcytosis

Hemostasis/Coagulation
- Define hemostasis
- Explain the general interaction of systems involved in maintaining hemostasis
- Describe how changes in one homeostatic system affect the other systems
  - Vasculature
Platelets
Plasma coagulation factors
Fibrinolysis
Differentiate between primary and secondary hemostasis Level 1

Vascular
Explain the functions of the vascular system in maintaining hemostasis Level 1
Describe metabolic functions of the endothelium and substances contributing to the thromboresistance properties of endothelium Level 1
Heparan sulfate
Thrombomodulin
Tissue plasminogen activator
Prostacyclin (PGI2)
Tissue factor pathway inhibitor

Platelets
Discuss the production of platelets Level 1
State the average time in circulation, normal peripheral count, and total body distribution of platelets Level 1
Describe the ultrastructural components of a platelet Level 1
Alpha granules
Dense bodies
Lysomes
Microtubules
Open canalicular system
Platelet membrane
Glycocalyx
Discuss the physiological role of platelets in hemostasis Level 1
Platelet plug formation
Maintaining normal vascular integrity
Describe the series of morphologic changes that occur in platelets following physiologic stimulation Level 1
Adhesion
Aggregation
Activation
Discuss the effect of aspirin on platelet function Level 1
Biochemical mechanism
Duration of the effect
Compare and contrast test methodologies for the bleeding time test Level 1
Describe the principle of the platelet function assay Level 1
Review results of a bleeding time and/or platelet function assay test Level 2
Significance in terms of platelet function
Associated abnormal conditions
Sources of error
Discuss the principle and clinical significance of platelet aggregation Level 1
Perform the procedure Level 1
Describe the procedure Level 1
Describe appropriate quality control procedures and sources of error Level 1
Plasma coagulation factors

Define the coagulation factors
- Roman numerals
- Common names
- Synonyms

Discuss the physiological role of the coagulation phase within the hemostatic process

Discuss characteristics of the coagulation factors
- Contact group
- Prothrombin group
- Fibrinogen group

List the vitamin K-dependent factors

Diagram the pathways of coagulation
- Intrinsic
- Extrinsic
- Common

Identify substances that are contact activators

Explain the interaction of the coagulation system with the vascular and platelet systems to form a hemostatic plug

Describe the physiologic controls of hemostasis
- Blood flow
- Feedback inhibition
- Liver clearance

Identify the inhibitors of hemostasis
- Antithrombin
- Tissue factor pathway inhibitor (TFPI)
- Protein C
- Protein S

Discuss the special precautions that must be taken in the collection and subsequent handling of specimens for coagulation testing
- Anticoagulant
- Ratio of blood to anticoagulant
- Patient hematocrit values
- Centrifugation
- Storage

Identify and describe tests that are used to monitor the coagulation phase of hemostasis

Discuss the principle and clinical significance of the Prothrombin time test
- Perform the procedure
- Describe the procedure
- Describe appropriate quality control procedures and sources of error
- Interpret results
- Describe the International Normalized Ratio (INR)
- Calculate an INR given the international sensitivity index of the thromboplastin

Discuss the principle and clinical significance of the Activated partial thromboplastin time
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Discuss the principle and clinical significance of the Activated clotting time
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Discuss the principle and clinical significance of the Thrombin clotting time
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Discuss the principle and clinical significance of the Fibrinogen assay
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Discuss the principle and clinical significance of Factor assays
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Identify technical conditions that cause false coagulation testing results

Fibrinolytic system
Define fibrinolysis
Discuss the physiological role of the fibrinolytic system
Identify the major components of the fibrinolytic system
Discuss the mechanisms of the activation of plasminogen
  Intrinsic activators
  Extrinsic activators
  Exogenous activators
List the major fragments of fibrinogen degradation
Explain the role and clinical significance of physiologic controls
  Alpha-2-antiplasmin
  Alpha-2-macroglobulin
  Plasminogen activator inhibitors (PAI)
Identify and describe laboratory procedures that are used to evaluate the fibrinolytic system
Discuss the principle and clinical significance of the FDP assay
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Discuss the principle and clinical significance of the D-Dimer Assay
Perform the procedure
Describe the procedure
Describe appropriate quality control procedures and sources of error
Interpret results
Identify technical conditions that cause false coagulation testing results with or without established protocol

Disorders of primary hemostasis
Define the following terms associated with hemostasis disorders
Thrombocytopenia
Thrombocytosis
Thrombocytemia
Describe the clinical features, and laboratory findings of quantitative defects of platelets
Idiopathic thrombocytopenic purpura
Thrombotic thrombocytopenic purpura
Disseminated intravascular coagulation
Hemolytic uremic syndrome
Describe the clinical features and laboratory findings of qualitative defects of platelets
von Willebrand’s disease
Bernard-Soulier syndrome
Glanzmann’s thrombasthenia

Disorders of secondary hemostasis
Describe the clinical features and laboratory findings of hemophilia and other congenital disorders of secondary hemostasis
Factor I deficiency
Factor II deficiency
Factor V deficiency
Factor V Leiden
Factor VII deficiency
Factor VIII deficiency (Hemophilia A)
Factor IX deficiency (Hemophilia B)
Factor X deficiency
Factor XI deficiency
Factor XII deficiency
Factor XIII deficiency
von Willebrand’s disease
Antithrombin deficiency
Protein C deficiency
Protein S deficiency
Plasminogen deficiency
Homocystinemia/homocystinuria
Describe clinical features and laboratory findings of acquired coagulation disorders
Vitamin K deficiency
Liver disease
Renal disease
Describe the significance and clinical implications of the development of circulating anticoagulants

- Specific factor inhibitors
- Nonspecific factor inhibitors

Identify and describe laboratory procedures that are used to evaluate circulating anticoagulants or inhibitors

Discuss the principle and clinical significance of Correction study using normal plasma
- Perform the procedure
- Describe the procedure
- Describe appropriate quality control procedures and sources of error
- Interpret results

Discuss the principle and clinical significance of the Dilute Russell viper venom time (DRVVT)
- Perform the procedure
- Describe the procedure
- Describe appropriate quality control procedures and sources of error
- Interpret results

Discuss the principle and clinical significance of the Platelet neutralization procedure
- Perform the procedure
- Describe the procedure
- Describe appropriate quality control procedures and sources of error
- Interpret results

Disorders of fibrinolysis
- Differentiate between primary and secondary fibrinolysis
- Define disseminated intravascular coagulation (DIC)
- Identify mechanisms by which clotting is initiated during DIC
- Describe the effect of DIC on laboratory procedures
  - Prothrombin time
  - Activated partial thromboplastin time
  - Thrombin clotting time
  - Platelet count
  - Fibrinogen
  - Fibrin/fibrinogen degradation products (FDP)
  - D-dimer
  - Blood smear
- Describe conditions that are predisposing to recurrent thrombosis
  - Antithrombin III deficiency
  - Heparin cofactor II deficiency
  - Primary antiphospholipid antibody syndrome
  - Protein C deficiency
  - Protein S deficiency
  - Activated Protein C resistance
- Describe laboratory tests for antithrombin III, protein C, and protein S comparing activity vs. antigen techniques
Interpret results  

**Anticoagulant therapy**

- Explain the action of anticoagulant therapy  
  - Vitamin K Reductase inhibitors  
  - Direct acting oral anticoagulants  
  - Heparin high/low molecular weight  
  - Antiplatelet agents  

- Identify laboratory tests used to monitor anticoagulant therapy  
  - Oral anticoagulant therapy (warfarin)  
  - Heparin high/low molecular weight

**Instrumentation**

- Identify basic concepts of electrical impedance, optical detection, radio frequency, and of light scatter plus cytochemical stain systems  
  - Discuss the principle  
  - List components  
  - Describe operation  
  - Perform Analysis  
  - Describe maintenance and troubleshooting  
  - Perform maintenance/corrective action

- Identify basic concepts of quality assurance for automated hematology cell counting systems

- Describe acceptable practices  
- Perform basic quality assurance  
- Assess data to ensure quality  
- Monitor quality assurance program  
- Describe the limitations and list interfering substances

- Identify and describe hemogram parameters  
  - Evaluate patient data  
  - Describe the flagging system  
  - Correlate scatter plots, histograms and data plots with the peripheral smear  
  - Describe the mathematical calculations used to monitor instruments  
  - Recognize unexpected results  
  - Troubleshoot and corrective action

- Discuss the principle of Automated reticulocyte counting

- Describe acceptable practices  
- Perform basic quality assurance  
- Assess data to ensure quality  
- Monitor quality assurance program  
- Describe the limitations and list interfering substances

- Identify basic concepts of electromechanical and photo-optical systems

- Describe acceptable practices  
- Perform basic quality assurance  
- Assess data to ensure quality  
- Monitor quality assurance program  
- Describe the limitations and list interfering substances

- Identify basic concepts of quality assurance for automated coagulation systems
Describe acceptable practices Level 1
Perform basic quality assurance Level 2
Assess data to ensure quality. Level 3
Monitor quality assurance program Level 3
Describe the limitations and list interfering substances Level 1
Identify basic concepts of spectrophotometric, chromogenic substrate assays Level 1
Describe acceptable practices Level 1
Perform basic quality assurance Level 2
Assess data to ensure quality. Level 3
Monitor quality assurance program Level 3
Describe the limitations and list interfering substances Level 1
Identify basic concepts of overall laboratory quality assurance Level 1
Describe acceptable practices Level 1
Perform basic quality assurance Level 2
Assess data to ensure quality. Level 3
Monitor quality assurance program Level 3
DOCUMENT CHANGES

Associate physical findings with the presence of hematologic disease

State the physical findings commonly present in hematologic disease

Prepare and stain bone marrow smears

Describe the preparation of bone marrow smears and stains used

Deletion w/ no replacement:

Cytochemical stains deleted from bone marrow stains

Describe terms and apply concepts to assess bone marrow

Describe terms used to assess bone marrow structure and function

Describe key terms and apply concepts to assess iron stores in bone marrow

Describe concepts related to the assessment of iron stores in bone marrow

Perform differential counts

Perform differential counts on normal specimens

Addition:

Distinguish between normal and abnormal hematopoietic elements found within the peripheral blood

Correlate bone marrow findings with peripheral blood evaluation

Correlate complete blood count findings with peripheral blood smear evaluation

Addition:
List and define components of commonly used stains

Good stain Quality
Acceptable stain quality

Deletions with no replacements

Research new concepts and emerging technologies
Describe therapeutic use of growth factors and stem cells to stimulate hematopoietic recovery
Discuss bone marrow/stem cell transplant to treat hematologic disease
Discuss molecular biologic techniques in hematology analysis

Identify distinctive features used to characterize developing cells
Describe the distinctive features used to characterize developing cells

List and identify stages of the maturation sequence of erythrocytes
List the maturation sequence of developing erythrocytes

Addition:
Distinguish nucleated erythrocyte precursors from other hematopoietic elements

Associate nutritional and regulatory factors with erythropoiesis
List nutritional and regulatory factors with associated with erythropoiesis

Deleted with no replacement:
List hormones associated with erythropoiesis
**The hormones were merged with another objective**

**Describe metabolic pathways used for red cell ATP**
Describe the purpose of the metabolic pathways used by erythrocytes

**Graph and interpret shifts to the oxygen disassociation curve when altered**
Identify the effect various conditions can have on an oxygen disassociation curve

**Grammatical change:**
Removed ‘Standard operational’ from procedures

**Discuss automated hemogram parameters**
Discuss the automated hemogram parameters used for erythrocyte evaluation

**Calculate MCV, MCH, and MCHC**
Calculate red blood cell indices when provided appropriate data

**Perform standard procedures to evaluate reticulocytes**
Perform standard reticulocyte assays

**Perform standard operational procedures in peripheral smear examination for red cell morphology**
Determine the appropriate area of a peripheral blood smear to evaluate red blood cell morphology

**Addition:**
Distinguish between normal and abnormal red blood cell morphology
List the maturation sequence and identify distinguishing morphology for stages of developing blood granulocytes using Romanowsky-stained smears, photographs, electronic images, or kodachrome slides.

**Editorial change:**
Deletion of all kodachrome slide references

**Additions:**
Differentiate band neutrophils, segmented neutrophils, eosinophils, and basophils
Determine if a granulocyte is mature or immature
Discuss the clinical utility of the absolute neutrophil count

**Editorial Change:**
Agranulocytes changed to lymphocytes and monocytes

**Addition:**
List the maturation sequence of monocytes and macrophages
List the maturation sequence of lymphocytic cells
Describe monocyte and macrophage function

**Deletion with no replacement:**
Determine differential cell counting using automated methods
Identify and classify white cells on a properly Romanowsky stained blood smear

Identify and classify normal white blood cells on a properly stained Romanowsky blood smear

Deleted with no replacement:

Characterize granulopoietic alterations

Discuss pathophysiology, causes and conditions quantitative and qualitative leukocyte disorders with expected results

Associate quantitative and qualitative leukocyte disorders with expected results

Identify on Romanowsky stained smears, photographs, electronic images or kodachrome slides morphologic changes in neutrophils that may accompany nonmalignant neutrophilic disorders

Review and compare characteristic abnormalities and clinical features for the qualitative/functional disorders of neutrophils

State characteristic abnormalities and clinical features for the qualitative/functional disorders of neutrophils

Deleted with no Replacement:

List the defect, substance accumulated, and clinical features for the major disorders characterized by an accumulation of lipids in monocytes and macrophages—

_____________ Gaucher’s disease ______

_____________ Neimann-Pick disease—

_____________ Tay-Sachs disease______

_____________ Mucopolysaccharidoses
Sea-blue histiocytosis

Identify from Romanowsky stained smears, photographs, electronic images, or kodachrome slides of the bone marrow.

Gaucher’s cells

Neimann-Pick cells

Sea-blue histiocytes

Addition:
Identify abnormal lipid accumulations within monocytes and macrophages.

*Be it noted that this objective succinctly achieves what the above deletions aimed to accomplish.

Appraise non-neoplastic disorders of lymphocytes and plasma cells

Identify causes of non-neoplastic disorders of lymphocytes and plasma cells.

Identify reactive/variant lymphocytes on Romanowsky stained smears, photographs, electronic images, or kodachrome slides of peripheral blood.

Differentiate between reactive and resting lymphocytes on Romanowsky stained smears.

Evaluate among benign causes of lymphocytosis

Identify the causes of reactive lymphocytosis.

