SF CLS Program Perry Center for Emerging Technologies 14180 NW 119th Terrace Alachua, FL 32615

Academic Director; Eileen Monck, M.S.
Clinical Director; Myra Urso, MS-Ed, MT (ASCP)
Clinical Laboratory Sciences Program

**Acknowledgement of Essential Functions and Expectations**

**Essential Functions**

- Ability to use oral and written communication effectively in the English language and to read, understand and follow directions both written and oral.

- Display manual dexterity required to perform laboratory tasks, e.g. operation of various instruments, performance of phlebotomy and pipetting procedures, and manual entry of data into computers.

- Demonstrate microscopic and macroscopic visual acuity required to perform all technical activities requiring visual skills.

I acknowledge that I have received the SF College CLS Internship manual and have read the Expectations and Essential Requirements for the program. To the best of my knowledge, I will be able to perform these requirements upon completion of the program.

To enable me to meet these Essential Requirements, I request the following accommodations:

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Name (print): _________________________________________
Signature: ____________________________________________
Date: ________________________________________________

Witness: __________________________________  ______ ______________________________
Name (print)      Signature
# Pre-internship Checklist

## Student INFORMATION

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student name / ID:</td>
<td></td>
</tr>
<tr>
<td>Telephone number:</td>
<td></td>
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<tr>
<td>Email address:</td>
<td></td>
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<tr>
<td>Projected start/end date:</td>
<td></td>
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<tr>
<td>Preferred internship site(s):</td>
<td></td>
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*The student’s preference will be taken into account but is not guaranteed. Some examples of extenuating circumstances which could influence the placement are; when excessive travel would be involved or student is already an employee of one of the affiliates.*

## Requirement

- Physical & Immunization record
- Drug Screen
- Background Check: Click here to enter name of agency.
- Fingerprinting: Click here to enter name of agency.
- Training license application sent out.
- Training license received. Attach Copy to Back of this Page
- Internship site specific training completed.
- Internship site specific paperwork completed.
- Pre-internship skill set forms verified by instructors.
  - Hematology
  - Clinical Chemistry
  - Immunohematology
  - Microbiology

## REQUIRED SIGNATURES

I understand that by signing this form, I am acknowledging that all documents I have submitted are genuine and have not been modified from their original format. I also acknowledge that any falsification or misrepresentation on my part to the granting agency or persons providing service will result in me being dismissed from the internship program.

I certify that I have reviewed the documentation submitted by the student and that they appear to be genuine and to relate to him/her.
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Roles and Expectations

**Academic Director, SF College Perry Center for Emerging Technologies:**
- Provide academic leadership of the CLS, IB, Biotechnology, and Biomedical Engineering programs. Director will have overall authority and responsibility for class scheduling, loading, advising, resolving student complaints, partnering with other departments to assess student needs and create appropriate course offerings.

**Clinical Director, SF College CLS Program:**
- Provide leadership and guidance for the CLS program curriculum, especially in matters related to clinical practice.
- Provide supervision for students involved with clinical practice.
- Collaborate with the academic director to establish and nurture strong industry advisory group of external stakeholders in the CLS program.
- Maintain standards for NAACLS program accreditation.

**Academic Program Advisor, SF College Perry Center for Emerging Technologies:**
- Ensure that prerequisites are satisfied by the student prior to scheduling the internship course.
- Continue to maintain contact with student.
- Maintain student contact information for tracking and reporting purposes.

**Internship Faculty/Coordinator, SF College CLS Program:**
- Track student progress throughout the semester.
- Schedule a personal or electronic contact with work-site supervisor to establish a working relationship that will benefit the student.
- Coordinate necessary paperwork throughout the internship period including preparation of learning agreements and completion of preliminary, mid-semester and final evaluations.
- After consultation with work-site supervisor, evaluate student performance, assign grade, and post it.

**Clinical Affiliate Supervisor:**
- Provide a professional environment conducive to student learning.
- Set goals for internship experience. Collaborate with faculty internship instructor to establish specific learning objectives; identify outcomes or expected products.
- Help student build professional work-site relationships.
- Supervise the student throughout the internship experience at the work-site. Offer an orientation program and supply necessary resources to support student success.
- Provide supervision, guidance, and feedback.
- Report immediately to the faculty internship instructor any student problem that develops.
- Work directly with the faculty internship instructor to evaluate the student performance, possibly three times: preliminarily during the first few weeks, at a mid-point in the internship experience, and at the end of the experience.
Clinical Laboratory Sciences Program

SF Policies

Student Rights & Responsibilities

The purpose of this document is to provide students with a general overview of both their rights and responsibilities as members of the Santa Fe College community. For a complete list of students’ rights and responsibilities go to http://www.sfcollege.edu/studentaffairs/index.php?section=policies/student_rights

College Academic Integrity Statement

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.

Americans with Disabilities Act (ADA) Student Rights

If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations. For more information, see http://www.sfcollege.edu/student/drc/index.php?section=faculty_resources/rights_responsibilities

Discrimination/Harassment Policy

SF prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to College Rule 2.8 at http://dept.sfcollege.edu/rules/content/media/PDF/Rule_2/2_8.pdf

EA/EO Notice

Santa Fe College is committed to an environment that embraces diversity, respects the rights of all individuals, is open and accessible, and is free of harassment and discrimination based on, but not limited to, ethnicity, race, creed, color, religion, age, disability, sex, marital status, national origin, genetic information, political opinions or affiliations, and veteran status in all its programs, activities and employment.

Inquiries regarding non-discrimination polices should be directed to:

Lela Frye, Equal Access/Equal Opportunity Coordinator
3000 NW 83rd Street, R-Annex, Room 105, Gainesville, Florida 32606 (352) 395-5420
lela.frye@sfcollege.edu

Accreditation Information:

In addition to being accredited by SACS-COC, this program is actively seeking accreditation by NAACLS and has recently been awarded serious applicant status. For more information, please contact:

National Accrediting Agency for Clinical Laboratory Sciences (NAACLS)
5600 N River Rd, Suite 720
Rosemont, IL 60018
773.714.8880 (tel), 773.714.8886 (FAX)
info@naacls.org http://www.naacls.org

Southern Association of Colleges and Schools Commission on Colleges (SACS-COC)
1866 Southern Lane, Decatur, GA 30033
(404)679-4500 • Fax: (404)679-4558
http://www.sacscoc.org
Instructions for Students

Prior to first rotation: Students are responsible for meeting with the CLS program coordinator in their last semester of coursework. They should request the pre-internship packet which includes a checklist and all forms and instructions for obtaining the required testing and documentation. It will also be the students’ responsibility to check in with the coordinator to ensure that all paperwork is complete and on file. Make sure health insurance is up to date.

Once you have received your rotation schedule, you should make contact with the affiliate coordinator(s) and ask the following:

- What to wear?
- When to report?
- Where to report?
- Where to park?

During each rotation students are responsible for the following:

- Review prior course material along with the clinical rotation objectives/questions in the CLS Internship Manual before beginning the clinical rotation.
- Bring your internship manual and corresponding textbook for each rotation with you to the clinical site.
- Present yourself in a professional manner at all times. You are representing your college and your program.
- Report on time every day. There are no allowed absences except for extreme circumstances that must be discussed with the SF instructor or coordinator and the affiliate supervisor.
- Keep the SF coordinator and instructor apprised of your experience. Report any problems or conflicts that you are unable to resolve with your supervisor.
- Check into your online class at least once a week.

At the end of each rotation the student is responsible for the following:

- Student Evaluation: Students will have the opportunity to evaluate their experience. This is confidential and will only be seen by SF CLS personnel.
- Meet with the affiliate supervisor to discuss their evaluation of your performance.
- Make sure you and your affiliate supervisor are able to access the final exam.
Instructions for Clinical Site Supervisors/Coordinators

Acquaint the student with your facility and with the daily operations and workflow of your laboratory:

1. Give the student a brief orientation of the facility (cafeteria, lounges, etc.).
2. Inform the student of the administrative hierarchy of your laboratory areas.
3. Discuss the student's daily time schedule.
4. Introduce the laboratory staff to the student.
5. Give the student an overview of each laboratory.
   a. Outline the work flow pattern of the lab and the range of diagnostic tests performed.
   b. Emphasize those tests the student will ultimately be responsible for performing.
6. Review the student's knowledge gained from previous course work.
7. Discuss with the student who will be contributing to his/her evaluation and when the evaluation will be completed. Evaluate the student's performance using the evaluation forms provided.
8. Students must keep an accurate record of attendance in each laboratory area. Attendance sheets for each practicum are included in the handbook. It is the student’s responsibility to have this record completed and signed by each area supervisor (or his designee) and to return the record to the Program Director at the end of the practicum rotation.

Instructions for Clinical Trainers

The following objectives apply to all areas of the clinical laboratory and should be used for evaluative purposes. In general a student should receive “exceeds expectations” when the following are met.

A. AFFECTIVE DOMAIN (attitudes, values, interests)
   a. The student wears protective clothing in all laboratories at all times.
   b. The student consistently arrives on time.
   c. The student consistently adheres to safety rules in all areas of the laboratory.
   d. The student reports patient test results only to appropriate authorized persons.
   e. The student handles patient specimens carefully to avoid contamination of the specimen and personnel.
   f. The student consistently cleans instruments and work counter and keeps the work area well supplied.
   g. The student performs all assigned tasks willingly.
   h. The student offers assistance to others in the laboratory when his or her work is completed.
   i. The student is organized and asks questions when appropriate.

B. COGNITIVE DOMAIN (knowledge, integrating, problem-solving)
   a. The student accurately states normal values for the various test procedures.
   b. Given appropriate reagents and supplies, the student selects what is needed for each test procedure.
   c. The student selects appropriate quality control products and specimens from supplies provided in the laboratory.
   d. The student identifies the proper time to collect various specimens which are sent to the laboratory.
   e. The student performs routine calculations used in the clinical laboratory.
   f. The student explains the principal and theory of the various tests explains the clinical significance of the findings.
   g. The student recognizes abnormal values and immediately report these findings to the appropriate persons.
   h. Given appropriate quality control parameters, the student evaluates the validity of test results and institutes proper procedures to remedy discrepancies.
Clinical Practicum Goals and Prior Experience Specific to Each Rotation

Overall Goals: Because of the variety of techniques instrumentation, the goals are stated in terms of desirable types of learning experiences rather than in terms of specific techniques to be mastered. These include providing the student with the opportunity to:
1. Assume responsibility for some clinical tests
2. Learn a few specific techniques thoroughly
3. Receive broad exposure to a variety of techniques
4. Receive exposure to laboratory operation and supervision.
5. Students have been trained in blood borne pathogen, chemical, and general lab safety and should continue to follow these practices in each practicum.

Chemistry
Prior Knowledge: The students complete one Clinical Chemistry lecture/laboratory course and one Biochemistry lecture course prior to their clinical practicum. The following is a list of tests/equipment that students are familiar with.
1. Spectrophotometry: theory, calibration and operation
2. Standard colorimetric bench procedures: total protein (biuret)
4. Electrolyte analysis
5. Chromatography: column, HPLC, GC-MS
6. Extraction using organic solvents
7. Pregnancy: beta HCG using target method
8. Use of the following equipment: spectrophotometer, pH meter, vortex mixer, electronic balance, heating blocks, distilled water apparatus, cuvettes, calibrated glassware, and automatic pipettes.
9. Use of the following lab math: acid-base problems, Beer's law, calibration and standard curves, unit conversion, determination of mean, SD and CV

Expectations: Students should participate in routine activities specific to the lab. The following list is not all-inclusive or mandatory.
- Perform instrument set-up for all routine analyzers. Students are told that they
- Run daily controls and evaluate for acceptability.
- Evaluate specimens for suitability for testing.
- Perform necessary specimen preparation for testing.
- Run patient specimens for all routine testing and evaluate results.
- Perform electrophoresis and evaluate results.
- Perform blood gases.
- Perform chemical analyses on body fluids other than serum/plasma, if sufficient specimen is available.
- Perform therapeutic drug analyses.

Hematology
Prior Knowledge: The students complete one Hematology lecture/laboratory course prior to their clinical practicum. Students study of the formation and development of blood and its coagulation mechanism, including the following diagnostic tests, methods, and instruments used.
1. CBC
2. Differential
3. PT and APTT
4. Platelet count
Clinical Laboratory Sciences Program

5. ESR
6. Sickle cell screen
7. D-Dimer

Expectations: Students should participate in routine activities specific to the lab. The following list is not all-inclusive or mandatory.

1. Perform Complete Blood Counts (CBCs) with differentials.
   a. Student results must be consistent with the laboratory’s criteria for reproducibility.
   b. Perform instrument set-up.
   c. Run daily controls and evaluate for acceptability.
   d. Evaluate specimens for suitability for testing.
   e. Perform necessary specimen preparation for testing.
   f. Run, correlate and evaluate scattergrams for at least 15 patients, normal and abnormal.
   g. Set up an erythrocyte sedimentation rate (ESR).

2. COAGULATION:
   a. Perform instrument set-up.
   b. Run daily controls and evaluate for acceptability.
   c. Evaluate specimens for suitability for testing.
   d. Perform necessary specimen preparation for testing.
   e. Run and evaluate a minimum of 20 PT’s and APTT’s.
   f. Run fibrinogen/thrombin and D-dimer.

3. Participate in special testing, such as factor assays and hemoglobin electrophoresis*, as available.
   *Note: If electrophoresis is performed in chemistry, and the student is scheduled for chemistry at the same facility, this can be done in chemistry.

Microbiology

Prior Knowledge: The students complete one Pathogenic Microbiology lecture/laboratory course prior to their clinical practicum. The following is a list of tests/equipment that students are familiar with.

1. Organisms
   a. Staphylococcus
   b. Streptococcus
   c. Bacillus
   d. Enterobacteriaceae
   e. Neisseria
   f. Moraxella catarrhalis
   g. Parasites
   h. Fungi (molds & yeast)

2. Media
   a. Sheep blood Agar
   b. Chocolate Agar
   c. MacConkey medium
   d. Hektoen Enteric medium
   e. Chrome orientation agar
   f. Mueller Hinton agar
   g. TSI (triple sugar iron) Slants

3. Techniques and procedures
   a. Isolation streaking
   b. Gram stain
   c. Catalase
   d. Coagulase & Staph latex kit
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e. Oxidase
f. Indole
g. Rapid ID kit
h. Bauer-Kirby antibiotic sensitivity test
i. Carbohydrate

Expectations: Students should participate in routine activities specific to the lab. The following list is not all-inclusive or mandatory.
1. Choose appropriate media for various clinical specimens.
2. Process specimens both aerobically and anaerobically.
3. Demonstrate knowledge of environmental influences on microbial growth.
4. Differentiate between normal flora and pathogens.
5. Apply methods of sterile technique in the laboratory at all times.
6. Read cultures and learn protocol for identification of microorganisms and pattern recognition of common isolates.
7. Perform testing for identification of fungi and parasites.
8. Read and perform antibiotic susceptibility tests.
9. Log specimens and record and report appropriate results.
10. Participate in quality control procedures.

Immunohematology

Prior Knowledge: The students complete one Immunohematology lecture/ laboratory course prior to their clinical practicum. The following is a list of tests/equipment that students are familiar with.

1. The student will gather reagents and supplies needed and perform the following procedures:
2. ABO and RH typing
3. Direct antiglobulin test
4. Antigen typing
5. Rh globulin work-up
6. Antibody screening and identification

Expectations: Students should participate in routine activities specific to the lab. The following list is not all-inclusive or mandatory. The student will observe and/or perform when appropriate the following procedures:
1. Issuing of blood or blood derivatives for transfusion purposes
2. Preliminary transfusion reaction investigation procedures
3. Inventory of blood supplies
4. Administration of blood components
5. Quality control
6. The student will prepare appropriate red blood cell suspensions for testing.
7. Given specimens for which the results were previously determined, the student will perform ABO and Rh typing with no errors. Using specimens and reagents provided, the student will identify the specificity of an antibody with 95% accuracy.
8. Using specimens and reagents provided, the student will perform compatibility tests with no errors.
9. Given selected patient specimens, the student will perform ABO and Rh typing, detect any discrepancies, and suggest possible solutions.
10. Given selected patient specimens, the student will recognize rouleaux and hemolysis while reading reactions and give plausible explanations for their occurrence.
11. When performing Rh testing on selected specimens, the student will be able to resolve a positive Rho control, if used.
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Urinalysis
Prior Knowledge: The students are presented with urinalysis and fluids (other than blood) concepts in the Clinical Chemistry course prior to their clinical practicum. The following is a list of tests/equipment that students are familiar with.

1. Utilize reagent test strips and tablets and measure specific gravity by the refractometer.
2. Examine slides of formed elements.

Expectations: Students should participate in routine activities specific to the lab. The following list is not all-inclusive or mandatory. The student will observe and/or perform when appropriate the following procedures:

1. Perform:
   a. manual macroscopic and microscopic routine urinalysis, including specific gravity and confirmatory tests
   b. automated routine urinalysis.
2. Identify the following abnormalities:
   a. cellular elements
   b. crystals
   c. casts
   d. abnormal macroscopic results
3. Perform microscopic examination and/or biochemical analysis of other fluids, as available, to include:
   a. Cerebrospinal
   b. Synovial
   c. Cavity Effusion
   d. Seminal
   e. Cyst fluid
   f. Other: specify

Phlebotomy
Prior Knowledge: The students are presented with phlebotomy concepts in the Hematology and again in Immunohematology course prior to their clinical practicum. The following is a list of procedures that students are familiar with.

1. Approach the patient in a friendly manner and identify self as a medical laboratory student who needs to obtain a blood sample.
2. Identify patients according to the lab protocol and label tubes.
3. Follow appropriate methods for venipuncture including:
   a. Selection, preparation and organization of equipment
   b. Selection of vein
   c. Preparation of venipuncture site
   d. Filling tubes in correct order
   e. Proper handling of collected blood
   f. Proper disposal of used equipment
4. Follow the appropriate universal precautions protocol when drawing blood.

Expectations: Students should perform venipuncture to achieve at least 25 successful sticks.

Serology/Specials
Prior Knowledge: The students complete one Molecular Diagnostics lecture/ laboratory course and are presented with Immunodiagnostics concepts and procedures prior to their clinical practicum. The following is a list of tests/equipment that students are familiar with.

1. RPR
2. Monospot
Clinical Laboratory Sciences Program

3. ELISA
4. ANA
5. Hepatitis testing
6. HLA/Tissue Typing
7. Flow Cytometry

Expectations: Students should participate in routine activities specific to the lab. The student will observe and/or perform the aforementioned tests when available as well as any additional tests that may be available.
Section 1
Chemistry Rotation
Clinical Laboratory Sciences Program

Instructions for Evaluations for Students and Clinical Supervisors

Qualitative Student Competency Checklist: This form should be completed by the student to evaluate their performance early in the rotation.

Technical Competencies Checklist: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. The student should rate their ability to perform accurate and reliable testing in a timely manner in the areas listed on the Chemistry internship checklist. The student’s time during each rotation will be spent observing and performing various procedures and reviewing theory and test principles. Performing tests in duplicate or performing tests under the direct supervision of the clinical instructor is encouraged. The checklists are provided as a guideline to ensure that routine procedures have been observed and performed. As a particular skill is performed, the student should indicate whether there was satisfactory or unsatisfactory performance. Otherwise, indicate whether the skill was only observed or discussed, or if it was not available (NA).

Quantitative Final Evaluation: This evaluation consists of 4 parts; rotation specific psychomotor skills, overall knowledge and skills, the student’s professional behavior, and summary comments. Please complete these forms by the last day of the student’s rotation. The affiliate supervisor should review these forms with the student. The student and evaluator will sign the forms and return them to the Santa Fe College Internship Coordinator.

Part 1 Psychomotor Evaluation: This form is to be utilized by the clinical instructor to evaluate the student’s technical skills specific to the rotation.