Deletion with no replacement:

Perform infectious mononucleosis evaluation—

Presence of reactive/variant lymphocytes—

Positive serologic tests—

Cytomegalovirus (CMV).
Toxoplasmosis
Pertussis (whooping cough)
Infectious lymphocytosis
Viral hepatitis

List the major immune deficiencies in relation to T and B cell development

Recognize hematologic alterations in acquired immune deficiency syndrome (AIDS)

Lymphocytopenia (T cell CD4 and CD8 ratio)
Leukopenia
Anemia
Thrombocytopenia

Identify the clinical signs, symptoms of hematologic findings of anemia

State the clinical signs and symptoms of anemia

Describe the categories used in a morphological classification of the anemias

List the categories used in a morphological classification of the anemias

Describe the pathophysiologic classification of the anemias

Describe the expected laboratory results seen in the various pathophysiologic classifications of anemia

Define and calculate RBC indices; explain sources of errors

Explain sources of error of the red blood cell indices

Deletion with no replacement:

Interpret results and relate results to physiologic conditions
State the criteria that define
Define common words used to describe red cell morphology

**Additions:**
Differentiate between normal and abnormal RBC morphology

Associate a given red blood cell morphology with routinely encountered conditions

- Iron deficiency/alterations in iron metabolism
- Vitamin B12/Folate deficiency
- Thalassemia
- Sickle Cell Disease/Trait/other hemoglobinopathies
- Malaria
- Hereditary membrane abnormalities (spherocytosis, elliptocytosis, ovalocytosis, etc)
- RBC Enzyme abnormalities (G6PD and PK deficiencies)
- Extracorpucular (immune and non-immune) mediated RBC defects

**Deletions with no replacements:**
Recognize and quantitatively/qualitatively evaluate red cells

- Normal size erythrocytes
- Microcytes
- Macrocytes

State the criteria that define variations in color

- Normal
- Hypochromic
- Polychromatric
State the criteria that define poikilocytosis

Microscopically, identify alterations in red cell distribution

Rouleaux

Agglutination

Describe the composition and morphology, methods to identify, and list the possible pathologic inclusions

Correlate clinical conditions associated with the abnormal changes in size, shape, color, distribution, and inclusions

Identify and describe changes in the bone marrow and peripheral blood with polycythemia

Describe changes in the bone marrow and peripheral blood with polycythemia

Discuss the etiology and pathophysiology

Iron deficiency anemia

Sideroblastic anemia

Anemia of chronic disease

Hemochromatosis/Hemosiderosis

Porphyrias

Thalassemia

List the causes of hypochromic anemias

Deletions with no replacement:

Outline a laboratory approach to the evaluation of a patient’s iron status

Discuss megaloblastic transformation
Outline a sequential approach to the differential diagnosis of megaloblastic anemia using the following laboratory procedures—

Discuss tests methods commonly used to assess megaloblastic anemia

Identify common factors associated with the development

Describe the possible pathophysiology

Define Congenital dyserythropoietic anemias (Types I, II, and III)

Describe the clinical features

Describe the laboratory findings

Describe the etiology, pathophysiology, clinical features, and laboratory findings of red cell membrane defects

Describe the clinical features and laboratory findings of red cell membrane defects

Identify and correlate data from laboratory tests that are used to detect increased RBC destruction and production

Discuss the principle of the Sugar water (sucrose hemolysis) test

Describe the clinical features

Describe the laboratory findings

Perform /observe the procedure

Apply appropriate quality control procedures

Evaluate results
Discuss the principle of the acidified serum (Ham’s) test

Describe the clinical features

Describe the laboratory findings

Perform /observe the procedure

Apply appropriate quality control procedures

Evaluate results

Addition:

Describe the utility of flow cytometry in assessing red cell membrane defects

Describe the etiology, pathophysiology, and clinical features of red cell enzyme abnormalities

Describe the clinical and laboratory features of red cell enzyme abnormalities

Editorial Change

Non-immune and immune mediated hemolytic anemias were merged into one category for all hemolytic anemias.

Describe the physiologic abnormalities and clinical findings

Describe the clinical and laboratory findings of hemoglobinopathies

Deletions with no replacement:

Describe the physiologic abnormality

Hemoglobin variants with altered oxygen affinity

Unstable hemoglobins

Methemoglobinemia

Describe the clinical features associated with different gene combinations in alpha and beta thalassemia
Describe the pathophysiology of alpha and beta thalassemia

Correlate screening test for sickling hemoglobin with peripheral blood morphology and electrophoretic patterns of hemoglobin

Additions:

Describe the etiology of anemia of acute blood loss

List the clinical symptoms of acute blood loss

Identify the laboratory findings of acute blood loss

Describe the etiology and pathophysiology and identify laboratory findings associated with nonhematologic disorders

Describe the clinical features and laboratory findings associated with nonhematologic disorders

Additions:

Identify major systems used to classify neoplastic disorders of leukocytes

Editorial Comment:

Hematology educators were unsure of need for LAP and TRAP stains

Deletion with no replacement:

Read case studies of neoplastic disorders and apply knowledge and skills in interpreting laboratory results

Editorial Comments:

Incorporation of WHO system into Acute Leukemia objectives and removal of FAB system from myelodysplastics

Removal of pathophysiology, etiology, and treatment objectives from Acute leukemia objectives
No expectation that MLT students would perform acute leukemia differentials at the entry level

Deletions with no replacements:

Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images

Correlate the diagnostic blood and bone marrow findings to the differential identification

Refractory anemia (RA)
Refractory anemia with ringed sideroblast (RARS)
Refractory anemia with excess blast (RAEB)
Chronic myelomonocytic leukemia (CMML)
Refractory anemia with excess blasts in transition (RAEB-t)

Describe characteristics of MDS

Epidemiology
Chromosomal association with pathogenesis
Clinical course with associated hematologic changes
Treatment options

Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images

Correlate diagnostic criteria to these findings for the differential identification

Describe the clinical and laboratory findings commonly found in MPD

Deletion with no replacement:

Identify treatment options and recognize effects on peripheral blood white cells, red cell parameters, and platelets

Chemotherapy
Splenic irradiation/splenectomy
Phlebotomy

Bone marrow transplant

Apply diagnostic criteria to blood and bone marrow findings for the differential identification of chronic lymphoid leukemias.

Identify key morphologic features on permanently stained blood and bone marrow smears, photographs, kodachromes, or electronic images.

Recognize and describe features associated with aggressive forms of the disease.

Autoimmune hemolytic anemia (AIHA)

Chromosome abnormality—trisomy 12—

Richter’s syndrome—

Name and compare systems used to stage disease severity and progress.

Modified Rai—

Binet—

Editorial comment:

The hematology educators felt that knowing immunophenotypic profiles of chronic lymphocytic neoplasms was not appropriate at the MLT level.

Deletion with no replacement:

Describe the presence of lymphoma cells on permanently stained blood and body fluid smears, photographs, kodachromes, or electronic images.

Addition

Describe the principle of the platelet function assay.

Deletion with no replacement:

Perform a bleeding time test.
Differentiate between disorders of the vasculature

- Acquired purpura
- Henoch-Schölein purpura
- Hereditary hemorrhagic telangiectasia
- Hlers-Danlos syndrome
- Pseudoxanthoma elasticum
A. **Basic principles**

1. Differentiate among microorganisms
   - a. Bacteria
   - b. Yeasts, molds
   - c. Viruses
   - d. Parasites
   - e. Prions

2. Describe the classification of bacteria
   - a. Taxonomy
   - b. Nomenclature
   - c. Identification

3. Describe the phenotypic characterization of bacteria
   - a. Cell growth and reproduction
   - b. Metabolism and nutrition

4. Describe the staining characteristics of bacteria
   - a. Gram-positive, Gram-negative and Gram-variable
   - b. Acid-fastness

5. Differentiate microscopic morphologies of bacteria
   - a. Cocci in chains, clusters, tetrads, pairs
   - b. Diplococci and coccobacilli
   - c. Bacilli/Rods
   - d. Lancet
   - e. Fusiform
   - f. Pleomorphic
   - g. Branching
   - h. Palisading
   - i. Endospores
   - j. Capsules
   - k. Flagella
   - l. Spirochetes
   - m. Intra- and extra-cellular

6. Define terms used in bio- and molecular technology
   - a. Deoxyribonucleic acid (DNA) relatedness
   - b. Nucleic acid probes/hybridization
   - c. Amplification procedures including but not limited to polymerase chain reaction

7. Demonstrate the proper use of the microscope (also found in General Practice)
   - a. Use
   - b. Maintenance
   - c. Troubleshooting
B. Role of the Clinical Microbiology Laboratory
   1. Pre-analytical Phase
      a. Communicate with health professionals to insure quality specimens for submission Level 1
      b. Recognize (Level 2) potential errors and resolve (Level 1) according to predetermined criteria
   2. Analytical Phase
      a. Accurately perform appropriate and timely testing in a cost effective manner Level 1
   3. Post-analytical Phase
      a. Provide accurate and timely results Level 2

C. Laboratory examination of specimens for bacterial culture
   1. Properly identify specimen type Level 2
      a. CSF
      b. Blood and bone marrow
      c. Pleural
      d. Synovial
      e. Peritoneal
      f. Pericardial
      g. Amniotic
      h. Gastric
      i. Genital
      j. Eye/ear/throat
      k. Nasopharynx/sinuses
      l. Sputum/Bronchial
      m. Tissue, skin, and bone
      n. Catheter tips
      o. Urine
         i. Catheterized
         ii. Clean voided midstream
         iii. Suprapubic
      p. Wound
         i. Abscess aspiration/purulent material
         ii. Surgical
         iii. Soft tissue
      q. Gastrointestinal
      r. Autopsy
   2. Provide proper accession of specimens Level 1
      a. Log in
      b. Request form information/Laboratory information system orders
      c. Labeling
3. Evaluate acceptability of the specimen
   a. Collection method/site preparation/aspecfic technique
   b. Collection time
   c. Container/sampling device
   d. Transport system (temperature, atmosphere, media)
   e. Time in transit
   f. Patient therapy
   g. Number
   h. Quality/Rejection criteria
   i. Quantity
   j. Contamination/spillage

4. Select appropriate storage temperature/environment if delay in processing

B. Growth and Media

1. Choose appropriate growth media and tests
   a. Select proper routine primary isolation media
      i. Enriched
      ii. Selective (differential/enrichment)
      iii. Nutrient/general purpose
   b. Describe the purpose of each media
      i. Nutrients/constituents/supplements
      ii. Antibiotics
      iii. pH
      iv. Antibiotic removal
      v. Environment
   c. Select special isolation media
   d. Select special stains/direct tests

2. Prepare specimen for inoculation
   a. Centrifugation
   b. Homogenization

3. Perform proper inoculation of media
   a. Order of media for inoculation
   b. Quantitative
   c. Semi-quantitative
   d. Standard inoculation and streaking techniques
   e. Swab
   f. Loop sterilization
      i. Reusable metal
      ii. Plastic
      iii. Calibrated
   g. Streaking for isolation
   h. Stab
4. **Determine appropriate conditions**
   - **Level 2**
     a. **Choose appropriate atmosphere**
        i. Aerobic-ambient
        ii. Capneic (3-5%,5-10%,microaerophilic)
        iii. Anaerobic
     b. **Choose appropriate temperature**
        i. 4°C
        ii. 25°C
        iii. 30°C
        iv. 35°C
        v. 42°C
     c. **Humidity**
     d. **Determine appropriate length of incubation**

5. **Prepare direct microscopic smears of specimen**
   - **Level 2**
     a. **Prepare smear (one cell thick, dry, fixed)**
     b. **Stain smear appropriately**
        i. **Wet mounts**
           1) Saline
           2) Iodine
           3) KOH
           4) Methylene Blue
        ii. **Gram**
        iii. **Spore**
        iv. **Acid-fast**
           1) Ziehl-Neelsen
           2) Kinyon
           3) Modified Kinyons
        v. **Fluorescent**
           1) Acridine orange
           2) Auramine-rhodamine
           3) Calcofluor white
           4) Fluorescein conjugated (FITC)

6. **Interpret direct microscopic smears of specimen**
   - **Level 1**
     a. **Wet mounts and Vaginal wet preps**
        i. Saline
        ii. Iodine
        iii. KOH
     b. **Gram**
7. Evaluate and quantitate microscopically  
   a. Bacteria  
      i. Structures  
      ii. Capsule  
      iii. Spores  
   b. Yeasts and hyphal elements  
   c. White and red cells  
   d. Epithelial cells - columnar and squamous, i.e. Clue cells  
   e. Artifacts and background material  
8. Quantitate organisms and cells  
9. Evaluate quality of a specimen  
10. Differentiate normal flora from potentially pathogenic organisms based on body site and specimen type  

D. Bacterial Culture Examination  
1. Distinguish colony morphologies  
   a. Staphylococci  
   b. Streptococci and Enterococci  
   c. Gram-negative cocci  
   d. Enterobacteriaceae  
   e. Pseudomonads  
   f. Other non-fermentative Gram-negative rods  
   g. Fastidious and other miscellaneous Gram-negative rods  
   h. Non spore-forming Gram-positive rods  
   i. Spore-forming Gram-positive rods  
   j. Branching and filamentous Gram-positive rods  
2. Differentiate common growth characteristics  
   a. Blood Agar media  
      i. Hemolysis (alpha/beta/gamma)  
         1) Double beta  
         2) Subtle or narrow zone  
   b. Selective Gram Negative media (i.e. MacConkey)  
      i. Fermenter vs. non-fermenter  
      ii. Detection of H2S  
      iii. Lysine decarboxylation  
   c. Chocolate media  
      i. Modified Thayer Martin (MTM)  
   d. Campy-blood agar (BA)  
      i. Cefoperazone  
      ii. Vancomycin  
      iii. Amphotericin B (CVA)
e. Colistin-nalidixic acid (CNA) blood agar
   i. Phenylethyl alcohol (PEA)
   ii. Mannitol salt agar (MSA)

f. Anaerobic media
   i. Anaerobic blood agar
   ii. Kanamycin-vancomycin laked (KVL)

g. Other media
   i. Group B selective broths
   ii. Routine enrichment broths
   iii. Mueller-hinton
   iv. Chromogenic agar

3. Select for significant uncommon organisms using selective media  
   a. Enrichment media
   b. Buffered charcoal yeast extract (BCYE)
   c. Stool selective media
   d. Corynebacterium selective media

4. Evaluate growth on primary isolation media  
   a. Correlation of direct gram stain results and culture results
   b. Correlation of clinical diagnosis and specimen source
   c. Variations in colony morphology
      i. Colony characteristics
         1) Size
         2) Shape
            a) Elevation
            b) Form
            c) Margin
               i) Umbilicated
               ii) Swarming, etc.
            d) Surface appearance
               i) Mucoid
               ii) Transparent
               iii) Opaque, etc.
            e) Pigmentation
            f) Changes in media
               i) Hemolysis
               ii) Pitting
               iii) Fermentation, etc.
         3) Correlation of growth on different media
         4) Normal flora vs. potential pathogens
         5) Characteristic odors of selected organisms
         6) Growth quantitation

E. Organism identification
1. **Apply principles of identification**
   a. Limitations and sources of errors
   b. Troubleshooting according to set guidelines
   c. Sensitivity and specificity
   d. Environmental requirements atmosphere, growth temperature, etc.