Part 2 Evaluation of Knowledge & Skills: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. Please rate the student’s overall ability to perform accurate and reliable testing in a timely manner.

Part 3 Evaluation of Professional Behaviors: This form is to be utilized by the clinical instructor to evaluate the student’s professional behaviors.

- Please be honest in rating each of the professional characteristics of the student.
- Base your judgment on behavior which you feel is characteristic of the student during the period of evaluation
- Please comment on any rating in the Needs Improvement of Unsatisfactory category.

Part 4 Summary Comments: In this section please feel free to write a brief overview of the student’s performance. Any problems that you encountered with the student, as well as praise, should be noted here. This is very helpful to students so they will learn their strengths and weaknesses.

NOTE: If any problems or conflicts arise while the student is in your department, please bring them to the attention of the SF liaison as soon as possible so it can be resolved.

Forms are located in the appendix (printable versions).
Santa Fe College Clinical Laboratory Sciences Program

Chemistry Internship Syllabus

COURSE NUMBER: MLS 4820L
TITLE: Chemistry Internship
CREDIT: 4 credits
TEXT: Board of Registry Study Guide: Clinical Laboratory Certification Examinations
INSTRUCTOR: Myra Urso, Med, BSMT (ASCP CM), myra.urso@sfcollege.edu
Work phone: (352) 381-3750

COURSE DESCRIPTION: The student will attend a clinical internship in a well-equipped and properly staffed laboratory for technical experience in clinical chemistry.

Note: This course may begin and/or end after the official published semester dates in order to accommodate scheduling availability at our clinical affiliates.

COURSE OBJECTIVES: By the end of the clinical internship, the CLS student should be able to complete or explain all of the following objectives with 70% accuracy.

1. Evaluate a patient specimen to determine if it is acceptable or unacceptable for chemical analyses.
2. Evaluate patient chemistry results according to established chemistry department protocol.
3. Record QC, evaluate QC records, and troubleshoot when QC values fall outside established limits.
4. Perform protein analysis using an automated analyzer to the satisfaction of the clinical instructor.
5. Perform enzyme testing, to include diluting specimens when out of instrument range high.
6. Perform electrolyte analysis using an automated analyzer to the satisfaction of the clinical instructor.
7. Perform glucose testing on serum, plasma and CSF using an automated analyzer to the satisfaction of the clinical instructor.
8. Perform hormone analyses to include BHCG and TSH using an automated instrument to the satisfaction of the clinical instructor.
9. Perform a lipid profile using an automated analyzer to the satisfaction of the clinical instructor.
10. Perform vitamin B12/Folate analysis or aliquot specimens for send out.
11. Perform manual chemistry procedures, which may include a porphyrin screen and/or a myoglobin.
12. Perform a renal profile using an automated analyzer to the satisfaction of the clinical instructor.
13. Perform a liver profile using an automated analyzer to the satisfaction of the clinical instructor.
14. Perform amylase and lipase analysis using an automated analyzer to evaluate acute pancreatitis.
15. Observe a gastric analysis.
16. Perform a thyroid profile using an automated analyzer to the satisfaction of the clinical instructor.
17. Perform analyses for tumor markers to include PSA, CEA, APF and BHCG.
18. Perform therapeutic drug monitoring for commonly measured analytes using an automated analyzer.
19. Perform rapid drugs of abuse screens using enzyme immunoassay techniques.
20. For each chemistry analyzer, demonstrate knowledge of operation by performing its basic operations.
22. Apply technical knowledge while performing basic laboratory procedures.
23. Display responsibility for one’s actions while at the clinical affiliate.
24. Accept constructive criticism to improve developing work habits.
25. Self-evaluate the interpersonal relationships with co-workers and others of the healthcare team.
26. Follow standard operating procedure manual and admit to errors or mistakes when they occur.
27. Organize the workload, prioritizing STATs and reducing turn-around-times.
28. Display dependability by arriving to clinical at designated times and days.

METHOD OF TEACHING: Laboratory Bench Instruction
Demonstration
Role modeling

EVALUATION METHOD: Students will be evaluated in four areas:
1. Technical competency achieved by the end of the clinical internship in a specified laboratory procedure evaluated by the clinical instructor.
2. Professionalism demonstrated during the clinical internship evaluated by the clinical instructor(s).
3. Theoretical knowledge demonstrated by a written examination on the last day of the clinical internship given by the College.
4. Weekly discussion board posts documenting what you have learned at the clinical affiliate.

TECHNICAL COMPETENCY:
Your technical competency will be assessed at the end of your clinical rotation by the clinical faculty. This psychomotor evaluation is worth 30% of your total grade in this course. It is your responsibility to know what tasks are on the checklist and to ask your clinical instructor(s) to initial it on a weekly basis as the assigned tasks are completed. Completion of the checklist is scored as either 100% or 0%.

PROFESSIONALISM:
Your professionalism will be assessed at the end of your clinical rotation by the clinical faculty. This affective evaluation is worth 30% of your total grade in the course. Remember that from the first day of your clinical internship, you are being evaluated for potential employment opportunities. Take advantage of this opportunity and ask your clinical instructors if they would be willing to be one of your references when you start applying for open positions.

WRITTEN EXAMINATION:
There is one multiple choice question examination at the end of clinical rotation. This cognitive evaluation is worth 30% of your total grade in this course. A self-paced study guide is provided to assist you with your preparation for the examination. Material included on the examination will be taken directly from the study questions focusing on theory, methodology, and clinical significance of each chemistry analyte.
DISCUSSION BOARD:
The weekly discussion board posts are due every Friday by 5:00 p.m. The discussion board should include what instrument you trained on, what profiles were performed, what analytes were measured, the principles of the analytes, any critical results that were phoned, and any interesting patient results that you encountered. In addition, you are required to answer all of the instructor’s questions on the discussion board by Sunday evening at 12:00 midnight for full credit.

GRADES:

<table>
<thead>
<tr>
<th>Grade</th>
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<tbody>
<tr>
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<table>
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CALCULATION OF GRADE

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<tr>
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<td>10%</td>
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<td>Total</td>
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</tbody>
</table>

The CLS student must pass this course with a “C” or better in order to continue in the CLS Program. There are no excused absences from the clinicals. The student must notify the clinical instructor if he/she is going to be late or absent before the time he/she is scheduled to be at the clinical facility. Make-up time is at the discretion of the clinical instructor.

Americans with Disabilities Act (ADA) Student Rights
If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations.

Discrimination/Harassment Policy Statement
Santa Fe College prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to the SFC Human Resources Policies website.

College Academic Integrity Statement
The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.
Chemistry Psychomotor Objectives

*By the end of the chemistry internship, the student should be able to:

- Familiarize yourself with the chemistry department, including, but not limited to:
  - Important safety equipment, including personal protective equipment, eyewash and safety shower, fire alarm and extinguisher, and hazardous disposal containers
  - Chemical hygiene plan
  - Material safety data sheet (MSDS) archive
  - All safety manuals
  - All protocol manuals
  - Major analytical instruments
  - Centrifuges
  - Key windows, benches or tables for specimen receiving and processing
  - Specimen storage areas
  - Reagent storage areas

- Read the department standard operating procedures
- Locate the safety manual and the material safety data sheets (MSDS)
- Locate the fire safety equipment including fire exits, fire extinguishers, fire blankets etc.
- Demonstrate universal precautions to be taken when handling biohazardous materials
- Communicate critical results to the healthcare professionals
- Demonstrate professional attitude during the clinical internship
- Evaluate patient specimens as acceptable or unacceptable for chemical analyses
- Utilize the laboratory information systems for specimen tracking
- Prepare automated and manual equipment for routine use
- Operate automated analyzers to perform routine chemistry tests

For each routine chemistry procedure:
- Recognize the normal, abnormal and improbable values
- Recognize critical values and take appropriate action within predetermined parameters
- Correlate test results with their clinical correlations
- Explain the theory and principle behind each test performed

- Perform routine chemistry calculations such as: dilutions, creatinine clearances, etc.
- Perform daily quality control for instruments in the chemistry department
- Interpret quality control results
- Perform preventative maintenance including calibration of chemistry analyzers
- Dispose of laboratory waste in proper containers.
- Perform calibrations on the automated general chemistry analyzers
- Perform daily maintenance on automated instruments
- Access reagents from refrigerator and restock reagents on instruments as needed
- Investigate delta checks
- Interpret results from the analyzer for changes in results and or flags
- Troubleshoot flags from automated analyzers
- Observe weekly instrument maintenance
- Program STAT specimens
- Perform quality control and troubleshoot results outside of 2SD
- List the analytes in chemistry profiles to include cardiac, hepatic, renal or other profiles
- Prepare dilutions on patients with elevated analyte levels
- Explain the methodologies of each orderable analyte
Observe monthly maintenance on any instrument
Perform urine chemistries on random and 24 hour specimens
Perform a urine and serum osmolality
Perform semi-automated and manual chemistry procedures
Load patient samples and initiate run
Prepare sample dilutions to the specifications of final volume and dilution factor
Use pending logs to identify problem samples that require immediate follow up
Perform daily startup as applicable
Perform quality controls on urinalysis instrument
Process a 24-hour urine collection, and properly label an aliquot for testing
Perform therapeutic drug monitoring
Perform serum protein electrophoresis and immunofixation
Perform chemical analysis by nephelometry
Perform endocrinology, toxicology and hepatitis testing
Perform immunoassays including CIA, EIA, and FIA.
Correlate patient results to disease states
Perform therapeutic drug monitoring
Perform procedures in accordance with the standard operating procedure manual
Recognize unacceptable quality control results and take appropriate corrective action
Record all QC corrective actions according to laboratory policy
Demonstrate accountability by arriving at designated times for the internship
Perform a calibration and/or calibration verification procedure
Manually program, load and process patient samples
Perform reagent inventory and replace reagents and supplies as needed
Record the temperature of freezers, refrigerators, incubators and heating blocks
Determine the acceptability of specimens submitted for blood gas analysis
**Introduction to Chemistry**