2. **Perform confirmatory identification tests (including rapid tests)**
   a. Catalase
   b. Oxidase/DMSO modified
   c. Coagulase
   d. TSI and KIA slants
   e. Methyl Red
   f. Phenylalanine deaminase (PAD)
   g. Amino acid (ornithine and lysine) decarboxylase, i.e., lysine iron agar (LIA)
   h. Acid production from carbohydrates
      i. Fermentation/oxidation
   i. Indole
      i. Tube
      ii. Spot
   j. Porphyrine (Delta aminolevulinic acid) (ALA)
   k. Pyrrolidonyl arylamidase (PYR)
   l. Salt tolerance
   m. Esculin hydrolysis
      i. Rapid
      ii. Bile esculin slant
   n. Hippurate hydrolysis
   o. H2S production
   p. Nitrate reduction
   q. Citrate utilization
   r. Urease
   s. Butyrate esterase
   t. Voges-Proskauer
   u. Bile solubility
   v. Growth factors (X, V, and XV)

3. **Perform Disk identification tests**
   a. Novobiocin
   b. Optochin (ethylhydrocupreine hydrochloride)
   c. Special potency disks
   d. Bacitracin
   e. Beta lactamase
   f. Colistin, Kanamycin, Vancomycin

4. **Choose other testing**
a. Satellitism, i.e., Staphylococcus aureus streak
b. Motility
c. Aerotolerance
d. Colony fluorescence

5. Explain basic principles and concepts of commercial identification systems
   a. Non-automated
      i. Miniaturized
      ii. Rapid
         3) Substrate based
         4) Spot tests
   b. Automated
      i. Nucleic acid detection
         1) Nonamplified
            a) Hybridization probes
         2) Amplified, including but not limited to real time polymerase chain reaction (PCR)
         3) Maldi-TOF
         4) Microarray

6. Discuss basic concepts of serological identification
   a. Coagglutination
   b. latex agglutination
   c. urine antigen detection
   d. Toxin detection
   e. Immunofluorescent assays (Direct-DFA/Indirect-IFA)
   f. Enzyme linked immunoabsorbant assay (ELISA)
   g. Serotype

7. Use established algorithms and databases to establish identification

F. Clinically Significant Organisms
   6. Isolate organisms
   7. Isolate organisms at the identification levels
      Heard of it
      Can identify it
      Can assess significance of culture findings based on identification and specimen site

a. Staphylococci
   i. Staphylococcus aureus (Level 3)
   ii. Methicillin-resistant Staphylococcus aureus (MRSA) (Level 3)
   iii. Vancomycin-intermediate S. aureus (VISA) (Level 3)
   iv. Vancomycin-resistant S. aureus (VRSA) (Level 3)
   v. Staphylococcus epidermidis (Level 1)
   vi. Staphylococcus saprophyticus (Level 2)
   vii. Staphylococcus lugdunensis (Level 1)
   viii. Other coagulase-negative Staphylococci (Level 2)

b. Micrococcus spp. (Level 2)
c. Streptococci
   i. *Streptococcus pyogenes* (Group A) (Level 3)
   ii. *Streptococcus agalactiae* (Group B) (Level 3)
   iii. Other beta-hemolytic Streptococci (Level 3)
   iv. *Streptococcus pneumoniae* (Level 3)
   v. Viridans group (Level 3)
   vi. Alpha and non-hemolytic Streptococci (Level 2)

d. Enterococcus, VRE,
   i. *Enterococcus faecalis* (Level 3)
   ii. *Enterococcus faecium* (Level 3)

e. Group D Streptococcus ie *S. galolyticus* (previously *S. bovis*) (Level 3)

f. Aerobic Gram-negative cocci
   i. *Neisseria gonorrhoeae* (Level 3)
   ii. *Neisseria meningitidis* (Level 3)
   iii. *Moraxella catarrhalis* (Level 3)


g. Enterobacteriaceae
   i. *Escherichia coli* (Level 3)
      1) Enterohemorrhagic *E. coli* due to Shiga toxin
      2) Other diarrheagenic *E. coli*
   ii. *Shigella sp.* (Level 3)
   iii. *Klebsiella sp.* (Level 3)
      1) *K. pneumoniae*
      2) *K. oxytoca*
   iv. *Enterobacter sp.* (Level 3)
      1) *E. aerogenes*
      2) *E. cloacae*
   v. *Serratia sp.* (Level 3)
   vi. *Citrobacter sp.* (Level 3)
   vii. *Salmonella spp.*, i.e., *Salmonella enterica biovar typhi* (Level 3)
   viii. *Proteus sp.* (Level 3)
      1) *P. mirabilis*
      2) *P. vulgaris*
   ix. *Providencia sp.* (Level 1)
   x. *Morganella morganii* (Level 1)
   xi. *Yersinia enterocolitica* (Level 3)

h. Other facultative Gram negative rods
   i. *Vibrio cholera* (Level 3)
   ii. *Aeromonas sp.* (Level 3)
   iii. *Campylobacter jejuni* (Level 3)
   iv. *Helicobacter sp.* (Level 1)
   i. Glucose non-fermenting Gram-negative rods
i. *Pseudomonas aeruginosa* (Level 3)
ii. *Stenotrophomonas maltophilia* (Level 2)
iii. *Moraxella sp.* (Level 2)

j. HACEK and other fastidious Gram negative rods
i. *Aggregatibacter aphrophilus* (previously known as *Haemophilus aphrophilus/H. paraphrophilus*) (Level 1)
ii. *Aggregatibacter actinomycetemcomitans* (previously known as *Actinobacillus actinomycetemcomitans*) (Level 1)
iii. *Cardiobacterium hominis* (Level 1)
iv. *Eikenella corrodens* (Level 1)
v. *Kingella sp.* (Level 1)

k. Other delicate/fastidious Gram-negative coccobacilli
i. *Bordetella sp.* (Level 1)
ii. *Brucella sp.* (Level 1)
iii. *Francisella tularensis* (Level 1)
iv. *Haemophilus influenzae* (Level 3)
   1) Serotypes b and non-b
   2) *Biovar aegyptius*
v. Other *Haemophilus sp.* (Level 2)
vi. *Legionella pneumophila* (Level 1)

l. Aerobic Gram-positive rods
i. *Gardnerella vaginalis* (Level 1)
ii. *Corynebacterium diphtheriae* (Level 1)
iii. Other *Corynebacterium species* (Level 2)
iv. *Listeria monocytogenes* (Level 1)
v. *Bacillus anthracis* (Level 1)
vi. *Bacillus cereus* (Level 2)

m. Anaerobic Gram-positive rods
i. *Clostridium perfringens* (Level 1)
ii. *Clostridium difficile* (Level 1)

n. Anaerobic Gram-positive cocci
i. *Peptostreptococcus sp.* (Level 1)

o. Anaerobic Gram-negative rods and cocci
i. *Bacteroides fragilis* group (Level 1)
ii. *Bacteroides sp.* (Level 1)
iii. *Fusobacterium sp.* (Level 1)
iv. *Prevotella sp.* (Level 1)
v. *Veillonella sp.* (Level 1)
10. Use public health and reference laboratories for special tests
   a. Reference laboratory resource information
   b. Specimen handling
      i. Packaging and shipping regulations
      ii. Safety precautions
      iii. Transport conditions
   c. Requisition information
   d. Records/documentation/protocols
   e. Cost

F. Antimicrobials
1. Apply standard performance principles and quality control to antimicrobial susceptibility tests
   a. Principles
   b. Limitations and sources of errors
   c. Troubleshooting according to set guidelines
   d. Sensitivity and specificity
   e. Quality control
2. Perform disk diffusion (Kirby Bauer) and antimicrobial gradient method (E-test)
   a. Media
      i. Depth
      ii. Supplements
      iii. Storage
   b. Inoculum
      i. Organism
      ii. Standardized suspension
      iii. Time limit for inoculation
      iv. Pattern of inoculation
      v. Time limit for application of disks
      vi. Disk placement
   c. Incubation
      i. Time
      ii. Temperature
      iii. Atmosphere
   d. Disk potency and storage
   e. Reading
   f. Interpretation
      i. Qualitative
      ii. Quantitative
   g. Reporting
   h. Special techniques
      i. Error detection and resolution according to predetermined criteria
3. Discuss the importance and principles of Beta-lactamase detection \textbf{Level 1}

4. Identify organisms using Minimum inhibitory concentration (MIC) – micro-broth and automated systems \textbf{Level 2}
   a. Inoculum
   b. Selection of appropriate organism for method
   c. Incubation
   d. Reading
   e. Interpretation
   f. Reporting
   g. Supplements and special techniques
   h. Error detection and resolution according to predetermined criteria

5. Discuss Clinical and Laboratory Standards Institute (CLSI) guidelines \textbf{Level 1}

6. Perform susceptibility testing and special resistance detection methods on appropriate organisms \textbf{Level 2}
   a. Oxacillin resistance for \textit{Staphylococcus} spp.
   b. Inducible clindamycin resistance for \textit{Staphylococcus}, beta-hemolytic \textit{Streptococcus} spp. and \textit{Streptococcus pneumoniae}
   c. Vancomycin resistance for \textit{Staphylococcus} and \textit{Enterococcus} spp.
   d. High level aminoglycoside resistance for \textit{Enterococcus} spp.
   e. Penicillin resistance for \textit{Streptococcus pneumoniae}
   f. Extended spectrum beta-lactamases (ESBL) for Enterobacteriaceae
   g. \textit{ampC} enzymes for Gram-negative rods
   h. Carbapenemase resistant Enterobacteriaceae (CRE)

8. Interpret results according to set guidelines \textbf{Level 3}
   a. Qualitative
   b. Quantitative

9. Recognize unusual antimicrobial profiles according to set guidelines \textbf{Level 1}

10. Recognize “predictor” antimicrobial agents used to detect specific resistance mechanisms \textbf{Level 1}

11. Recognize multidrug-resistant organisms (MDRO) \textbf{Level 1}

12. Report data according to set guidelines and utilizing cascade and selective reporting \textbf{Level 1}

13. Relate antimicrobial agents to mode of action and spectrum of activity \textbf{Level 1}

14. Explain the common mechanisms of bacterial resistance \textbf{Level 1}

F. \textbf{Results}

1. Prioritize reporting of direct smears \textbf{Level 1}

2. Prepare \textbf{(Level 2)} culture reports and assure \textbf{(Level 2)} quality of results based on predetermined criteria
   a. Culture correlation with
      i. Direct Gram stain
      ii. Body site/specimen type
      iii. Patient history/population
      iv. Identification testing results
      v. Susceptibility testing results
vi. Clinical significance of organisms
vii. Other significant information

b. Selective reporting of antimicrobials

3. Report normal flora appropriately
   Level 1
4. Designate preliminary or finalized status
   Level 1
5. Recognize (Level 2) and resolve (Level 1) issues according to predetermined criteria
6. Report cultures concisely, clearly and in a timely fashion
   Level 2
7. Document work performed
   Level 2
Mycology – MLT Entry Level Curriculum

A. Basic principles of Mycology
   1. Describe characteristics of fungi Level 1
      a. Classification, Taxonomy
      b. Eukaryotic cells
      c. Reproduction
      d. Growth requirements
      e. Morphologic structures

B. Laboratory examination of fungal specimens
   1. Describe proper collection methods Level 1
   2. Discuss appropriate transportation and storage of specimen Level 1
   3. Determine acceptability of specimen Level 2
   4. Select appropriate media for culture of fungal specimens Level 1
      a. Primary isolation media
      b. Without antibacterial or antifungal agents
      c. With antibacterial agents (chloramphenicol, ciprofloxacin, gentamicin, penicillin or streptomycin)
      d. With antibacterial agents and antifungal agents (cyclohexamide)
      e. Dermatophyte test medium (DTM)
      f. Mycosel or mycobiotic agar
      g. Selective and differential for yeast, eg CHROMagar Candida
   5. Discuss the purpose of each media preparation Level 1
      a. pH
      b. Antibacterial agents
      c. Antifungal agents
   6. Inoculate media using Level 2
      a. Aspirates, tissue, bone
      b. Blood and bone marrow
      c. CSF and other body fluids
      d. Upper and lower respiratory specimens
      e. Urine
      f. Hair, skin, nails
   7. Discuss the influence on incubation Level 1
      a. Temperature
      b. Length of incubation and examination schedule
   8. Perform (Level 2) and interpret (Level 2) direct microscopic smears of fungal specimen according to set guidelines
      a. KOH
      b. India ink
c. Gram stain

9. Differentiate common yeasts and molds from bacteria on routine mycology media  
   \textbf{Level 2}

10. Describe procedures for microscopic observation of fungi  
    \textbf{Level 1}
    a. Germ tube
    b. Cornmeal/rice (chlamydospore agars)
    c. Scotch tape preparation with LPCB
    d. Slide cultures

11. Relate patient history and clinical symptoms with growth on media, colonial morphology and 
    microscopic structures to assist in identification of fungi and assessment of clinical significance  
    \textbf{Level 1}

a. Yeasts
   i. Candida
      1) \textit{C. abicans}
      2) \textit{C. glabrata}
      3) \textit{C. tropicalis}
      4) Other \textit{Candida} \textit{sp.}
   ii. Cryptococcus
      1) \textit{C. neoformans}
      2) Other \textit{Cryptococcus} \textit{sp.}
   iii. \textit{Trichosporon} \textit{sp.}
   iv. \textit{Geotrichum} \textit{sp.}
   v. Malassezia spp., ie \textit{M. furfur}

b. Dimorphic moulds
   i. \textit{Blastomyces dermatitidis}
   ii. \textit{Coccidioides} \textit{spp.}, ie \textit{C. immitis}
   iii. \textit{Histoplasma capsulatum}
   iv. \textit{Sporothrix schenckii}
   v. \textit{Paracoccidioides brasiliensis}

c. Brightly colored/hyaline molds
   i. \textit{Aspergillus} \textit{spp.}
      1) \textit{A. fumigatus}
      2) \textit{A. flavis}
      3) \textit{A. niger}
      4) Other \textit{A. sp.}
   ii. \textit{Penicillium} \textit{sp.}
   iii. \textit{Fusarium} \textit{spp.}

d. Dermatophytes
   i. \textit{Microsporum} \textit{spp.}
   ii. \textit{Trichophyton} \textit{spp.}
   iii. \textit{Epidermophyton} \textit{floccosum}

e. Zygomycetes
i. *Rhizopus* spp.

ii. *Mucor* spp.

iii. *Absidia* spp.

f. other fungi

i. *Pneumocystis jiroveci*

12. Describe test methodologies for fungi identification  
   a. Principles
   b. Limitation and sources of errors
   c. Troubleshooting according to set guidelines
   d. Sensitivity and specificity
   e. Rapid and traditional testing methods
      i. Assimilation/fermentation
      ii. Temperature tolerance
      iii. Mould/yeast conversion
      iv. Wood’s lamp fluorescence
      v. In-vitro hair perforation
      vi. Antigen detection methods
         1) Cryptococcal antigen
      vii. Commercial methods
      viii. Molecular methods

13. Use databases and reference materials in identification of fungi  
    Level 1
Parasitology – MLT Entry Level Curriculum

A. **Taxonomy and terminology for categories of parasites**
   1. Describe the distinguishing characteristics of categories of parasites ________ Level 1
      a. Nematodes (roundworms)
         i. Tissues
         ii. Intestinal
      b. Cestodes (tapeworms)
      c. Trematodes (flukes)
      d. Protozoan
      e. Amebae
      f. Flagellates
      g. Sporozoa
         i. Plasmodium spp.
         ii. Coccidia
      h. Ciliates
   2. Recognize characteristic structures of adults, larvae, ova, cysts, trophozoites, etc. ________ Level 1

B. **Specimen Collection and handling**
   1. Determine specimen acceptability in parasitic identification ________ Level 2
      a. Collection method
      b. Collection time/receipt time
      c. Specimen storage
      d. Number of specimens
      e. Presence of interfering or contaminating substances
      f. Preservatives for parasitic specimen
         i. Polyvinyl alcohol (PVA)
         ii. 10% Formalin
         iii. Schaudinn solution (mercury free)
         iv. Sodium acetate-acetic acid-formalin (SAF)
         v. Less toxic single tube systems
      g. Rejection criteria

C. **Examination of specimens**
   1. Examine the specimen macroscopically ________ Level 2
      a. Color
      b. Presence of blood or mucous
      c. Consistency (watery/Loose,semisolid,formed)
      d. Worm components (proglottids, adult, scolex, etc)
   2. Describe the process of direct microscopic examination of specimen ________ Level 1
      a. Proper use of the microscope, objectives, and light source
b. Use of ocular micrometer for measurement of size
   i. Calibration

c. Use of direct wet mounts with saline and iodine preparations

d. Systematic examination of prepared slide

e. Detection of parasites

3. Select and perform appropriate concentration methods and stains
   Level 1
   a. Principles
   b. Limitations and sources of errors
   c. Trouble-shooting according to set guidelines
   d. Sensitivity and specificity
   e. Quality control
   f. Concentration methods
      i. formalin-ethyl acetate
      ii. alternate solvents sedimentation
   g. Permanent stained smears
      i. trichrome/modified trichrome
      ii. iron-hematoxylin
      iii. modified Kinyons (acid-fast)
      iv. Calcofluor white
      v. Auromine O
   h. Preparations of reagents and stains
      i. Preparation of malarial smears
         i. Thick smears
         ii. Thin smears

4. Explain the detection and differentiation of specific parasites
   Level 1
   a. Immunoassays
   b. Nucleic acid assays

5. Detect and identify parasites
   Heard of it
   Can identify it
   Level 1
   a. Nematodes
      i. Intestinal
         1) Ascaris lumbricoides (Level 2)
         2) Strongyloides stercoralis (Level 1)
         3) Hookworm (Level 2)
            a) Necator spp.
            b) Ancyclostoma spp.
         4) Trichuris trichiura (Level 2)
         5) Enterobius vermicularis (Level 2)
      ii. Blood and tissue
         1) Trichinella spiralis (Level 1)
2) *Wuchereria bancrofti* (Level 1)
3) *Brugia malayi* (Level 1)
4) *Loa loa* (Level 1)
5) Mansonella (Level 1)
6) *Onchocerca volvulus* (Level 1)
7) *Dracunculus medinensis* (Level 1)

b. Cestodes
i. *Taenia solium* (Level 2)
ii. *Taenia saginata* (Level 2)
iii. *Echinococcus granulosus* (Level 1)
iv. *Diphyllobothrium latum* (Level 2)
v. *Hymenolopis nana* (Level 2)
vi. *Hymenolopis diminuta* (Level 1)

c. Trematodes
i. *Paragonimus westermani* (Level 2)
ii. *Fasciolopsis buski* (Level 2)
iii. *Fasciola hepatica* (Level 2)
iv. *Clonorchis sinensis* (Level 2)
v. *Schistosoma mansoni* (Level 2)
vi. *Schistosoma haematobium* (Level 2)


d. Protozoa
i. Amoeba
   1) *Entamoeba hystolytica* (Level 2)
   2) *Entamoeba dispar* (Level 2)
   3) *Entamoeba coli* (Level 2)
   4) Other *Entamoeba* sp. (Level 2)
   5) *Iodamoeba bütschlii* (Level 2)
   6) *Endolimax nana* (Level 2)
   7) *Acanthamoeba sp.* (Level 1)
   8) *Naegleria fowleri* (Level 1)
   9) *Blastocystis hominis* (Level 2)

   ii. flagellates
      1) *Giardia lamblia/intestinalis* (Level 2)
      2) *Trichomonas vaginalis* (Level 2)
      3) *Dientamoeba fragilis* (Level 2)

   iii. *Trypanosoma spp.* (Level 1)

   iv. *Leishmania spp.* (Level 1)

   v. Sporozoa (Level 2)
      1) *Plasmodium spp.*
      2) *Babesia spp.*
3) *Cryptosporidium parvum*

e. Ciliates
   i. *Balantidium coli* (Level 2)

6 Use pertinent clinical information in order to identify parasites Level 2
   i. Diagnostic stage, i.e., characteristic structure(s) present
   ii. Knowledge of life cycle
   iii. Specimen of choice for detection
   iv. Detection methods available

7 Differentiate artifacts from parasites (Level 2)
   i. White and red blood cells
   ii. Epithelial cells
   iii. Pollen granules
   iv. Vegetable fibers and cells
   v. Yeast cells
   vi. Charcot-Leyden crystals
   vii. Fungal spores (morels)
   viii. Diatoms
   ix. Hair

8 Examine specimens other than stool Level 1
   i. Cellophane tape/vaspar paddle preparation for *Enterobius vermicularis*
   ii. Wet mount/culture for *Trichomonas species*
   iii. Duodenal capsule or string technique (Entero-Test)
   iv. Thick and thin blood films
   v. Bone marrow and body fluids
   vi. Urine
   vii. Lower respiratory
   viii. Biopsy
Mycobacteriology – MLT Entry Level Curriculum

A. General Characteristics
   1. Describe the general characteristics of mycobacteria Level 1
      a. Acid-fastness
      b. Growth requirements
      c. Rate of growth
      d. Atmosphere requirements
      e. Temperature

B. Specimen management
   1. State the safety requirements for working with mycobacteria Level 1
      a. Biological safety cabinet (BSC/Biosafety level (BSL))
      b. Personal protective equipment
         i. Respirator
         ii. Gloves
         iii. Liquid impervious gowns
         iv. Centrifuges with safety carriers
         v. Germicides
      c. Equipment
      d. Negative pressure facility
      e. Annual tuberculin skin test
         i. Chest x-ray if skin test is positive
         ii. Effects of BCG vaccine
   2. Discuss specimen collection and transportation procedures Level 1
      a. Pulmonary sites
         i. Sputum, expectorated and induced
         ii. Bronchial alveolar lavage (BAL), bronchoscopy, etc.
      b. Extrapulmonary sites
         i. Non-contaminated
            1) Blood and bone marrow
            2) Body fluids
            3) Tissue
         ii. Contaminated
            1) Urine
            2) Skin lesions, wound, abcesses
            3) Gastric lavage or aspirate
            4) Stool for Mycobacterium avium complex
         iii. Blood for interferon gamma release assay (QuantiFERON – TB test)
      c. Collection method/site preparation
         i. Container
ii. Collection time
iii. Number of specimens
iv. Quality
v. Optimum volume
vi. Rejection criteria

3. Describe (Level 1) specimen processing procedures
   i. Contaminated specimens
      1) Digestion and decontamination
         a) Liquefication
         b) Decontamination
         c) Centrifugation
            i) Speed
            ii) Time
            iii) Equipment required
         d) Limitations and potential sources of errors
         e) Quality assurance, e.g., maintenance of a contamination rate of 3-5%
   ii. Non-contaminated specimens
      1) Centrifugation
      2) Direct inoculation

C. Smears and Stains
   1. Discuss the preparation, staining and screening of smears
      Level 1
         a. Specimen selection
            i. Smear preparation, standardization, fixation
               1) Direct
               2) Concentrated
               3) Cytocentrifugation with bleach
         b. Stains
            i. Reagent preparation
            ii. Acid-fast stain procedures
               1) Principle
               2) Acid-fast: fuchsin
                  a) Ziehl-Neelsen
                  b) Kinyoun
               3) Acid-fast: fluorochrome
                  a) Auramine O
                  b) Auramine-rhodamine
            iii. Quality control
            iv. Limitations and potential sources of errors
            v. Troubleshooting and according to set guidelines
            vi. Sensitivity and specificity
c. Microscopic evaluation
   i. Magnification
   ii. Scanning pattern
   iii. Organism morphology, e.g., serpentine cording
   iv. Specificity
   v. Sensitivity

2. Describe the interpretation and reporting of smear
   a. Sources of false positives
      i. Nocardia
      ii. Rhodococcus
      iii. Cryptosporidium, Cystoisospora and Cyclospora oocysts
      iv. M. gordonae from a tap water source
      v. Other
   b. Appearance of artifacts, debris, background
   c. Reporting scheme
   d. Internal review process for quality assurance

D. Culture medium
   1. Describe the culture media most appropriate for primary cultures by specimen type
      a. Egg-based
         i. Lowenstein-Jensen
      b. Agar-based
         i. Middlebrook 7H10 and 7H11
      c. Liquid based
         i. Middlebrook 7H9, 7H12 and 7H13
      d. Commercial systems
      e. Other
   2. Discuss the incubation of the primary media
      a. optimal temperature to isolate mycobacteria
         i. 35o C vs. 37o C
         ii. 25-33o C
      b. optimal atmospheres of incubation
      c. optimal length of incubation
      d. Reading schedule for inoculated media

E. Identification
   1. Describe the identification of isolates using established algorithms and databases
      a. Acid-fastness of the organism
      b. Preferred temperature of growth
      c. Rate of growth
         i. Rapid grower (< 7 days)
ii. Slow grower (> 7 days)

2. Discuss variations in colony morphology
   i. Pigment

F. **Testing**
   1. Discuss Biochemical testing of mycobacteria
   2. Describe other methods for organism identification
      a. Molecular diagnostics
      b. Amplification methods for direct detection of *Mycobacterium tuberculosis*
   3. Describe mycobacteria based on key criteria
      a. *Mycobacterium tuberculosis* complex
      b. *M. tuberculosis*
      c. *Mycobacterium avium-intracellulare* complex (MAC or MAI)
   4. Correlate the presence of organisms with the most common types of clinical infections and clinical significance according to set guidelines
      a. Routes of transmission
      b. Signs and symptoms

G. **Reporting**
   1. Describe the turnaround time and reporting of direct smear, culture, and susceptibility results
Virology – MLT Entry Level Curriculum

A. Characteristics of viruses
   1. Describe the basic structure/components of viral agents Level 1
      a. Virion
         i. Type of nucleic acid present (RNA or DNA)
         ii. Capsid
         iii. Envelope
         iv. Glycoprotein spikes
   2. Differentiate viruses from bacteria Level 2
      a. Requirement for living cells
      b. Size
      c. Structure
      d. Replication
      e. Therapy

B. Classification of viruses
   1. Outline the criteria for classifying or grouping viruses Level 1
      a. Nucleic acid type (RNA or DNA)
      b. Host
   2. Associate agents of infections infection with disease or pathologic manifestations and route of transmission Level 2
      a. Hepatitis viruses
      b. Simplex virus, Herpesvirus 1 and 2
      c. Cytomegalovirus (CMV)
      d. Varicella-Zoster (VZV)
      e. Influenza virus A
         i. H1N1
         ii. H5N1
      f. Influenza virus B
      g. Respiratory syncytial virus (RSV)

C. Specimen collection and processing
   1. Discuss important information for specimen collection and processing of specimens Level 1
      a. Selection of body site/Specimen type
      b. Collection methods, devices and containers
      c. Safety precautions
      d. Transport media
      e. Temperature
      f. Time
2. Utilize proper specimen storage upon receipt in laboratory  
   Level 1
3. Utilize proper specimen shipment methods are used  
   Level 1
4. Utilize specimen processing algorithms based on most likely virus present  
   Level 2
   a. Rejection criteria
   b. Specimen type/body site
   c. Specimen preparation
   d. Age of patient
   e. Time of year/virus seasonality
   f. Virus suspected
   g. Immune status

D. Laboratory procedures
1. Describe laboratory procedures for detection of viral agents and particles  
   Level 1
   a. Principles
   b. Limitations and sources of errors
   c. Troubleshooting according to set guidelines
   d. Sensitivity and specificity
   e. Quality control
   f. Direct detection methods
      i. Immunodiagnostic
         1) Direct and indirect immunofluorescent
         2) Antibody methods
         3) Enzyme immunoassay methods (EIA)(ELISA)
      ii. Molecular methods
      iii. Cell culture systems
      iv. Serology
Infection Prevention and Control – MLT Entry Level Curriculum