1. Distinguish between the different types of water used in the laboratory.
2. List the different available pipets, and describe the markings (etchings) and the terms TD, TC, blow out and volumetric. Determine which type is preferred for viscous fluids.
3. Recognize, name and state the use of common laboratory glass and plastic ware.
4. Understand centrifugation and balances.
5. State the properties of solutes, solvents, and solutions; calculate solution concentrations.
6. Define units of measure and relate the differences among various units.
7. Recognize various laboratory hazard signages and state the appropriate course of action when an accident occurs.
9. Why is it important to have reagent grade water?
10. List and give a brief explanation of at least three purification processes of water. What are their advantages? Disadvantages?
11. Name and differentiate (by usage) and purity the three types of reagent grade water.
12. Manual pipettes are defined as either transfer or measuring. (List an example of each)
13. What is the most accurate pipette type for the delivery of non-viscous fluid?
14. What is the purpose of balances in the clinical laboratory?
15. Briefly describe the requirements of operation and maintenance procedures for balances in the clinical laboratory.
16. How often should thermometers and temperature-controlled devices in the clinical laboratory be checked and recorded?
17. What is the recommended accuracy range of thermometers?
18. List and briefly describe the three types of centrifuges available in the clinical laboratory.
19. In regards to laboratory safety, list the two programs mandated by OSHA.
20. Which organizations are responsible for these inspections?
21. Which organization sets the standards for all equipment used in the clinical laboratory?
22. List the various types of fire-extinguishers and what types of fire they are most commonly used to extinguish. Which is the best all-purpose?
23. Name the organizations that can classify hazardous materials.
24. What are MSDS and why is it important to have them? What is an LD50?
25. Outline the NFPA labeling system for all stored chemicals.
26. What is the specific purpose for “universal precautions” as defined by the CDC and adopted by OSHA?
27. Describe (and be able to apply) the most commonly used equations for preparing dilutions.
28. Name the three basic forms of concentrations?
29. What is the difference between molarity and normality?
30. What OSHA rules govern the workers right to know?
31. What documents describe chemical safety?
32. What is the BBP act?
33. What is the needle stick directive?
34. Distinguish between work practice controls, PPE, and engineering control.
35. Give the equation for conversion of Fahrenheit to Celsius (centigrade units).
   Give the equation for conversion of Celsius to Fahrenheit.
Basic Principles of Lab Analyses and Safety
1. State the sample types used in the clinical laboratory. Describe the proper method of specimen collection.
2. Determine the type of color-coded, evacuated tube that is appropriate for assessment of various analytes.
3. List anticoagulants and state both their action on whole blood and their appropriate uses in various laboratory tests.
4. State the effects of physiological, biological, and environmental factors on laboratory analyses.
5. Briefly describe the cyclic biological causes of analyte variation.
6. What effects do patient-related physical variables have on an analyte? Are these pre, analytical or post variables?
7. Give an example of how a patient’s diet might affect the validity of an assay.
8. Differentiate between arterial, capillary, and venous blood. How could these differences cause misleading results?
9. List the most commonly used anticoagulants and the indications for their use.
10. What is the specific action or chemical basis of these anticoagulants or additives?
11. What are the effects of hemolysis? Which electrolyte is affected?
12. List 3 enzymes that are affected by hemolysis.
13. How can blood drawn from the same side of the tourniquet as a catheter affect chemistry assays?
14. What are the most common causes of erroneous lab results?
15. What is the primary reason for laboratories to develop criteria for rejection of specimens?
16. State the main difference between serum and plasma.
17. State the most commonly used anticoagulant for STAT chemistries.

Spectrophotometric Techniques
1. List the energy spectrum from X ray to microwave. Which has the longest wavelength? How is wavelength related to energy?
2. State Beer’s law. Calculate concentration from absorbance of standard and unknown.
3. Define photometry, absorbance, percent transmittance, bandwidth, stray light, and linearity.
4. Determine absorbance from measured percent transmittance.
5. List the components of a spectrophotometer and provide examples of each component.
6. Draw a spectrometer schematic and label the parts. How are UV and VIS measurements different (3 ways).
7. What quality control checks should be performed to certify that spectrophotometers are functioning within specifications?
8. Describe the specific methods for verifying wavelength calibration. What filters are used for visible light? For UV light?
9. Briefly explain the principle behind atomic absorption. What types of molecules are commonly measured?
10. Which type of lamp is most often used for emitting radiant energy in atomic absorption?
11. Briefly explain the principle of fluorometry.
12. In chemiluminescent assays, which enzyme is typically used to yield light as the part of the reaction product?
14. Compare and contrast turbidity versus nephelometry assays.
15. Which cuvette is most commonly used to measure ultraviolet range wavelengths in spectrophotometry?
16. List three spectral interferences. How can these interferences be corrected?
17. What is the best method for eliminating the interference caused by turbidity?
18. Do most spectral interferences give falsely elevated or falsely decreased results? Why?
19. How does the use of kinetic measurements help alleviate the problems of spectral interferences?
20. Briefly describe the principle of a two-point kinetic assay.
21. What is the difference between a sample blank and a reagent blank?
22. Explain atomic absorption with respect to sample preparation, energy source, and type of cuvette; draw a schematic.

**Evaluation of Methods/Statistical Techniques**
1. Discuss the need for method selection and evaluation in the clinical laboratory.
2. Define mean, median, standard deviation, correlation coefficient, regression analysis.
3. State the considerations that must be examined in the selection of a new analytical method.
5. Define accuracy, analytical sensitivity, analytical specificity.
6. Define Gaussian distribution. Which statistical values are calculated for use in this evaluation of data?
7. Define linear regression.
8. Define coefficient of variation. Be able to calculate it.
9. Compare and contrast precision to accuracy.
10. What indicator describes perfect correlation?

**Establishment and Use of Reference Values**
1. Define reference value, prevalence.
2. Compare selection criteria and exclusion criteria and provide examples of each.
3. Determine reference intervals using parametric and nonparametric measures.
4. Define sensitivity, specificity, and positive and negative predictive value of laboratory tests and calculate each.
5. Demonstrate how predictive value of a laboratory procedure is affected by prevalence.
6. Which organization establishes guidelines and procedures for determining valid reference values and reference intervals for quantitative clinical laboratory test?
7. Why is it important to have partitions (age, sex, and race) within a population of reference individuals?
8. List five examples of possible exclusion of *pre-analytical* variables that could possibly affect results within a population of reference individuals.
9. How are clinical decision limits different from reference intervals?

**Quality Management**
1. Define quality and total quality management.
2. List examples of pre-analytical, analytical, and post-analytical variables that affect laboratory test results and state how each is controlled.
3. Compare internal quality control with external quality assessment.
4. Define quality control.
5. Explain the need for control charts in the clinical laboratory.
6. List and explain the Westgard rules for interpretation of laboratory control data.
7. Apply the Westgard rules to actual control data and determine what actions must be taken to correct out-of-limit control values.
8. Define proficiency testing.
9. Explain the primary analytical goals of a clinical laboratory's quality control program.
10. Define action limits, target values, and performance specifications.
11. What type of chart is used to plot QC?
12. List the Westgard rules. What is the purpose of the Westgard rules? How is it applied?
13. Define shift and trend.
14. Explain the purpose of delta checks.
15. What is the difference between controls and calibrator?
16. What is the difference between a definitive method and a reference method?
17. Give one example of how a laboratory could verify the validity of a test that is run “in-house”?
18. What are the two requirements that apply to all pooled material (especially sera) used for quality control?
19. How does normality relate to molarity?
20. Practice the application of \( V_1C_1 = V_2C_2 \)

**Carbohydrates**
1. What is the difference between glycolysis and gluconeogenesis?
2. Provide examples of a monosaccharide, disaccharide, and polysaccharide.
3. Discuss the regulation of glucose concentration in the body.
4. State the healthy reference interval of glucose.
5. Compare type 1 and type 2 diabetes mellitus using laboratory data.
6. State the basic criteria for the diagnosis of diabetes mellitus (ADA guidelines).
7. Describe glucose, ketones, and HbA1C findings in an insulin-deficient individual.
8. Outline the procedure for an oral glucose tolerance test.
9. List 3 causes of hypoglycemia.
10. List 4 methods of serum glucose analysis.
11. Define glycohemoglobin, state its usefulness and list three methods of measurement.
12. Insulin is synthesized in the endocrine pancreas by the beta cells of the _________.
13. What is the most significant laboratory finding for the diagnosis of diabetes mellitus?
14. What is the purpose of screening women for gestational diabetes?
15. List the symptoms and effects upon the fetus in cases of gestational diabetes.
16. What is the most common complication of diabetes mellitus?
17. Obesity is most often associated with which type of diabetes mellitus?
18. Define ketoacidosis.
19. How are HLA antigens theorized to be involved with type 1 diabetes mellitus?
20. List four hormones (other than insulin) that act as hyperglycemic agents.
21. Name the organization who determines the diagnostic criteria for diabetes mellitus.
22. Define secondary diabetes.
23. List five causes of secondary diabetes.
24. Explain the genetic inheritance of diabetes mellitus.
25. Why do type 2 diabetics have a greater propensity to atherosclerosis than non-diabetics?
26. Which laboratory tests are used for the diagnosis of diabetic ketoacidosis?
27. Outline the oral glucose tolerance test. What forms of diabetes is it appropriate for?
28. Give the empirical formula for glucose.
29. List the molecules that form the disaccharides sucrose, lactose, and maltose.
30. Explain the two types of starches.
31. List three moieties that can be covalently linked to carbohydrates.
32. Which polysaccharide are humans least able to digest? Describe how carbohydrates are ultimately digested. List the common disaccharides and their monosaccharides.
33. Outline and briefly discuss the two stages of glycolysis.
34. Why is the measurement of urinary glucose a poor marker for diabetes mellitus?
35. Explain the glucose oxidase method for the measurement of glucose.
36. What is the most common method in use for glucose analysis?
37. What reaction is the basis for the hexokinase assay for glucose?
38. List the common interferences for the measurement of urinary glucose by the urine dipstick method.
39. What is the universal energy source of biological reactions?
40. What is glycosylated hemoglobin?
41. How will hemolytic anemia affect the result of HbA1C? What disorder has the opposite
disorder has the opposite
42. What is microalbumin? What might it indicate?
43. Describe insulin processing. Why is C-peptide a better indicator than insulin level?
44. Describe insulin resistance.
45. Describe the caveats associated with A1C testing.
46. Compare Clinitest to urine glucose by dipstick for sensitivity and specificity.