A. Disease transmission
   1. Define terms associated with disease transmission Level 1
      a. Epidemiology
      b. Community acquired infections
      c. Nosocomial infections
      d. Epidemic
      e. Endemic
      f. Outbreak
      g. Cluster
      h. Surveillance
      i. Morbidity
      j. Mortality
   2. Describe the origin and mode of spread Level 1
      a. Droplet
      b. Airborne
      c. Fomite
      d. Vector
      e. Reservoir
      f. Endogenous
      g. Exogenous
   3. Compare and contrast Level 2
      a. Colonization
      b. Infection
      c. Carrier state

B. Infection prevention methods
   1. Relate underlying patient condition/factors to acquisition of infection Level 1
      a. Medical devices (Catheters, respirator)
      b. Immunocompromised
      c. Immunosupressive therapy
      d. Antimicrobial therapy
      e. Malignancy
      f. Age
      g. Occupation
      h. Surgery
      i. Prosthetic devices (pacemaker, artificial heart valve, shunt, joint)
   2. Apply concepts of disease transmission to disease prevention Level 2
a. **Education**
   i. Health care professionals
   ii. Patients
   iii. Environmental services (housekeeping)

b. **Precautions**
   i. Standard Precautions
   ii. Transmission-based
      1) Direct and indirect contact
      2) Droplet
      3) Airborne
   iii. Immunizations
   iv. Treatment  
       1) Antibiotics
       2) Antiviral
       3) Antifungal
       4) Antiparasitic

C. **Role of clinical microbiology laboratory**

1. Culture microbial pathogens  
   a. Common bacteria
   b. Multiple drug resistant organism (MDRO)
   c. Mycobacteria
   d. Fungi
   e. Unusual organisms
   f. Viruses
   g. Parasites

2. Identify common bacteria through culture, microscopic, or rapid testing

3. Detect microbial organisms through microscopic or rapid testing
   a. Mycobacteria
   b. Fungi
   c. Unusual organisms
   d. Viruses
   e. Parasites

4. Report relevant cultures/organisms to infection control personnel

5. Assist medical laboratory scientists with surveillance of infectious diseases
   a. Environmental samples
   b. Personnel specimens
   c. Patient specimens
   d. Rapid diagnostic testing
e. Organism identification
f. Antimicrobial susceptibility testing
g. Epidemiologic analysis of microorganisms
   i. Phenotypic techniques
   ii. Genotypic techniques
6. Report communicable diseases/organisms to the appropriate public health agencies  
   Level 1
7. Monitor for bioterrorism agents and emerging infections  
   Level 1
   a. Centers for Disease Control (CDC) categories of organisms
   b. CDC laboratory response network
   c. Specimen packing and shipping
   d. Biosafety
   e. Protocols to rule in/rule out critical agents
8. Handle and dispose of biohazard materials  
   Level 2
   a. QC of autoclaves
   b. Identification of biological, pathological, and surgical infectious materials
   c. Cleaning, sterilization, disinfection
   d. Laboratory safety procedures manual
   e. Aseptic technique
Laboratory Practice – MLT Entry Level Curriculum

A. Quality management
1. Follow policies and procedures  
2. Perform (Level 2) procedures and review (Level 2) results of standard quality control  
   a. Media  
   b. Stains  
   c. Reagents/kits  
   d. Equipment  
   e. Physiological tests  
   f. Antimicrobial testing  
   g. Serological tests  
   h. Stock organisms  
   i. Inventory  
   j. Automated systems  
   k. Immunological test  
   l. Microscope calibration  
3. Recognize errors according to set guidelines  
4. Participate in data collection for a quality management plan  
5. Assist in the education and training of others  
   a. Laboratory science students  
   b. Healthcare personnel  
   c. Co-workers  
6. Maintain knowledge and skills through continuing education

B. Laboratory Safety
1. Describe (Level 1) and use (Level 2) accepted safety precautions to prevent laboratory acquired infections  
   a. Standard Precautions  
      i. Handwashing  
      ii. Protective clothing/devices  
   b. Engineering controls  
      i. HEPA filtration  
      ii. Ultraviolet germicidal irradiation  
      iii. Negative pressure room  
   c. Emergency action protocol  
   d. Training  
   e. Health care facilities  
      i) Emergency care
ii) Respirator fit testing
iii) Treatment
f. Aseptic techniques
g. Handling and disposal of sharps
h. Use of biological safety cabinets
i. Center for Disease Control and Prevention (CDC)/biological safety level (BSL) classification
   i. Classifications of BSL requirements
   ii. Correlation of specific organisms and required BSL
j. Bio-hazardous materials discard
k. Decontamination, disinfection, sterilization
l. Emergency first aid, eye wash, showers
m. Immunizations
n. Employee health services

2. Take immediate and appropriate action when an incident occurs  
   Level 3
3. Describe the procedures for prevention of aerosolization of microbial agents (mycobacteria and other bacteria, fungi, and viruses)  
   Level 1
   a. Aseptic techniques
   b. Containment procedures
   c. Decontamination, disinfection, sterilization
   d. Centrifuge use
e. Bio-hazardous materials discard

4. Describe the collection and discard of infectious waste materials  
   Level 1
   a. Environmental Protection Agency (EPA)/state regulations
   b. Definition of infectious waste

5. Discuss hazards of chemicals in the workplace  
   Level 2
   a. Safety data sheets (SDS)
   b. Storage, labeling and use
      i. Physical hazards
         1) Flammable
         2) Oxidizer
         3) Corrosive
      ii. Health hazards
         1) Toxicity
         2) Carcinogenicity
      iii. Environmental hazards
   c. Fire protocol (RACE - rescue, alarm, contain, extinguish)
   d. Classes of fire extinguishers
   e. Fire evacuation plan
   f. Fire extinguisher protocol (PASS - pull pin, aim, squeeze, sweep base of fire)
C. **Laboratory Information System (LIS)**

1. Describe data entry  
   a. Automated/Manual  
2. Describe the reporting of data  
3. Discuss data retrieval to provide relevant information for microbiology  
   a. Analysis  
   b. Integration  
   c. Antibiogram  
4. Describe the retrieval of information by clinics/providers  
   a. Results  
   b. Services provided  
   c. Specimen handling  
   d. Education  

D. **Administrative tasks**

1. Explain the responsibilities of laboratory management  
   a. Personnel  
      i. Safety  
      ii. Training  
      iii. Proficiency  
      iv. Competency  
   b. Physical facilities  
   c. Communication  
      i. Public health authorities  
      ii. Infection prevention/epidemiology  
      iii. Service providers/clinicians  
      iv. Administration  
      v. Education  
      vi. HIPAA  
      vii. Finance, i.e., cost containment
DELETIONS & ADDITIONS

**DELETIONS**

- **Bacteriology**
  - TM, NYC, Jembec, and ML agar, leaving only MTM agar for choc media types
  - CCFA agar
  - CAMP
  - India Ink
  - Some of the more unusual tests
  - Nutritionally variant Strep.
  - Unusual organisms
  - Mechanism of action for antibiotics
  - E-test
  - Minimum bactericidal concentration (MBC)
  - Standard performance principles to bioassays of body fluids

- **Mycology**
  - Structural characteristics of mycology
  - Generalized media into groupings – removed specific types (changed to Level 1)
  - Interpretation of fungal smears
  - Periodic acid Schiff, Gomori methenamine silver, hematoxylin and Eosin stains
  - Scotch tape prep and tease prep
  - Correlation of clinical symptoms with fungal identification
  - Some fungal pathogens

- **Parasitology**
  - Structural terms
  - Malaria consolidated into species instead of specific organisms.

- **Mycobacteriology**
  - Taxonomic differentiation of Nocardia, Rhodococcus, Streptomyces, and Mycobacterium
  - Phenotypic characterization
  - Microscopic morphology (coccoid, filamentous, beading, cording, ghosts)
  - Colony morphology and identification

- **Virology**
  - Helical/icosahedral/complex
  - EBV

- **Administration**
  - Issues of staff performance
  - Budget
  - Implement safety precautions
ADDITIONS

- Catheter tips
- Group B selective broths (dropped specific types and added a general category)
- Routine enrichment broth category (consolidated enrichment broths instead of specific types)
- Stool selective media (consolidated TCBS, Yersinia, and CIN media)
- Corynebacterium selective media (Consolidated Bordet Gengou/Reagan Lowe, Loeffler’s and Tinsdale media)
- Added back anaerobic identification disks
- Maldi-TOF and Microarray
- *Aeromonas sp.*
Molecular Diagnostics – MLT Entry Level Curriculum

1. Basic Foundation Concepts
   a. Describe a brief history of the development of molecular diagnostics Level 1
   b. Discuss the impact molecular diagnostic will have on:
      i. Laboratory medicine Level 2
      ii. Diagnosis and management of diseases
      iii. Ethical implications
   c. Discuss the basic functions of DNA Level 1

2. Nucleic Acid Biochemistry
   a. Explain semi-conservative DNA replication Level 1
   b. Describe DNA Level 1
      i. Central dogma
      ii. Transcription
      iii. Translation (codons/anticodons, ribosomes, genetic code/degeneration)
      iv. Extrachromosomal (plasmid, mitochondrial transmission)

3. Genetics
   a. Describe chromosome morphology Level 1
   b. Discuss Mendelian and non-Mendelian genetics Level 1
   c. Define mutations and polymorphisms Level 1

4. Molecular methodologies
   a. Describe nucleic acid extraction/isolation/quantitation/purification techniques Level 1
      i. purpose of technique
      ii. reagents and purpose
      iii. acceptable sample types
   b. Discuss nucleic acid modifying enzymes Level 1
      i. storage criteria
      ii. enzyme inactivation
      iii. basic function of the following enzymes
         1. Endonucleases
         2. Exonucleases
         3. Ligases
         4. Polymerases
         5. Reverse transcriptases
         6. Phosphatases
         7. kinases
   c. Discuss Nucleic acid electrophoresis Level 1
      i. role of size, charge, and shape or conformation in migration/movement
   d. Compare and contrast blotting techniques Level 2
1. Western, northern, and southern blotting
2. Nucleic substance tested (DNA, RNA, protein)
3. Consider the following variables when performing various blotting techniques
   a. Restriction fragment length polymorphism (RFLP)
   b. Stringency
   c. Hybridization
4. Pros and cons of each method
e. Discuss Amplification assays
   i. polymerase chain reaction (PCR)
      1. Amplification reaction
      2. Cycle (denature, anneal, extend)
      3. Stringency
      4. Components/concentration
         a. Primers and primer design
         b. DNA template, bases, and polymerase
         c. Buffer
   5. Probe assays
   6. Master mix
   ii. List types of amplification assays
      1. Target amplifications
         a. Polymerase Chain Reaction (PCR)
         b. Differentiate PCR modification techniques (end-point versus real-time)
            i. Real time PCR
            ii. Nested PCR
            iii. Multiplex PCR
            iv. Reverse transcription-polymerase chain reaction (RT-PCR)
      2. Probe amplification
      3. Signal amplification
   iii. Explain florescence in situ hybridization (FISH)

5. Laboratory Operations, Quality Control and Quality Assurance in the molecular laboratory
   a. State variables of concern for pre-analytical testing
      i. Test request
      ii. Specimen collection/handling
   b. State variables for the analytical phase
      i. specimen extraction and storage
      ii. Lab design
      iii. Contamination monitoring
      iv. Contamination prevention
      v. QC/preventive maintenance
   c. State concerns for the post-analytical phase
i. Reporting of results
ii. Follow-up recommendations
iii. Confidentiality

d. Describe controls used in molecular testing

e. Compare and Contrast test system categories
   i. analyte specific reagent (ASR)
   ii. research use only (RUO)
   iii. in vitro diagnostics (IVD)
   iv. lab developed test (LDT)

f. Discuss regulations and standards (CLIA; CAP; CLSI)

6. **Impact of molecular testing on the following**
   a. Discuss the role of molecular testing in evidence based medicine
   b. List ethical issues associated with molecular testing
      i. Discrimination
      ii. Confidentiality
      iii. Informed consent
MLT Entry Level Curriculum
Phlebotomy

The Health Care System and Services

- List components of the health care delivery system and the services each provides- Level 1
  - Inpatient facilities:
    - Hospitals
    - Long term care facilities
    - Birthing Centers
  - Outpatient facilities:
    - Managed Care Systems including Health Maintenance Organizations (HMO)
    - Solo practices--Physicians' Offices
    - Prenatal care facilities
    - Respite care facilities
    - Hospice
    - Home health care
    - Chronic care facilities
    - Blood donor collection facilities

- Name and describe various departments and services within the health care setting in which interactions with patients, departments, and services occur because of duties related to phlebotomy- Level 1
  - Emergency facilities—emergency room (ER) or emergency department (ED) and trauma center
  - Cardiac care units
  - Electrocardiography
  - Encephalography
  - Geriatrics
  - Intensive care units
  - Nuclear medicine
  - Nursery
  - Occupational Therapy
  - Pediatrics
  - Pharmacy
  - Physical Therapy
  - Psychiatric units
  - Radiation Therapy
  - Radiology and diagnostic imaging services
  - Respiratory therapy
  - Surgical Units
  - Outpatient laboratory
  - General Medicine units

- List each laboratory specialty area, including the reference laboratory and list tests most frequently performed in each area- Level 1
  - Clinical Chemistry
• Name medical specialty areas within the health care delivery system such as obstetrics, gynecology, oncology, etc.- Level 1
• List and generalize the roles and qualifications of the health care professionals most often encountered in phlebotomy- Level 2
  o Medical laboratory scientists
  o Medical laboratory technicians
  o Cytotechnologists
  o Electrocardiogram (EKG) technicians
  o Histologists
  o Histotechnicians
  o Patient care technicians
  o Phlebotomists
  o Nurses
  o Nurse practitioners
  o Occupational therapists
  o Physical therapists
  o Pathologist
  o Physicians
  o Physicians assistants
  o Radiologists
  o Respiratory therapists
  o Others as applicable
• Demonstrate a knowledge and proficiency in the use of computers as related to job duties and responsibilities- Level 2
• Define and utilize medical terminology pertinent to phlebotomy, and laboratory testing, and patient care-Level 2

Patient and Laboratory Safety
• List and discuss precautions, practices and procedures to assure patient safety- Level 1
  o Correct identification of patients
  o Communication and its applications to patient safety
• Use of proper equipment and procedures for specimen/sample collection
• Identification and avoidance of safety risks including but not limited to nerve damage
• Preventing errors in specimen/sample collection
• Preventing errors in point-of-care testing
• Relevance of specimen/sample collection to preventing errors in testing procedures
• Identification of improper specimens/samples and the impact on testing, e.g., hemolysis, insufficient blood collected in tubes with anti-coagulant, improper draws, etc.

• Demonstrate an understanding of safety hazards and precautions and identify symbols- Level 2
  • Biological hazard
  • Electrical safety
  • Chemical safety
  • Radiation safety
  • Fire safety
  • Mechanical safety

• Discuss and apply OSHA standards and compliance within phlebotomy and clinical laboratory practice- Level 2

• Discuss institutional safety procedures and practices- Level 1
  • Handling biological specimens routinely
  • Biological and physical safety of oneself and others in the workplace
  • Proper labeling of biohazardous specimens/samples routinely
  • Handling biological substances in cases of bioterrorism and emergency response situations relevant to the scope of practice
  • Hazardous materials
  • Natural disasters including weather emergencies
  • Fire and electrical safety
  • Cleaning protocols including cleaning phlebotomy trays and equipment, cleaning up of specimen/sample spills, and other biohazard spills
  • Waste disposal

• Comply with federal and state mandates and regulations and organizational requirements regarding safety policies- Level 2

• Develop and evaluate safety protocols for phlebotomy- Level 3
• Select and evaluate safety equipment for use in phlebotomy- Level 3

Infection Prevention

• List the principles of infection prevention- Level 1
  • Source of infection
  • Modes of transmission
  • Hosts
  • Susceptibility to infection
- Healthcare-associated infections (HAI)

- List the elements of the chain of infection and mechanisms to break the chain- Level 1
- Discuss and demonstrate sterile technique related to the scope of practice- Level 2
- Discuss and apply the OSHA bloodborne pathogen standards and compliance with these standards- Level 2
- Discuss and apply standard precautions, workplace practices and engineering controls as related to phlebotomy and related services- Level 2
  - Use of solution procedures
  - Masking
  - Use of gloves
  - Gowning
  - Face shields
  - Hand washing and hand antisepsis
  - Sterile technique
  - Needle and other sharps disposal
  - Environmental controls- use of approved surface disinfectants
  - Other
- Discuss and apply the isolation procedures and personal protective equipment requirements in accordance the standard precautions and identify an example of when each would be used- Level 2
  - Airborne/droplet precautions
  - Contact precautions
  - Protective precautions
  - Body substance isolation
- Relate the types of isolation associated with specific inpatient or clinical treatment units- Level 2
  - Burn unit
  - Dialysis
  - Intensive care units
  - Nursery
- Discuss and evaluate protocols for exposure to blood and other body fluids, including accidental sticks with contaminated needles- Level 3
- Discuss and demonstrate proper handwashing procedure and hand asepsis- Level 2

**Human Anatomy and Physiology**

- Describe terminology related to direction, anatomic positions, body planes and body cavities- Level 1
- Describe body systems by discussing- Level 1
  - Major organs
  - Components and structures
  - Primary functions
  - Common disorders and clinical laboratory tests/results
• State specimen/sample requirements and laboratory tests commonly performed for evaluation of each body system- Level 1
• List components of and describe the circulatory system- Level 1
  o Characteristics of blood and its components
  o Blood vessels for arterial, capillary and venipuncture
• Discuss the proximity of nerves to arteries and veins and the impact on phlebotomy- Level 1
• Discuss the vascular system in the skin and how it applies to phlebotomy and phlebotomy practices- Level 1
  o Sites for skin puncture for capillary blood collection
  o Limitations and precautions related to capillary blood collection

Specimens/Samples

• Define specimen/sample- Level 1
• List types of specimens tested in the clinical laboratory- Level 1
• Discuss requirements for assuring integrity of each type of specimen- Level 1
• Discuss specimen/specimen collection including order of draw, preservation processing, and analysis integrity of each specimen/sample type- Level 1
• Name the components of blood- Level 1
• List and discuss factors that affect basal state of specimens/samples- Level 1
  o Age
  o Dehydration
  o IV therapy
  o Diet
  o Exercise
  o Stress
  o Posture
  o Diurnal variation
  o Tourniquet application
  o Altitude
  o Smoking
  o Lipidemia
  o Obesity
  o Use of improper collection devices
• Describe the procedures and discuss the rationale for handling urine specimens- Level 1
  o Collection
  o Preservation
  o Transporting
  o Handling
  o Processing
• State factors that compromise the integrity of specimens/samples as related to the accuracy of clinical laboratory testing- Level 1
- Timing of collection, transport and testing
- Order of draw during specimen/sample collection
- Light
- Temperature
- Medications/drugs
- Evaluate specimens/samples and determine the integrity and appropriateness for specific tests requested- Level 3
- Name the types of additives used for blood collection- Level 1
  - EDTA (citrate, potassium and disodium forms)
  - Heparin
  - Sodium fluoride
  - Oxalate
  - Antiglycolytic agents
  - Clot activators
  - Thixotropic gel, polymer gel
  - Preservatives
- Discuss the modes of action and appropriate use of each additive used for blood collection- Level 1
- Match the blood collection tube colors with the correct additive- Level 1
- Name, select, and evaluate appropriate equipment and supplies to be used for skin puncture and venipuncture for a variety of patient type- Level 3
- List specimens/samples used for commonly ordered clinical tests- Level 1
- Match the laboratory section in which commonly ordered tests are performed- Level 1

**Equipment and Supplies**

- Name, select and evaluate equipment and supplies used for phlebotomy and discuss proper use of each- Level 3
  - Evacuated tube system
  - Syringes
  - Winged and non-winged infusion sets
  - Micro collection containers
  - Skin puncture devices
  - Arterial blood collection equipment
  - Blood culture collection equipment
  - Micro pipette dilution systems
  - Tourniquets
  - Antiseptics
  - Disinfectants
  - Puncture resistant containers
  - Phlebotomy trays and carts
  - General supplies (gauze, bandages, etc)
  - Newborn screening testing kits
POCT test kits

- Name, select and evaluate appropriate protective wear to be used during blood collection, transport, and handling - Level 3
- Use equipment and supplies appropriately such that specimens/samples of quality and high integrity are obtained and efficient service of high quality are realized - Level 2
- Appropriate store equipment and supplies - Level 2
- Appropriately dispose of used or contaminated equipment and supplies - Level 2

Specimen/sample collection

- Instruct the patient on specimen/sample collection - Level 2
- Discuss patient readiness for quality specimen/sample collection including adherence to diet, medication, and determination of patient readiness through interviews/communication - Level 1
- Prepare and organize equipment and supplies prior to performing phlebotomy and related services - Level 3
- Name and select the appropriate collection site for arterial puncture, skin puncture, and venipuncture after considering factors that affect site selection - Level 2
  - Intravenous fluid lines
  - Transfusion
  - Presence of burns
  - Broken skin
  - Scars
  - Mastectomy
  - Other
- Collect blood via appropriate collection site and standard venipuncture techniques - Level 2
  - Syringe system
  - Winged and non-winged infusion set system
  - Evacuated tube system using correct order of draw
- Collect blood via appropriate collection site using standard skin puncture techniques on various patient types - Level 2
  - Adults
  - Infants
  - Children
- Evaluate specimen/sample integrity by proper patient preparation for tests ordered - Level 3
  - Accurate patient identification
  - Use of proper collection site and supplies, devices and procedures including order of draw
  - Accurate labeling, transport and handling of specimens/samples collected
- Discuss and appropriately use special precautions when collecting blood specimens/samples - Level 2
  - Decontaminating the skin for routine collection
  - Aseptic technique for blood cultures
- Warming devices
- Collecting appropriate Sample size
- Suitability of site for collection
- Implementing, monitoring, and evaluating quality assurance methods relevant to the scope of practice

- Discuss the purpose of performing arterial punctures - Level 1
- Discuss the modified Allen test - Level 1
- Discuss the factors in donor blood collection - Level 1
  - Donor screening
  - Procedures and precautions
  - Blood products

- Discuss technical complication associated with blood collection and methods of correction - Level 1
  - Needle insertion
  - Loss of vacuum

- Discuss patient factors or physiological conditions that affect phlebotomy specimen/sample collection - Level 1
  - Vein damage
  - Collapsed veins
  - Scar tissue
  - Infections
  - Difficult veins
  - Pain
  - Petechiae
  - Excessive bleeding
  - Syncope
  - Seizures
  - Nausea
  - Vomiting
  - Insulin shock
  - Tattoos

- Discuss methods to prevent or address technical and physiological complications in phlebotomy - Level 1
- Define and discuss the prevention of phlebotomy complications - Level 1
  - Hematoma
  - Hemoconcentration
  - Hemolysis

- Prepare peripheral blood smears that are appropriate for testing using standard procedure - Level 2
  - Technical error associated with peripheral blood preparation and precautions to alleviate complications

- Label specimens/sample with appropriate information - Level 2
- Name and label biohazard specimens/samples - Level 2
• Prepare specimens/samples for transport or mailing to reference laboratories or other off site laboratory using appropriate standard protocol (triple packing system)- Level 2
• Describe and demonstrate proper disposal of contaminated equipment, supplies and discard specimens/samples- Level 2

Point of Care Testing (POCT)

• List tests commonly performed at the patients’ bed side or chair side- Level 1
• Name practitioners who are qualified to perform point of care tests- Level 1
• Discuss qualifications of practitioners who may perform point of care tests- Level 1
• Name and select equipment and supplies used for point of care tests, and newborn screens such as phenylketonuria- Level 2
• Perform point of care procedures as established using standard protocol and predetermined criteria for testing and quality assurance- Level 2
• Demonstrate knowledge and proficiency in operating equipment and use of supplies in POC testing procedures performed- Level 2
• Demonstrate accurate measurement and proper use of measuring systems in calculating results- Level 2
• Discuss the purpose of each POCT test- Level 1
  o Sample/specimen requirements
  o Precautions
  o Limitations
  o Sources of error
  o Reference values
  o Quality assurance
• Record and report POCT tests appropriately and accurately- Level 2
• List critical values and follow established criteria for reporting such values- Level 2

Quality Assurance

• Define and distinguish among the terms quality control, quality assurance and quality improvement- Level 3
• Discuss quality assurance in phlebotomy and related services- Level 1
  o Requisitioning
  o Patient preparation
  o Phlebotomy procedures
  o Aspects of post phlebotomy care
  o Specimen labeling, transport, handling and procurement
  o Point of Care testing
• Discuss methods of improving phlebotomy services and related patient outcomes- Level 1
• Discuss and demonstrate proper documentation of procedure and quality assurance using established standards- Level 2
  o Specimen logs
  o Tracking specimens manually and with the computer system
• Evaluate specimens/samples for acceptability for tests requested- Level 3
  o Labeling discrepancies or absence of labels
  o Hemolysis
  o Specimen collection using the Wrong additive
  o Use of outdated supplies
  o Improper storage or transport

• Discuss the volume of blood that can be taken from a patient with regard to age and standard practice- Level 1

• Discuss standard practices related to the number of time a patient can be punctured by the same phlebotomist- Level 1

Human communication theory and application to practice

• Discuss effective human communication in phlebotomy and related services- Level 1
  o Definitions
  o Theories
  o Key components

• Discuss and demonstrate the application of communication theories in practice as a means of assuming the role of listener, speaker, and ultimately, effective communicator as a phlebotomist and patient care provider- Level 2

• Demonstrate effective communication in providing patients with instructions for preparing for phlebotomy procedures- Level 2
  o Fasting specimens/samples
  o Glucose tolerance tests
  o Urine collection
  o Occult blood test

• Demonstrate proper communication skills in interviewing a patient/client as related to phlebotomy and phlebotomy services- Level 2

• Demonstrate proper greeting of patients/clients, visitors, peers, and other health care professionals- Level 2

• Discuss and demonstrate effective communications with diverse clients encountered including pediatric and geriatric patients- Level 2

• Describe factors that influence effective communications between patient/client and phlebotomists, medical laboratory technician (MLT) or medical laboratory scientist (MLS), the health care professional and their colleagues/other health care professionals, the health care professional, and patients’ families and guests- Level 2
  o Cultural sensitivity
  o Language barriers
  o Technical jargon
  o Disabilities
  o Age
  o Stress
  o Medication
Professionalism, legal and ethical aspects

- Discuss professionalism and behaviors associated with professionals practicing phlebotomy- Level 1
- Demonstrate professional appearance by proper grooming and wearing professional attire- Level 2
- Discuss basic theories of ethics and application to persons practicing phlebotomy- Level 1
- Discuss the Patients’ Bill of Rights and its application to phlebotomy and related services- Level 1
- Discuss the importance of patient confidentiality and demonstrate maintenance of patient confidentiality and how it related to HIPPA- Level 1
- Discuss the legal and ethical implications associated with breach of patient confidentiality- Level 1
- Discuss and apply laws that impact upon phlebotomy and related services- Level 2
  - Clinical Laboratory Improvement Amendments of 1988
  - Occupational Safety and Health Administration regulations
  - Health Insurance Portability & Accountability Act (HIPPA)
  - Patient Self-Determination Act of 1990
  - Affordable Care Act (2010)
  - Other
- Discuss and apply the ethical and legal responsibilities of the Patient’s Bill of Rights especially as they relate to phlebotomy and phlebotomy service- Level 2
  - HIPPA
  - The Patient Self-Determination Act of 1990
  - Confidentiality
  - Right to refuse treatment
  - Informed consent
  - Privacy
  - Other
- Discuss the United States legal system as it relates to Phlebotomists, MLTs, MLSs participating in duties related to phlebotomy- Level 1
- Discuss the importance of standard of care and legal implications associated with standards of care- Level 1
- Discuss the importance of labeling specimens/samples and the legal ramifications associated with improper specimen labeling- Level 1
- Discuss the legal ramifications of testing specimens/samples that lack integrity- Level 1
- Discuss the interrelationship of ethics, morals, professional and personal values, and legal aspects of care in performing phlebotomy- Level 1
- Discuss stress and the effects of stress on professionals performing phlebotomy and related services- Level 1
- State methods of handling stress or eliminating stress in the work place- Level 1
- Discuss measures that can be taken to avoid or reduce risks and liability in performing phlebotomy and related duties- Level 1
Phlebotomy MLT ELC Deletions