**Point of Care Testing**
1. Define point-of-care testing (POCT).
2. What are the driving forces and potential benefits to performing point-of-care testing?
3. What is the purpose for CLIA (Clinical Laboratory Improvement Amendments of 1988)?
4. List five CLIA ’88 waived tests.
5. Who is responsible for quality assurance (QA) monitoring of POCT?
6. List three duties of the laboratory technologist assigned to POCT programs.
7. What are the contraindications of POCT?
8. Define total quality management (TQM).

**Heme Derivatives (Hgb/ Iron/ Porphyrins/Bilirubin)**
1. List 4 proteins that contain heme.
2. State the clinical utility of analysis of erythrocyte protoporphyrin and zinc protoporphrin.
3. The assessment of lead toxicity.
4. State the physiological function of iron, transferrin, and ferritin.
5. Describe iron absorption and transport.
6. List and describe the symptoms of three disorders of iron metabolism.
7. List five conditions that affect serum iron concentration.
8. Describe the methods of analysis of serum iron and ferritin.
9. What is the iron binding capacity?
10. Describe bilirubin conjugation in the liver.
11. State the clinical utility of analysis of unconjugated and conjugated serum bilirubin.
12. Describe the methods of analysis for bilirubin.
13. What is the clinical significance of unconjugated bilirubin in the newborn?
15. Describe the mechanism of physiologic jaundice of the newborn.
16. Describe the mechanism of HDN.
17. Describe the mechanism of breast milk jaundice of the newborn.
18. What is the predominant source of iron within the human body?
19. Outline iron distribution and function in a normal adult male.
20. Why does the average adult female have less body iron than the average adult male?
21. Briefly explain how iron in the ferric state, which is mostly insoluble is absorbed.
22. List the three major sites of iron reserves in the human body.
23. What is the physiological function of transferrin in the human body?
24. Iron is stored in tissue in two forms. Compare and contrast these forms.
25. Name four disease or conditions that result in iron deficiency.
26. What tests are most commonly used for the measurement of a person’s iron status?
27. What is the most common cause of anemia?
29. Which stain is frequently used for determining the presence of hemosiderin?
30. What is the most common type of porphyria and how is it caused?
31. What is the most common cause of lead poisoning in young children?  
32. What are the five mechanisms that can lead to hyperbilirubinemia and jaundice in the newborn?

**Gastric, Pancreatic, and Intestinal Function**

1. Which pancreatic enzyme facilitates triglyceride digestion in the duodenum?  
2. What is the function of chief cells and how are they influenced?  
3. In what form are carbohydrates ultimately absorbed in the bloodstream as?  
4. List fat soluble vitamins.  
5. What is the primary physiological role of secretin?  
6. What is considered to be the direct cause of most cases of chronic active gastritis and peptic ulcers?  
7. Explain the Zollinger-Ellison syndrome.  
8. Which tests are used for the diagnosis of Zollinger-Ellison syndrome?  
9. What is the most common malabsorption disorder?  
10. Define achlorhydria.  
11. What is the clinical significance of the laboratory finding of achlorhydria?  
12. Describe the gastrin stimulation test.  
13. What is the most reliable method of determining lactose absorption?

**Trace Elements**

1. List the characteristics of trace elements  
2. List seven physiologically essential trace elements and state the clinical significance of each  
3. State the basic function of the seven essential trace elements  
4. List the analytical methods available for the assessment of trace elements  
5. State the specimen collection requirements for trace elements  
6. Describe the effects of carotenemia.  
7. What role do zinc fingers play in gene expression?  
8. What is the preferred method for the measurement of most trace elements  
9. List three factors that are associated with elevated serum copper levels.  
10. Briefly outline the classic symptoms of Wilson’s disease.
Diabetes mellitus

Table 1 Testing in Diabetes

<table>
<thead>
<tr>
<th>Test</th>
<th>Relevance in Diabetes mellitus. Give more than 1 sentence. Describe it if you can. Think of key words that may be associated with it.</th>
<th>Reference (normal or non-diabetic range) range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting glucose</td>
<td></td>
<td>Use negative if it should be negative.</td>
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<tr>
<td>2 hour glucose tolerance</td>
<td></td>
<td></td>
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<tr>
<td>Micro albumin</td>
<td></td>
<td></td>
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<tr>
<td>C-peptide</td>
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<tr>
<td>Urine ketones (what 3 types, in what order by concentration?)</td>
<td></td>
<td></td>
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<tr>
<td>Urine glucose</td>
<td></td>
<td>When can this be found in the urine?</td>
</tr>
<tr>
<td>HbA1c(glycated Hemoglobin)</td>
<td></td>
<td>What will interfere with this test?</td>
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<tr>
<td>Acetest (serum acetone)</td>
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<td></td>
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<tr>
<td>Arterial pH</td>
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</tbody>
</table>

Table 2 Type 1 versus Type 2 diabetes – indicate how these are different or the same

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto antibodies to pancreas, insulin or islet cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of ketoacidosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual demographics</td>
<td></td>
<td></td>
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<tr>
<td>POCT</td>
<td></td>
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<tr>
<td>SMBG</td>
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</tbody>
</table>

What is gestational diabetes, and what is the outcome if it is not managed? What test is done to diagnose it?

Glucose oxidase/peroxidase and hexokinase are the main tests used for glucose. What is the reaction? Which one does your lab use?

What is hypoglycemia? Is it dangerous?

What are the critical values for glucose in your lab? What does “critical value” mean?
Secondary diabetes can be caused by hormonal imbalance that produces excess glucose in the bloodstream. Review the hormones that regulate glucose (not just insulin). What diseases are associated with diabetes this way?

Your lab should test for galactose in the urine of infants. Why? What is galactose? Is it different than glucose? Is it a monosaccharide? Will galactose cause urine glucose to be positive? What test will detect its presence?

Iron deficiency anemia

There are many tests used when evaluating iron deficiency anemia. Indicate with an arrow if these are increased or decreased in iron deficiency. Which is the best indicator of iron stores? What is hemosiderin? What is the single most reliable indicator of iron deficiency?

<table>
<thead>
<tr>
<th>Table 3 Iron</th>
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</thead>
<tbody>
<tr>
<td><strong>Test</strong></td>
</tr>
<tr>
<td>Total iron</td>
</tr>
<tr>
<td>TIBC</td>
</tr>
<tr>
<td>UIBC</td>
</tr>
<tr>
<td>Ferritin</td>
</tr>
<tr>
<td>Transferrin</td>
</tr>
<tr>
<td>Hemoglobin</td>
</tr>
<tr>
<td>MCV &amp; MCHC</td>
</tr>
</tbody>
</table>

Compare hemachromatosis to iron deficiency anemia.

How does iron deficiency anemia affect HbA1c results?
**Jaundice**

The major classifications of jaundice are pre-hepatic, hepatic and post-hepatic. Look at a picture of the digestive tract, and follow the path from the gall bladder to the intestines. Review how bilirubin is processed normally, and how it increases in each of these conditions. Then indicate using arrows how each of the following will be altered. Be sure to know that direct + indirect = total bili. Also remember that direct = conjugated bilirubin. In your table, if you have an elevated direct bili you should have + urine bilirubin.

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Total bili</th>
<th>Direct bili</th>
<th>Urine bilirubin</th>
<th>Urobilinogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehepatic</td>
<td>increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatic</td>
<td>increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posthepatic</td>
<td>increased</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See if you can classify each of these conditions as pre-hepatic, hepatic and post hepatic:

Gallstones (cholecystitis), pancreatic cancer, hemolytic anemia, hemolytic transfusion reaction, cirrhosis, hepatitis, newborn jaundice, sickle cell anemia

What is it about carotene that will cause it to interfere with some assays for bilirubin? (Think of what it looks like).

What is Kernicterus? Who gets it?

**Pancreatic enzymes**

A patient comes to your ER with knifelike pain in the abdomen. The doctor suspects pancreatitis. Ask your training tech what 2 tests get ordered. Then, state what the role of those enzymes in a healthy individual.

**Other diseases**

Pernicious anemia is a deficiency of what?

Zollinger Ellison is an excess of what?

Cystic Fibrosis has what symptoms?

Lactose intolerance is tested how?

What is Wilson’s disease?

What is a common cause of lead poisoning in children?
Electrophoresis

1. Define electrochemistry.
2. Define potential and state the principle of potentiometry and its use in the laboratory.
3. List four types of electrodes available for laboratory use.
4. State the principles of amperometry and coulometry and list the uses of each technique in a clinical laboratory.
5. What are potentiometric methods based on?
6. Give the formula for calculating osmolality.
7. Define biosensor.
8. Which electrolyte is coulometry associated with?
9. What form of calcium is measured by ion-selective electrode potentiometry?
10. What is the most physiologically active form of calcium? How does pH affect this?
11. Describe the special modifications of electrodes that make them ion selective.

Electrolytes and Blood Gases

1. Define osmolality, oxygen saturation.
2. List the major physiological electrolytes.
3. Discuss the physiological functions and regulation of sodium, potassium, and chloride.
4. State the principle of the ion-selective electrode method specifically for sodium, potassium, and chloride analysis.
5. List the four colligative properties of a solution.
6. State the principle of the quantitative sweat test for cystic fibrosis.
7. State the Henderson-Hasselbalch equation.
8. State the methods used to assess blood pH, PCO2, PO2, and oxygen saturation.
9. List the sources of preanalytical error in blood gas analysis.
10. How does osmosis differ from diffusion?
11. What is the osmolal gap? What is the equation for calculating the osmolal gap?
12. What specific substances in plasma contribute the most to the osmolality?
13. List and briefly describe three clinical uses of osmometry.
15. What characteristic of a solution do colligative properties depend on the most?
16. What is the benefit of using a urine osmometer over measuring specific gravity by a refractometer in the evaluation of urine concentration?
17. What anticoagulant is preferred in the measurement of plasma osmolality? Why?
18. Which toxin would most commonly cause an excess osmolar gap?
19. Define colloid osmotic pressure.
20. What are the major intracellular and extracellular cations and anions?
21. List four measurements used for the determination of osmolality.
22. Which is commonly used?
23. In the freezing point depression method for determining osmolality, the freezing point of the solution is ____________ related to the osmolality.
24. The following statement can be made about vapor-pressure depression. There is a (n) ____________, relationship between the concentration of dissolved particles and the vapor pressure above a solution.
25. Compare and contrast indicator electrodes to reference electrodes.
26. What are the most commonly used reference electrodes for potentiometry?
27. What is an ionophore?
28. Briefly describe the ion-selective potentiometric method for the measurement of chloride.
29. What is the reference method for the measurement of chloride?
30. What is the reference method for the measurements of sodium and potassium?
31. Briefly explain the measurements of sodium and potassium by the chromogenic ionophore method.
32. Which specific ionophore is used for this measurement?
33. Which interferent must be strictly avoided in any method of measurement for potassium?
34. Define pilocarpine iontophoresis and the clinical significance of this test.
35. List 5 parameters measured by a blood gas analyzer.
36. What effect does degradation of the membrane have on ABG analysis?
37. What is the reference ranges for pH, PCO2 and PO2? How are these changed in respiratory acidosis and alkalosis?
38. What are the sample types for the above tests? What errors will occur if the incorrect anticoagulant is used in electrolyte testing?
39. What is the pK of the bicarbonate/carbonic acid buffer system?

Renal Function
1. Describe the anatomy of the renal system.
2. Define glomerular filtration rate.
3. List the functions (6) of the renal system.
4. State the clinical laboratory tests used to assess renal function and laboratory values associated with renal pathology.
5. What is the biological function of vasopressin?
6. What is pseudo hyperkalemia?
7. What is the clinical use of calculating the anion gap?
8. What is the greatest danger of hyperkalemia?
9. What is the function of the juxtaglomerular cells of the kidney?
10. What is the main cation of extracellular fluid? Intracellular fluid?
11. What are the two most common causes of hyperkalemia?
12. What is the predominant pH buffer of blood?
13. What is definitive urinalysis finding in the diagnosis of acute glomerulonephritis?
14. List the major clinical symptoms of nephrotic syndrome.
15. What are the three classifications of acute renal failure?
16. What are the basic processes involved in the formation of urine?
17. Describe the process of glomerular filtration.
18. Why is the hydrostatic pressure of the glomerular capillaries higher than most other body capillaries?
19. How does glomerular filtrate differ from plasma filtrate?
20. Approximately 80% of salt and water are reabsorbed from the glomerular filtrate in the __________________.
21. Which hormones regulate the function of the distal convoluted tubules? How?
22. List and describe three ways in which the kidneys regulate the acid-base balance.
23. Describe the phenomenon of the countercurrent mechanism responsible for water reabsorption within the Loop of Henle.
24. How is creatinine derived? Why is urine creatinine level frequently measured in the clinical laboratory?
25. Acting as the endocrine gland, which three hormones does the kidney produce?
26. Give (and be able to apply) the equation for the creatinine clearance test.
27. Briefly describe the Jaffe’ method for creatinine analysis.
28. How is plasma different from the glomerular filtrate?
29. What is the renal threshold for glucose?
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**Water, Electrolyte, Acid Base Metabolism**

1. Discuss total body water distribution.
2. Discuss the maintenance of homeostasis with regard to electrolyte concentrations.
4. List the physiological buffer systems.
5. Describe the contribution of respiration to acid base status.
6. Describe the contribution of the kidneys to acid base status.
7. List disease conditions associated with abnormal acid-base status.
8. Where is the regulatory center for water intake and water output in the body?
9. Outline the renin-angiotensin-aldosterone system in regards to water and sodium metabolism.
10. List the common signs and symptoms of dehydration.
11. What is the most common cause of water intoxication?
12. List the five clinical conditions associated with hyponatremia.
13. List the five clinical conditions associated with hypernatremia.
14. Give the definition of acids and bases.
15. What is the most important physiological volatile acid?
16. Compare and contrast metabolic acidosis and respiratory acidosis.
17. What role does bicarbonate have in the calculation of base excess and base deficit?
18. Compare and contrast metabolic alkalosis and respiratory alkalosis.
20. How are ketoacids produced? What are the two most common ketoacids?
21. Explain the effect of salicylate intoxication on the body’s acid-base equilibrium.
22. Outline the classes of acid-base disorders with their corresponding effects on selected blood-gas parameters.
23. Define the isoelectric point and pKa. What is their relationship to the body’s overall buffering capacity.
24. What is the physiological pH?
25. What is the relationship of bicarbonate to carbonic acid at the physiological pH?
26. What is the result of a shift to the left or right on a classic hemoglobin-oxygen dissociation curve?
27. What effect does the interaction of 2.3-diphosphoglycerate with hemoglobin have on the hemoglobin-oxygen dissociation curve?
28. List the common causes of metabolic acidosis. Metabolic alkalosis.
29. What is hypochloremic alkalosis? What typically causes this?
30. What is the most common cause of respiratory acidosis in infants?
31. What are the three physiological responses to respiratory acidosis?
32. What is the standard medical treatment for a patient with respiratory acidosis?
33. List the laboratory findings for a patient in diabetic ketoacidosis.
34. Hyperventilation is a compensatory response to respiratory acidosis. What is the danger in prolonged hyperventilation?
35. Define chloride shift.
36. Assessment of an individual’s acid-base status is aided by the direct measurement of _______________ and _______________.
37. What are the three types of blood specimens that may be used for blood-gas determination?
38. Why are glass syringes and tubes more suited for sampling, storage, and transport of specimens for blood-gas determination?
39. If there is a delay of more than five minutes between sample collection and analysis, how should blood-gas specimens be preserved?
40. How will the presence of an air bubble affect ABG results?
41. What is an acid? What is a base?
Adrenocortical Function
1. Describe the structure and function of the adrenal cortex.
2. What is the precursor for the adrenocortical hormones?
3. List the hormones synthesized by each specific zone of the adrenal cortex, and state their function.
4. Describe Addison’s disease, Cushing’s disease, Conn syndrome and Congenital Adrenal Hyperplasia.
5. List the laboratory tests used to assess adrenocortical function.
6. What is the primary glucocorticoid produced by the adrenal gland?
7. What is the relationship of cortisol with insulin?
8. What are the major biological effects of cortisol? How does it change during the day?
9. What is the primary mineralocorticoid produced by the adrenal gland?
10. What are the major physiological functions of aldosterone?
11. What are the main secretory products of the adrenal medulla?
12. What is the major cause of Cushing’s disease?
13. What is the major cause of Addison’s disease?
14. What is the most common cause of congenital adrenal hyperplasia (CAH)?
15. Distinguish between Cushing’s disease caused by a pituitary tumor versus an adrenal tumor.
16. Explain the dexamethasone suppression test.
17. What is the activity of renin? What is the effect of posture on renin values?

Non-protein Nitrogen Metabolites
1. List the non-protein nitrogen metabolites analyzed by a clinical chemistry laboratory.
2. Discuss the clinical utility non-protein nitrogen metabolite assessment.
3. Outline the biosynthesis of urea, creatine, creatinine, uric acid, and ammonia.
4. State the importance of creatinine clearance measurement.
5. List the methods of analysis and possible interferences for each of the clinically important non-protein nitrogen metabolites.
6. List 3 mechanisms that lead to increased uric acid levels.
7. Describe Reye syndrome.
8. Which non-protein nitrogen is also known as urea?
9. Describe the defect and consequences of Lesch-Nyhan syndrome.

Enzymology
1. Define enzyme and describe how enzymes are classified based on their structures or their actions.
2. Define first-order and zero-order kinetics.
3. Define $K_m$, $V_{max}$, enzyme inhibition (competitive, noncompetitive, and uncompetitive).
4. State the Michaelis-Menten and Lineweaver-Burk equations and relate them to enzyme kinetics. Draw and label a Michaelis-Menten curve and a Lineweaver-Burk plot.
5. List the factors that affect the velocity of an enzymatic reaction and how these factors affect enzyme kinetics.
6. State the way in which each type of inhibition affects enzyme kinetics.
7. List the physiological factors that affect blood enzyme levels.
8. Compare the methods available for analysis of clinically significant enzymes and describe how the rate of an enzyme-catalyzed reaction relates to the amount of enzyme activity present in a system.
9. Draw a Michaelis-Menten curve, and label the $K_m$, $V_{max}$, substrate concentration and velocity.
10. What is an international unit?
11. How does competition change the Michaelis-Menten constant?
12. Draw a picture showing competitive, noncompetitive, and uncompetitive inhibition.
13. NAD to NADH is a common mechanism used to measure enzymes. What wavelength, increase or decrease in absorbance, curvets are associated with this mechanism?
14. What factors must be optimized for enzyme measurement?
15. Name a common example of an oxidoreductase, transferase and hydrolase.
16. List the 3 phases of an enzyme reaction and describe the change in absorbance for each. Which phase is used for laboratory measurements?
17. Describe zero order, first order and second order kinetics.
18. Define first order and zero order enzyme reaction rates. Where is V\text{max} located?
19. Are most laboratory methods first or zero order? How is this accomplished?
20. Differentiate between and end-point and a kinetic enzyme method.
21. State 3 factors that must be considered when developing optimal enzyme assay conditions.
22. Why do enzyme assays incorporate buffers?
23. How are enzymes affected by temperature? How does a 1 Celsius degree rise in temperature affect enzyme activity? Compare the reactivity of enzymes at 25, 30, 37 and 56 degrees Celsius.
24. Name an enzyme that the concentration is affected by time of sampling. Age. Sex. Race. Exercise.