The Health Care System and Services

Deleted outdated names

Samples/Specimens

Bleeding time

Specimen/Sample Collection

Modified Allen test: demonstrate was taken out discuss was left in
Donor Blood: expiration and storage (Blood bank specific)

Human communication theory and application to practice

Bleeding time

Removed categories stress and legal combined with professionalism

Phlebotomy MLT ELC Additions

The Health Care System and Services

various inpatient and outpatient facilities
various departments in the hospital setting
various laboratory professionals and other healthcare professionals
computer use

Infection Control changed to infection prevention

Human Anatomy and Physiology

Vascular system and capillary draws

Samples/Specimens

Identify, select, and evaluate appropriate equipment and supplies to be used for skin puncture and venipuncture for a variety of patient type

Equipment and supplies

Updated test supplies and equipment
Equipment use for quality specimen
Storage and disposal
Specimen/Sample Collection

- Various sites
- Quality assurance
- Biohazard

Point of Care Testing

- Equipment for newborn screening

Quality Assurance

- Improvements in phlebotomy

Human communication theory and application to practice

- Cultural sensitivity

Professionalism

- Standard of care
- Labeling
- Specimens lacking integrity
- Interrelationship of ethics, morals, professional and personal values, and legal aspects of care
- HIPPA
- Patient Self-Determination Act of 1990
- Affordable Care Act (2010)
Renal Anatomy and the Urinary System

Describe the anatomy of the kidney  Level 1
  Shape
  Size
  Placement in the abdominal cavity

Describe the main role of each structure  Level 1
  Cortex
  Medulla
    Pyramids
    Papilla
    Calyces
    Pelvis

Diagram each portion of the nephron  Level 1
  Bowman's capsule
  Proximal convoluted tubule
  Ascending and descending limbs of Loop of Henle
  Distal convoluted tubule (macula densa)
  Collecting duct

Describe the function of each portion of the nephron  Level 1

State the function of each component of the glomerulus  Level 1
  Capillary endothelium
  Basement membrane
  Podocytes (epithelium)

Describe the renal blood circulation  Level 1
  Afferent and efferent arterioles
  Glomerulus
Peritubular capillaries
Vasa recta

Describe renal system structure anatomy and function Level 1
Ureters
Bladder
Urethra

Renal Physiology
Describe the process of glomerular filtration Level 1
Define hydrostatic and oncotic forces
Define glomerular filtration barrier (GFB)
Define glomerular filtration rate
Describe the process of urine formation Level 1

Tubular reabsorption and secretion
Define active and passive transport
List the solutes that are actively reabsorbed by the nephron Level 1
List the solutes that are passively reabsorbed by the nephron Level 1
List the solutes that are secreted by the nephron Level 1
State the nephron location of secretion for each solute Level 1
Explain changes in solute composition as ultrafiltrate passes through the nephron Level 1
Define tubular transport capacity in relation to renal threshold level Level 1
Summarize secretory mechanisms that regulate acid-base balance Level 1
   Hydrogen ion secretion to recover bicarbonate
   Hydrogen ion secretion to form acids
   Hydrogen ion secretion to form ammonium ions
Discuss mechanisms that maintain osmotic gradient of renal medulla Level 1
   Countercurrent exchange mechanism
   Role in urine formation and concentration
Discuss changes in urine volume and solute composition Level 1
Volume and composition of normal urine
Role of ADH/vasopressin in water reabsorption

Define the renin-angiotensin-aldosterone system Level 1
Define urine volume terminology Level 1

Anuria
Oliguria
Polyuria

Renal Disease

Describe Glomerular disease Level 1

Clinical features
Nephrotic syndrome

Correlate typical urinalysis findings in glomerular diseases Level 2
Acute glomerulonephritis
Chronic glomerulonephritis
Nephrotic syndrome

List tubular dysfunction diseases and discuss typical urinalysis findings Level 1
Acute tubular necrosis (ATN)
Cystinosis and cystinuria
Renal glycosuria
Renal tubular acidosis (RTA)
Fanconi Syndrome Level 1

Correlate clinical features and typical urinalysis findings in tubulointerstitial disease and urinary tract infections Level 2
Acute pyelonephritis
Acute interstitial nephritis (AIN)
Lower urinary tract infections (e.g. cystitis)

Explain the presence of non-bacterial organisms found in urine Level 1
Describe the etiology of renal vascular disease Level 1
Discuss effect of renal vascular disease on renal function Level 1
Describe formation of renal calculi  
List factors that influence calculi formation  

Extrarenal Diseases
List amino acid disorders and describe typical urinalysis findings  
   Cystinuria and cystinosis  
   Alkaptonuria  
   Maple Syrup Urine Disease  
   Phenylketonuria  
   Tyrosinuria and melanuria  

List carbohydrate disorders and describe typical urinalysis findings  
   Glycosuria  
   Diabetes Mellitus  
   Galactosuria  

List metabolic disorders and describe typical urinalysis findings  
   Diabetes Insipidus  
   Porphyrin disorders  

Urinalysis
Instruct others in proper collection of urine specimens  
Describe urine specimen collection techniques/procedures  
   Random void  
   Midstream clean void  
   Catheterization  
   Suprapubic aspiration  
   Pediatric collection bags  
   Timed collection  
Describe characteristics of urine specimen types  
   Random void  
   First morning void  
   Timed
Evaluate acceptability of urine specimens Level 3

Labeling and patient information

Sufficient volume

Time elapsed since specimen collection

Timed test intervals

Storage (light, temperature, preservatives)

Visual evidence of contamination

Collection technique and specimen container is appropriate

Storage parameters for testing

  Temperature

  Light protection

  Preservative requirements

Communicate to health care provider’s criteria for specimen rejection Level 2

Document unacceptable specimens and action taken Level 2

Determine and record temperatures in work area Level 2

  Room

  Refrigerator

  Freezer

Examine reagents for correct storage conditions Level 2

  Tightly sealed in properly labeled container

  Temperature

  Protected from light if necessary

  Expiration date not exceeded

Prepare calibration and quality control materials Level 2

  Reagent strip controls

  Refractometer calibrators and controls (if applicable)

  Microscopic controls

  Other chemical test controls
Perform and record calibration checks, quality control checks and equipment maintenance
Level 2
  Refractometer (if applicable)
  Centrifuge
  Microscope
  Osmometer
  Automated instrument
Recognize and follow established protocol when calibration or quality control check fails or
equipment malfunctions Level 2
Evaluate quality control values to determine analytical errors and implement corrective action
Level 3
Perform and record basic troubleshooting on equipment Level 2
Prepare specimens for analysis Level 2
  Mix specimen
  Aliquot for macroscopic and microscopic
  Prepare dilutions as necessary
  Centrifuge and remove supernatant
  Re-suspend sediment and stain if necessary
  Transfer sediment to standardized commercial slide
Ensure appropriate conditions for macroscopic evaluation Level 2
  Adequate room illumination
  Homogenous specimen
  Temperature
Interpret and record specimen color using established terminology Level 2
  Correlate color with specimen concentration Level 2
  Correlate color with patient medication Level 2
Correlate color and substances that produce them with clinical significance level 2
Interpret and record specimen clarity using established terminology Level 2
  Correlate clarity with microscopic examination Level 2
State substances that affect urine clarity and their clinical significance Level 1
Perform specific gravity measurements Level 2
   Refractometer (if applicable)
   Reagent strip
   Automated technology (if available)

Perform osmolality measurements Level 2

Identify principles employed in each method of concentration measurement Level 1
   Osmolality
   Refractometry
   Reagent strip specific gravity

Correlate urine concentration with clinical significance Level 2

Correlate abnormal urine odor and clinical significance Level 2

Perform (manually or using instrument) and record reagent strip chemical tests Level 2
   Dip and remove strips in urine appropriately and correctly, time and read, and interpret reactions Level 2

State limitations of various chemical techniques Level 1

Apply criteria for results that require confirmatory testing, alternate chemical testing, and/or dilutions Level 2

Describe principles and limitations of various chemical tests on urine Level 1
   pH
   Blood and myoglobin
   Leukocyte esterase
   Nitrite
   Protein
   Carbohydrates
   Ketones
   Bilirubin
   Urobilinogen
   Ascorbic acid by reagent strip
   Albuminuria (Microalbumin) by reagent strip
Creatinine by reagent strip

Use established terminology to report chemical examination results  Level 2

Correlate chemical examination results for acceptability and clinical significance  Level 2

Detect errors, discrepant and/or contradictory results and action to be taken before reporting results  Level 2

Preanalytical errors
  improper timing
  improper preservative
  exposure to light
  mislabeled specimens

Analytical errors
  interfering substances present in urine
  deteriorating reagents
  instrument malfunction

Postanalytical errors

Correlate results of macroscopic examination with microscopic examination  Level 2

Apply protocol for initiation of microscopic examination based on macroscopic examination  Level 2

Prepare microscope for optimal viewing (See microscope section in MLT General)  Level 2

Clean ocular and objective lenses

Adjust light source for proper illumination

Place filters in light path

Protect microscope from dust

Select type of microscopy and adjust for optimum viewing  Level 2

Optimize condenser position

Adjust field iris and condenser aperture diaphragms

Describe and utilize various microscopic techniques  Level 2

Brightfield
Phase contrast

Polarizing (if available)

Check and perform phase ring alignment for phase microscopy Level 2
Place polarizing filters in light path for polarizing microscopy Level 2

Place, focus and scan mounted specimen on microscope

Secure microscope slide on mechanical stage
Check and perform interpupillary and diopter adjustments
Use course and fine adjustments
Use mechanical stage adjustments to scan specimen

Distinguish and quantitate cellular elements Level 2

Red blood cells (typical, ghost and crenated forms) using high power magnification (400x)

White blood cells using high power magnification (400x)

Typical white blood cells
Atypical white blood cells (degenerative forms)

Oval Fat Bodies
Epithelial cells (squamous @100x, transitional, renal tubular @400x)

Abnormal and/or atypical cells

Distinguish, quantitate, and determine the type of casts, using 100x to locate and 400x to identify Level 2

Hyaline
Waxy

Cellular inclusions (RBC, WBC, renal epithelial, mixed)
Inclusions (finely and coarsely granular, fatty, crystals, hemosiderin)
Pigmented (hemoglobin, bilirubin)

Distinguish acidic, neutral, and alkaline crystals Level 2

Associate with pathology
Derived iatrogenically

Distinguish miscellaneous formed elements Level 2
Bacteria
Fat globules
Hemosiderin
Mucus
Parasites
Spermatozoa
Yeast
Contaminants (starch, fibers, fecal material, clue cells, etc)

Record microscopic examination results using established protocol and terminology
Level 2

Correlate microscopic with macroscopic and chemical examination Level 2

Correlate microscopic results with clinical significance Level 2

Use protocol to identify specimens that require confirmatory testing before reporting results
Level 2

Check for preanalytical and post analytical errors

Perform additional testing to resolve conflicting results

Interpret and report results Level 2

Evaluate quality control data and take necessary corrective action

Evaluate patient results for completeness

Intercept questionable and/or contradictory results and verify appropriate action is taken and documented

Utilize reference intervals to determine clinical significance Level 2

Correlate results with clinical significance Level 2

Correlate results with other tests results on same patient Level 2

Compare current results with previous results on same patient Level 2

Utilize protocol for identifying and reporting "critical values" Level 2

Utilize protocol to communicate results via computer, verbal or written Level 2

Respond to inquiries from health care personnel concerning test results, reference intervals, specimens Level 2
Renal Function Tests

Describe renal function tests  Level 1

Creatinine Clearance

Estimated Glomerular Filtration

Cystatin C

Beta₂-Microglobulin

Differentiate the advantage and disadvantages of substances for determination of renal clearance  Level 2

Creatinine

Inulin

Cystatin

List factors that can influence creatinine clearance results (timing, complete collection, body size)  Level 1

Use protocol for performing creatinine clearance tests  Level 2

Calculate creatinine clearance results using body surface area normalization  Level 2

Differentiate eGFR and GFR  Level 2

Identify factors that can influence eGFR results (age, muscle mass, pregnancy, ethnicity, race)  Level 2

Interpret and report results  Level 2

Evaluate quality control data and take necessary corrective action

Evaluate patient results for completeness

Intercept questionable and/or contradictory results and verify appropriate action is taken and documented

Ensure results are recorded in established format and terminology  Level 2

Utilize reference intervals to determine clinical significance  Level 2

Correlate results with clinical significance  Level 2

Correlate results with other tests results on same patient  Level 2

Compare current results with previous results on same patient  Level 2

Utilize protocol to communicate results via computer, verbal or written  Level 2
Renal Calculi
List factors that can influence calculi formation (increase in chemical salts, change in pH, urinary stasis, foreign body seed) Level 1

Describe the chemical composition of most renal calculi Level 1

Body Fluids
Explain basic concepts relating to the clinical significance of body fluids Level 1
Describe types of body fluids (production, source, function) used in analysis Level 1

- Cerebral spinal fluid (CSF)
- Pleural
- Peritoneal
- Pericardial
- Synovial
- Amniotic
- Seminal
- Sweat

Define body fluid analysis associated terminology Level 1
- Paracentesis
- Thoracentesis
- Arthrocentesis
- Ascites
- Effusion (transudate/exudate)
- Xanthochromia
- Chylous
- Pseudochylous
- Traumatic tap

Perform processing of specimens according to established laboratory protocol Level 2
- Storage conditions
- Specimen transport

Perform body fluid analysis according to laboratory protocol for CSF, Serous, Synovial Level 2

- Physical exam
- Chemical exam (glucose, total protein, other)
- Hematologic exam (cell count/differential)
- Microbiologic exam (gram stain, other)
- Crystal analysis (synovial)

Perform body fluid analysis according to laboratory protocol for seminal fluid Level 2
- Post-vasectomy

Perform fecal analysis Level 2

Evaluate acceptability of results Level 3
Report results according to laboratory protocol Level 2
Perform, document, and evaluate quality control Level 2
Correlate patient results with disease state or disorder Level 2
MLT- Urinalysis and Body Fluids

**Deleted Items**

Diagram glomerulus

Diagram renal blood circulation

Role of renal blood circulation related to renal function

Define capillary endothelium, basement membrane, podocyte filtration diaphragms

Explain the changes in osmolality as the ultrafiltrate passes through the nephron

Countercurrent multiplier mechanism

Urea cycle

Physiologic factors involved in determining the volume of urine excreted

Pathogenesis of glomerular damage

Compare and contrast acute and chronic renal failure

Verify acceptability of work area, equipment and supplies

Assemble worksheets and other documenting materials

Evaluate and select methodology

Dispense standardized volume of sediment to glass microscope slide and apply appropriate coverslip

Sulfosalicylic acid for protein

Watson-Schwartz for urobilinogen/porphobilinogen

Qualitative metabolic screening tests & substances detected to correlate with metabolic disease

Explain purpose of macroscopic tests to health care personnel

Interference contrast microscopy

Advantages/Disadvantages of microscopy types

Special stains (eosinophils, lymphocytes, etc.)