Automation in the Clinical Laboratory
1. Distinguish among batch, random-access, discrete, and sequential analysis.
2. List the 11 most commonly automated operations of a chemical analysis.
3. Describe the integrated, automated laboratory workstation.
4. Define point-of-care testing and provide examples of point-of-care analyzer.
5. Define the overall process of automation in the hospital laboratory.
6. State 2 advantages that automation provides for patient care.
7. How is automation of transfer of patient specimens to the lab accomplished?
8. State an advantage and a disadvantage of using unit test reagents.
9. How are reagents and samples proportioned in a continuous flow analyzer?
10. State the major goals of laboratory automation.
11. How do bar codes aid in the automation of sample preparation and identification?
12. Differentiate between single-point and multiple-point monitoring.
13. How does dwell time relate to throughput? Which is more important for STAT testing?
14. What is a reasonable TAT for a STAT request? How can a TAT of less than 10 minutes be accomplished?
15. Differentiate between kinetic measurements and end-point analyses.

Liver Disease
1. Define jaundice, viral and chronic hepatitis, and cirrhosis.
2. List and define the major functions of the liver.
3. List the enzymes synthesized in the liver, as well as their functions.
4. State the laboratory values obtained with each of the following hepatic diseases: acute hepatitis, chronic alcoholism, cirrhosis, Reye’s syndrome, Wilsons’ disease, and cholestasis.
5. Name the 2 primary cells of the liver.
6. What 2 body proteins are not synthesized in the liver?
7. What polysaccharide is produced by the liver? How does this relate to the maintenance of a constant blood glucose level?
8. State 3 functions of albumin. Is it increased or decreased in liver disease? Why do persons with liver disease often appear edematous?
9. What condition is indicated by decreased levels of prealbumin?
10. In what form does the liver primarily store iron?
11. List the steps in the degradation of heme to urobin. What is delta bilirubin? What is another name for bilirubin diglucuronide? Which forms are water soluble?
12. Characterize the following disorders as to being prehepatic, hepatic or posthepatic jaundice. State whether the jaundice is caused by conjugated or unconjugated bilirubin.
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a. Gilbert’s disease  
b. hemolytic anemia  
c. Dubin-Johnson syndrome  
d. Hepatitis  
e. Crigler-Njjar disease  
f. neonatal jaundice  
g. bile duct obstruction

13. Relate the results of tests for AST, ALT, GGT, bilirubin and alkaline phosphatase to the disease course of hepatitis.

14. What lab test is most noticeably elevated in drug and alcohol induced hepatic damage?

15. What is the significant lab result in Reye’s syndrome?

16. What is the metabolic defect in Wilson’s disease? What plasma substance is decreased?

17. What are the symptoms of alpha\textsubscript{1}-antitrypsin deficiency?

18. In what liver disorder is alkaline phosphatase most elevated? In addition to liver disease, what other disorders elevate alkaline phosphatase?

19. Why can a test for alkaline phosphatase not be run on plasma from a lavender top tube? Currently what is the most common alkaline phosphatase substrate?

20. What does a normal GGT and an elevated alkaline phosphatase indicate? A normal GGT and an elevated AST?

21. How does lactic dehydrogenase enter the serum? How does hemolysis affect LD results?
   a. AST results? ALT results? An LD that is higher than the AST and ALT is indicative of___________________

22. In continuous monitoring methods for ALT and AST what is the reaction that is monitored?

23. Differentiate between direct and indirect bilirubin. Total bilirubin and conjugated bilirubin.

24. Name the classic reagent used in bilirubin determinations. What is the purpose of an accelerator? Name 2 accelerators.

Disorders of the bone

1. Describe the structure and function of bone.

2. State the function of calcium and phosphorus and magnesium in bone metabolism.

3. State the function of parathyroid hormone and calcitonin in bone metabolism.

4. Describe how hyperparathyroidism and hypoparathyroidism and decreased vitamin D affect bone.

5. List four metabolic bone diseases.

6. List the markers of bone formation and resorption.

7. Name the 3 types of circulating calcium and their concentration.

8. What are the characteristic calcium and phosphorus results in hypoparathyroidism?

9. Hyperparathyroidism?

10. Name the 3 hormones that primarily control calcium and phosphorus levels.

11. What is the primary symptom of hypocalcemia?

12. What organ produces calcitonin? Does calcitonin increase or decrease serum calcium and phosphorus levels? By what mechanisms?

13. What stimulates release of calcitonin?

14. How does determination of PTH aid in determining what disorder is causing hypercalcemia?

15. Name the reagent most frequently used in calcium determinations. How is interference by magnesium eliminated?

16. Can a specimen for calcium be collected in a lavender-top tube? Why or why not?

17. Why should serum for calcium determinations be separated promptly?

18. Name the primary reagent used in phosphorus determinations. How does “alkaline tide” affect serum phosphorus?
19. Are higher levels of phosphorus found intracellularly or extracellularly? Magnesium?
20. How does a low serum magnesium level affect PTH levels?
21. Relate pregnancy and menopause to bone resorption.
22. Name the 2 major organs targeted by PTH and its 3 major effects. What is the main determinant of PTH secretion?
23. State 3 factors that greatly influence bone mass particularly in women.
24. Define bone remodeling. How does this affect older adults? What hormones are involved?
25. What is another name for osteomalacia? What is the primary deficiency? Describe the mechanism that produces this condition.
26. Differentiate among vitamin-D dependent osteomalacia types 1 and 2 and vitamin-D resistant osteomalacia.
27. What abnormal laboratory result can be found in a patient receiving long-term TPN?
28. What 2 aspects of Fanconi’s syndrome affect bone formation?
29. What is the lab test performed on serum that is most noticeably elevated in Paget’s disease? Test performed on urine? What happens in Paget’s disease?

**Enzymes**

1. List the factors that affect enzyme levels in blood.
2. State the physiological actions of the transaminases, creatine kinase, lactate dehydrogenase, the phosphatases, amylase, lipase, and trypsin.
3. List the isoenzymes methods of analysis, and compare mass assay to electrophoresis.
4. List five additional important enzymes and state their clinical significance.
5. List the major enzymes, their predominant source tissue, and diseases that increase or decrease them. Make a match game to help yourself.
6. Define enzyme activity. In an enzyme reaction what is actually measured? What is stereoisomeric specificity?
7. Define isoenzyme. How do isoenzymes differ from each other?
9. LD3? LD4? LD5?
10. List all sources of amylase and lipase, and the significance of their elevations.
11. What 2 enzymes are associated with the prostate? Which one can be measured accurately even after a digital exam? Which one can be measured as forensic evidence of rape?
12. How is the stability of acid phosphatase maintained for storage?
13. In what body fluid is acid phosphatase found in highest concentration?
14. What is PAP? When is its measurement useful in relation to prostate cancer?
15. List the major sources of alkaline phosphatase and lactate dehydrogenase.
16. Acid phosphatase (ACP) once was widely used to detect and monitor carcinoma of the prostate. What has replaced this test?

**Cardiovascular Disease**

1. Define coronary artery disease, ischemia, and myocardial infarction.
2. State the events that lead to an acute myocardial infarction.
3. List the cardiac markers and their order of appearance after a myocardial infarction.
4. State the methods used to measure cardiac markers.
5. A patient experiencing a crush injury is suspected of having an MI. How will this affect the enzyme tests used to diagnose the MI?
6. What are the 2 primary isoforms of ALP? What is their significance and the significance of Regan and Nagao isoenzymes?
7. Currently what is the primary methodology used for measuring CK-MB.
8. What substance supplies the energy for muscle contraction? How can this substance be stored for times of increased need?
9. What is the function of myoglobin in muscle tissue? Why can myoglobin be used as a marker for myocardial infarction?
10. Following AMI what physical factor determines the rate at which cardiac enzymes are released into the blood? What is the order for AST, LD and CK?
11. Name 3 cardiac drugs that the lab monitors serum levels in persons taking them.
12. What is the major disadvantage of myoglobin as a marker for AMI?
13. Which CK isoenzyme is used as an early marker for AMI? Can the diagnosis be made from a single test? Why or why not?
14. Why will utilization of troponin T or I probably replace the above isoenzyme for the detection of AMI?
15. Does normal serum contain more LD1 or LD2? What is the significance of a “flipped pattern”? What cells contain increased amounts of LD1 and LD2? What LD isoenzyme is associated with hemolysis and megaloblastic anemia?
16. In the most commonly used method for CK measurement, what are the 3 sequential enzyme steps? What is the final end product used in quantitating the amount of CK present?
17. What is the advantage of using mass assays for the measurement of CK-MB? What is the purpose of having an adenylate kinase inhibitor in CK assays?
18. What 2 substances does LD convert? How should samples for LD analysis be stored?

Lipids, Lipoproteins, and Apolipoproteins
1. Define Lipid. List five substances categorized as lipids.
2. Discuss the metabolism of cholesterol and triglyceride and state the healthy reference interval of each.
3. State the significance of the apolipoproteins in health and disease.
4. Compare and contrast the five lipoprotein classes.
5. List the hyperlipoproteinemias.
6. List the hypolipoproteinemias.
7. State the basic assay procedures for serum cholesterol and triglyceride and the specimen requirements.
8. State the procedures available to determine HDL and LDL concentration in blood.
9. State the Friedewald calculation for low-density lipoprotein.
10. Define lipoprotein.
11. Define apolipoprotein. Which apolipoproteins are associated with LDL and heart disease? Which are associated with HDL and heart health?
12. Which lipoprotein is considered a positive factor for CAD?
13. How does this lipoprotein physiologically help to eliminate cholesterol? What is the mechanism?
14. What is the major function of chylomicrons?
15. Which lipoprotein contains the highest percentage of lipids?
16. List and differentiate the four major classifications of hyperlipoproteinemias.
17. Lipids are substances that are _________ in water but _________ in organic solvents.
18. What substances make up the class of neutral fats? How did they get this designation?
19. What is the best known steroid?
20. What is the physiological function of cholesterol in the human body?
22. What is the common characteristic of all fatty acids?
23. How do bile acids aid in digestion?
24. What is the basis of all methods for quantitating triglycerides?
25. How does increasing or decreasing the chain length affect the melting point of fatty acids?
26. How does increasing the number of saturated bonds affect the melting point of fatty acids?
27. Briefly describe the physical, chemical, and physiological properties of chylomicrons, HDL, LDL, VLDL, and IDL.