Record maintenance for accreditation

Continuing education participation

Renal calculi chemical composition testing

Quality Management in the Urinalysis Laboratory

**Body Fluids:**

Amniotic Fluid
Seminal Fluid (EXCEPT post-vasectomy)

**Additions**

Specimen Collection technique - Timed collection

Specimen preparation - mix specimen

Reagent Strip Chemical Testing - Dip and remove strips in urine appropriately and correctly, time and read, and interpret reactions

Ascorbic acid by reagent strip

Microalbumin by reagent strip

Creatinine by reagent strip

Renal Function Tests - Creatinine Clearance, Estimated Glomerular Filtration, Cystatin C, Beta₂Microglobulin

Differentiate eGFR and GFR

Describe the chemical composition of most renal calculi

**Body Fluids:**
Sweat
Traumatic Tap
Post-Vasectomy semen analysis
Fecal Analysis
AMERICAN SOCIETY FOR CLINICAL LABORATORY SCIENCE

To: ASCLS Board of Directors
From: New Idea Factory Task Force
RE: Report to Annual Meeting BOD
BY: Alice Hawley, Chair
Date: June 26, 2016

Charge:
The New Idea Factory Task Force was given the following charge by President Snyderman as a follow-up from the Diversity Taskforce:

- Appoint a “New Idea Factory” task force from the Forum and ASCLS members at large to engage in diverse thinking and explore how it could contribute to diversity of thoughts and ideas and a culture of diversity and inclusiveness within ASCLS.

Actions:
- The Task Force has met by conference call every month beginning November 2015.
- Initial homework was to answer/respond to the following statement - When you think of diversity within ASCLS, what are our wins and what are our “losses” or areas of improvement...
- From there we were tasked with having discussions with our peers, others in health care, etc and to take that info to determine what would have the greatest “impact” and “relevance” to allow other laboratorians to feel that their “voices” are being “heard” and “valued”
- The following ideas were then brought to the table -
  - ASCLS Webpage – is the image portrayed one of diversity and inclusivity – is there a need to update with portrayals of a wider cultural diversity
    - The #IamASCLS photo contest was hopefully an avenue that we could use to obtain pictures of our current diverse membership which would allow for a possible scrolling picture opportunity on the ASCLS webpage. Said contest was not as productive as hoped as there were other ASCLS options also being offered at the same time. We still feel this is a viable way to obtain a “picture” of ASCLS' diversity but it needs to be held at a different time then during the month of April as that is a busy time for all laborators with Lab Week activities.
  - CE/Educational Opportunity – as we try to reach out to under-reached populations, might it be advisable to have hand-out info/instructions in other languages - the reader’s native language, eg: Spanish, Somali, French, Vietnamese, etc
    - This was tabled because when reaching out to said members from these nationalities, it was determined that since education and certification take place in English, that the need was minimal
• We do feel that there still may be a need to develop literature about the profession in various languages that could be used as an educational resource for high schools but unsure of who within ASCLS would be tasked with this

◦ Increase Diversity Representation on Committees – is the general membership really aware of what committees there are, what each committee's purpose is, what being on a committee entails, etc? Do we need to pursue educational materials to assist in that understanding

▪ In conversations with peers in regards to inclusiveness, the lack of diversity within the higher levels of ASCLS leadership was discussed. We felt that the lack of diversity in leadership was possibly a direct indication that members did not fully know how to get involved in ASCLS beyond becoming a member

• A taskforce member was designated to pursue developing an educational brochure that would discuss ASCLS and its committees, their purpose, their mission and whom to contact to get more info and possibly start a discussion. I am sad to say that we might have uncovered a great lack within ASCLS and that is the lack of communication and the lack of response to requests for information, which in turn led to much frustration and a question as to whether oversight of committee leadership is being properly maintained. We still feel that this project has merit but we would need to have better support from the constituent committees within ASCLS. Also by gleaning this info, we could present a better webpage area with all said information

◦ Social Activities – is there a way to allow it to be non-threatening to have some type of social/fun activity that would encourage all meeting attendees to step outside their sphere and interact with someone new

▪ Many ASCLS members mentioned that even though our focus needs to be education and advocacy that we do not present our membership with enough fun. It was mentioned that there are also a lot of “cliques” within ASCLS and might there be a way to dissolve some of those barriers

• Our goal for the next National meeting was to develop some opportunities for our membership to interact beyond the meeting itself, which led to

○ a Pub Crawl to get members out and about and hopefully to meet other members

○ the opportunity to donate to a Diversity scholarship and self-identify how each of us is unique/diverse

○ a “get-to-know-you” bingo game at the President’s Social to again help engage our members with others whom they might not know
Social Media – what can we continue to pursue on social media to entice a younger generation to see the impact that belonging to a professional organization can have on their lives

- This is an area in which we had our best success in that we were able to post many things on the ASCLS Facebook page and blog and begin to present other diverse sides to our members
  - Monday Moment with a Member
    - we are currently hoping to continue with this project of putting up a face of a diverse ASCLS member, a little about them and how ASCLS has impacted them on the ASCLS Facebook page. We have reached out to each state ASCLS President for assistance. It will also be discussed during the State President meeting this year at the National meeting with info being sent out again to those who were unable to attend the National meeting
  - #PHUNinPhilly
    - again to encourage the “fun” that laboratorians can have through ASCLS we generated ~30 #PHUNinPhilly posts to allow members to see the diversity of our host city and the opportunities to explore and hopefully again to meet other members. Millennials do not want to sit in meetings all day long so we need to address this upcoming generation of laboratorians to encourage them to see ASCLS as a professional group that will continue to strive to meet their needs in all areas of interest

- We are also currently on our second go-round of reaching out to others to further determine diversity/inclusivity opportunities and ideas as we proceed. Some opportunities are as follows:
  - Young Professional Membership - with the Educational Membership opportunity might the next step be the formation of ASCLS chapters on college campuses? We would be able to help these young professionals to see the advantages of a professional membership and possibly start them on a journey of life-long membership
  - Reaching Non-members – what can we do to go outside our own ASCLS ranks to allow non-ASCLS professionals to see what we do and who we are
    - by increasing our social media presence we have the opportunity to impact non-members through the use of our members sharing ASCLS posts with their circle of acquaintances
    - we need to get more of our membership to “like” our Facebook page and thus, the need for a social media “group” that would ensure that we are posting frequently and being relevant
  - Continued forays into other social media opportunities - might this be a time to actually form a Social Media Committee to oversee and continue to develop social media opportunities as they become available – Pod casts, increased blog activities, Instagram
pictures – even to the possibility of having an ASCLS sponsored job link in our world of short staffing everywhere

Work still on our “to-do” list:
1. continue to pursue the development of an ASCLS Committee overview brochure that could be used for new members, state meetings, etc – would allow all members to see where they could plug into ASCLS and thus allow them to eventually pursue leadership roles if desired
2. continue discussion about college chapters of ASCLS – a discussion that needs to happen at the National level and possibly put out as a discussion agenda item for the next CLEC Meeting
3. continuation of the #IamASCLS photo opportunity to develop a pictoral representation of the diversity and inclusiveness of ASCLS to be used in media opprotunities/brochures, etc
4. development of a #Lab4Life education brochure for distribution at the high school level. Could be made available by counselors, used in career fairs, etc to inform and encourage this profession as a profession to be considered by all who are science orientated. This could also play out in some type of social media presence??
5. a continuation of the “Monday Moment with a Member” which would be gladly undertaken by members of this year’s taskforce with involvement from the individual states or Region Directors to assist with the locating and communication with said “unique” members

Recommendations going forward:
1. the continual evolution of thought and ideas needs to continue in some format to keep ASCLS alive and relevant – whether that be a committee or a sub-committee - with said group spanning membership that respresents the wide group of ASCLS' present diversity (This group will be referred to as “committee” as this document continues). It would also make sense to make this into a possibly appointed 2 year term with half the group going off and half coming on to be able to continue with projects that are in the works and orientate people into a working “committee”.
2. there would need to be a more defined charge for the “committee” from ASCLS Leadership to better understand the outcomes that are expected - or allow said “committee” to develop some options to present to the BOD to allow for definition of duties for each year. Because, as new members are chosen each year, the “committee” make-up would change and thus, it would reflect people with new ideas and/or opportunities
3. the evolution of inclusivity ideas span almost every area of ASCLS - membership, leadership, PPC, etc - so the involvement of and with other committees may be needed and could be tied together as an overall goal of ASCLS for said year
4. there still needs to be some better definition of the roles and responsibilities of the DAC as that would seem to be the natural “home” of this “committee” but the “committee” would only be as effective as the parent, so defined expectations would have to be set forth for both
5. there needs to be an expansion of ASCLS' social media impact so the development of some type of group/standing taskforce that would be willing to undertake that opportunity and be the liaison to the other ASCLS committees would be advisable
6. there are still times that it appears that states really do self-govern, which is good, but do not see themselves as part of the whole, so their responses to communication are lacking. Might we have a more defined method of contacting each state and/or could there be a better definition of utilization of Region Directors as a source of communication
7. there needs to be a better defined and clear expectation of communication and action within ASCLS and all its committees - with all leadership being held accountable for their actions and more importantly, their inaction. We cannot afford to drift!
We look forward to the direction that new leadership will want to take and thus, the above will depend on that direction and the future charges of our leadership.

We appreciate the opportunity ASCLS afforded all of us to not only be a part of this taskforce but also the opportunity to interact with members outside our own spheres. It was an experience that we would wish for the entire membership – the opportunity to expand our horizons, thoughts, ideas, perspectives, friends and realize again that we share a common cause – the recognition of our profession, its members' diversity and its impact on healthcare!!

**Request for Action:** I move that the board approve reappointment of the New Ideas Task Force for the 2016-2017 association year to explore the recommendations in this report and return to the Board of Directors, if appropriate, with specific requests for action.

**Task Force Members:**
Alice Hawley, Chair
Cheryl Caskey
Vathani Logendran
Jimi March Mistler
Kemorine Roberts
Janelle Chiasera, BOD Liaison
Andrea Hickey, Staff Liaison
Report to: ASCLS Board of Directors
Report of: Mentorship Program
Submitted for: Annual Board Meeting
Prepared by: Stephanie Noblit
Date: 7/11/16

Goal: The goal of the mentor program is to create a supportive environment that fosters a feeling of belonging and value as a member of the ASCLS community. Students, new professionals, and new members will develop meaningful relationships with mentors to promote personal and professional growth within ASCLS and beyond.

Activities:

During the 2015-2016 pilot year of the ASCLS mentorship program, ten one-on-one pairs participated in the program. The mentors that were chosen to participate in the program this year were handpicked and asked by the committee to participate. Mentees came from a pool of students and new professionals that were newly appointed to ASCLS committees. In the future, the program will be open up to more people and follow a set criterion of who can be a mentor or mentee.

Mentors should be active ASCLS members with a professional I or II membership and have at least five years of membership within the organization. To qualify as a mentee, applicants should be ASCLS members in the Student or First Year Professional category or a new member/new professional that has been in the organization for less than five years. This year the program started in September and will end after the national meeting.

Each mentor/mentee pair needed to establish a positive, professional relationship with one another by establishing mutual trust and respect and maintaining regular interaction and consistent support. Pairs were required to have contact with each other at least once a month using some form of communication medium that was determined by the mentor/mentee pair. The most common types of communication used were email and phone calls. During the year, pairs were free to discuss any goals or challenges the mentee wished to work towards. Some of the topics that pairs discussed were applying for graduate school and the leadership academy, benefits and opportunities in ASCLS, and issues in the workplace, among other topics.

In addition to the one-on-one interaction between the pairs, the mentorship committee also provided PowerPoints on a variety of topics to help encourage and enhance discussion. The PowerPoint topics ranged from the history of ASCLS to how to
plan a state meeting. The supplemental information was provided to the mentors to share with their mentees, but they were not required. Therefore if a certain topic did not pertain to a particular mentee for whatever reason, the pair could choose to skip that PowerPoint. With each PowerPoint we also posted one or two discussion questions on the ASCLS mentorship community page. This allowed pairs to interact with other mentee/mentor pairs.

After the end of the formal mentorship year, pairs will be encouraged to stay in contact, but will not be required to do so. Mentors will be able to sign up to be a mentor again with another mentee and mentees will be able to reapply as mentors once they meet the requirements.

A survey conducted toward the end of the mentorship program year showed the majority of the participates were very satisfied with the program and that it was better than they expected it to be. Everyone surveyed stated they were very likely to recommend the program to others and would like to participate in the program again if they had the chance. When asked an open ended question if it was necessary for ASCLS to have a mentorship program, everyone gave answers explaining that it is necessary; citing that the program helped to build relationship, strengthen leadership skills, educate and inform others about the benefits and value of ASCLS, and develop confidence within personal and professional life.

Concerns: None

Request for Action: I move that the ASCLS Board of Directors continue support for the ASCLS Mentorship Program by converting this ad hoc committee to a permanent standing committee.

Mentorship Program Members:
For 2015-2016 Committee Chair-Stephanie Noblit; Members- Tim Randolph, Stacey Robinson, Lacey Campbell, Karen Larson; Board Liaison- Susie Zanto; Staff Liaison- Elissa Passiment

2015-2016 Mentors- Kathy Doig, Rick Panning, Mary Ann McLane, Mallory Janquart, Tim Randolph, Stacey Robinson, Rodney Rohde, Barbara Brown, Gilma Roncancio-Weemer, Deb Rodahl

2015-2016 Mentees- Kelsey Lowe, James Gardner, Samantha Treutel, Alexandra Nussbaum, Jason Frazier, Michelle Renee Campbell, Brunesha Johnson, Amanda Horn, Gretchen Brocksmith, Hillary 'Ally' Thompson