28. Which plasma lipid is typically measured as a marker of increased risk for coronary heart disease?

29. Which plasma lipid would be most likely to be adversely affected by a patient failing to fast for his/her lipid analysis? Why?

30. List three essential functions of cholesterol.

31. List the percentages of protein for each of the major classifications of lipoproteins.

32. Which classification of lipoprotein is responsible for the visible lipemia (milkiness) seen in specimens collected for analysis?

33. What effect does physical activity have on total serum cholesterol and serum LDL levels?

34. Briefly outline the treatment plan for hyperbetalipoproteinemia.

35. How often should patients on lipid-lowering drug therapy be monitored by laboratory analysis of their lipids?

36. What 3 major lipids are used to determine fetal maturity?

37. What is the causative agent for the nerve disorder, Gaucher’s disease?

38. What is the major physiological role of lecithins in the human body?

39. How are lecithins differentiated from other phospholipids and lipids?

40. Which steroid is found only in animal tissues and never in plants?

**Therapeutic Drug Monitoring**

1. Define the following terms: therapeutic index, peak and trough drug concentration.

2. List the five factors that affect the pharmacokinetics of drugs.

3. State the rationale for monitoring of therapeutic drug concentrations.

4. List the methods of analysis available for the assessment of therapeutic drug concentration.

5. List 5 antiepileptic drugs.

6. List 5 cardioactive drugs.

7. List 5 antidepressant drugs.

8. State the clinical use of lithium.

9. State the clinical use of anti-neoplastic drugs, immunosuppressant drugs, and antibiotics.

10. Name some of the clinical settings requiring therapeutic drug monitoring.

11. Name some of the drugs for which analyses should be available in the Stat. Laboratory when drug overdose is suspected.

12. Name 3 major causes of unexpected serum drug concentrations outside of the therapeutic range.


14. Name 2 drugs that have a narrow therapeutic index.

15. What is a peak? What is a trough? How many doses must pass before collecting them?

16. What is a half-life of a drug? How do you calculate the drug concentration using the half life?

17. What is the active metabolite of procainamide? Of theophylline? How is toxicity prevented in medications that have active metabolites?

18. Define TPN, body mass.

19. List the essential nutrients required for metabolism.

20. List the chemical components of body mass.

21. List the most common symptoms observed with kwashiorkor.

22. List the seven basic classes of nutrients as defined by the World Health Organization (WHO).

23. What is the purpose of parenteral nutrition (TPN)? How are they administered?

24. How does alcoholic liver disease affect protein, carbohydrate, and lipid metabolism?
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Optical
1. Define luminescence, fluorescence, fluorescence polarization, nephelometry, and turbidimetry.
2. State the principle of fluorometry and the factors that interfere with fluorescence measurements.
3. List the components of a basic fluorometer.
4. State the principle of nephelometry and the principle of turbidimetry and the factors that interfere with light-scattering measurements.
5. Compare turbidimetry to nephelometry.

Electrophoresis
1. Define the process of electrophoresis.
2. State the uses of electrophoretic procedures in a laboratory.
3. State the purposes of buffers and stains.
4. Discuss separation, detection and quantification.
5. List 5 different types of electrophoresis.
6. Define blotting.
7. Name 3 properties that determine the mobility of a particle.
8. Explain how proteins are amphoteric substances.
9. Name 3 types of continuous support mediums.
10. Discuss the advantages of agarose.
11. Define the Western blot technique.
12. What is the major virtue of the Western blot?
13. Match these commonly used stains with the proper substance:
   a. Coomassie Blue
   b. Paragon Violet
   c. Ponceau
   d. paranitrophenol
14. Describe the characteristics of a “densitometer”
15. Discuss these two commonly encountered problems in electrophoresis:
   a. no migration
   b. sample precipitates in support
16. What is the support medium used in hemoglobin electrophoresis?
17. What is the order of Hemoglobin variants in electrophoresis at basic pH?
18. What is the order to Hemoglobin variants in acid pH?
19. What is the modification to Hemoglobin A that results in Hemoglobin S or Hemoglobin C?
20. What is the common pH for SPE?
21. Which pole is the positive, the anode or the cathode?
22. Define endo-osmosis.
23. What are the 5 major categories of serum proteins separated by electrophoresis?
24. Where will fibrinogen fall on SPE?
25. Where will hemoglobin fall on SPE? How is this prevented?
26. How are serum proteins prevented from interfering with Hemoglobin electrophoresis?

Nucleic Acid Techniques
1. Describe a DNA molecule and compare its structure with that of an RNA molecule.
2. List the purines and pyrimidines and differentiate them.
3. Define the following terms: nucleotide, base pair, nuclease, polymerase, ligase.
4. List the steps involved in DNA replication, transcription, and translation.
5. Describe nucleic acid hybridization.
6. State the principles of three amplification methods used for nucleic acid analysis.
7. Describe how restriction enzyme digestion produces reproducible nucleic acid fragment lengths and provide an example of methods that use this technique.

8. Enzymes hydrolyze the phosphodiester bonds that connect bases within a nucleic acid strand.

9. Name the three steps in the cycle of a PCR reaction.

10. To perform amplification, one places the sample DNA in a tube along with two primers, dNTPs, buffer, __________ ion, and a thermostable DNA __________.

11. The most commonly used polymerase is isolated from the thermophilic organism ________.

12. As the ________ changes are repeated, the DNA between the two primers is synthesized.

13. In a typical experiment 30 cycles of amplification will produce enough specific DNA to be visualized on a __________-stained gel.

14. What is TMA? What enzymes are used?

15. How is it possible to PCR from an RNA virus?

16. Describe RT-PCR.

17. How is contamination limited in the Molecular Biology lab? List three means used.

18. Describe RFLP analysis.

19. What is an STR? Name a common use for STR testing.

20. Describe how a DNA probe binds its target.

21. What is LCR? Draw how LCR is different from PCR.

22. Distinguish between Western, Northern, and Southern blots.

23. List four genetic disorders that result from a single nucleotide change.

24. What is multiplex PCR? What genetic defect is tested using it?

25. Name some of the clinical applications of nucleic acid probe technology.

26. For prenatal diagnosis, name two methods of obtaining DNA from the fetus.

**Amino Acids**

1. Diagram the basic chemical structure of an amino acid.

2. Explain the formation of a peptide from acids.

3. State the primary source of amino acids.

4. State the metabolic cycle of amino acids.

5. Define aminoaciduria.

6. Describe the symptoms and deficient enzymes in phenylketonuria.

7. State the principle of the Guthrie test.

8. List the clinical laboratory procedures used to assess amino acids concentration.

9. Protein and give several examples.

10. Draw a peptide band.

**Proteins**

1. Define protein, globulin, immunoglobulin, acute phase reaction.

2. State and describe the four stages of protein structure.

3. List the principal plasma proteins.

4. List the immunoglobulin classes.

5. State the clinical laboratory analytical methods for determination of protein concentrations.

6. Define primary structure.

7. Define quaternary structure.

8. Describe the liver disease associated with alpha1-antitrypsin.

9. Name the dominant serum protein in early embryonic life.

10. Name the dominant serum protein in adult life.

11. List two methods to detect serum albumin, and determine which is used on automated instruments.

12. Name the disease associated with an elevated ceruloplasmin.
13. What is the significance of an elevated CRP? How is this different from hs-CRP?
14. Name the most sensitive laboratory indicator of hemolysis.
15. What disorder is associated with Bence-Jones protein?
16. What peculiar characteristic does BJ protein have?
17. Describe multiple myeloma; how is it diagnosed?
18. What is Waldenstrohm’s macroglobulinemia?

**Tumor Markers**
1. Define the following terms: cancer, tumor marker.
2. List and discuss the stages of cancer.
3. State the clinical application of tumor marker analysis.
4. Discuss the clinical relevance of PSA and its use in the detection of prostate cancer.
5. List the hormones and enzymes that are considered tumor markers.
6. List at least two oncofetal antigens that are considered tumor markers.
7. List the carbohydrate markers that are considered tumor markers.
8. Compare and contrast oncogenes and tumor-suppressor genes.
10. What is the second most common neoplasia in both women and men?
11. Name the best screening test for each of the following:
   a. breast cancer
   b. cervical cancer
   c. colon cancer
   d. rectal cancer
12. What are the characteristics of an ideal tumor marker?
13. What is the tumor marker for testicular carcinoma?
14. What is the tumor marker for colorectal cancer?
15. What is the most common method of analysis in use?
16. Two enzymes useful in cancer detection are acid phosphatase and PSA, a glycoprotein protease. Compare and contrast these enzymes.
18. Discuss the significance of positive receptors assays in relation to breast cancer.

**Trace Elements**
1. Define trace element.
2. List the characteristics of trace elements.
3. List seven physiologically essential trace elements and state the clinical significance of each.
4. State the basic functions of the seven essential trace elements.
5. List the analytical methods available for the assessment of trace elements.
6. List the specimen collection requirements for trace elements.

**Clinical Toxicology**
1. Define toxicology, toxin.
2. State the physiological factors that affect the toxicity of a substance.
3. List two analgesics that are toxic in overdose form.
4. List three alcohols that are toxic in overdose form.
5. Describe the manifestations of barbiturate, carbon monoxide, cyanide and ethylene glycol intoxication.
6. What is the NIDA 5?
7. What is adulteration? List 3 methods that can be used.
8. What is the specimen of choice for drugs of abuse testing?
9. What other samples may be tested? List the toxic effects of amphetamine, cannabinoid, cocaine, opiates, and phencyclidine.
10. List the toxic effects of overexposure to five metals.
11. State the methods of analysis for the toxic drugs.
13. Define toxic effect.
14. Which toxicant is more likely to penetrate the skin......those that are water soluble or those that are lipid soluble?
15. What is the molecular mechanism of toxicity of cyanide and carbon monoxide?
16. Name the most common drugs used as agents in suicide.
17. What is the most common toxic effect of acetaminophen?
18. What is the most common toxic effect of tricyclic antidepressants?
19. What is the toxic syndrome common in organophosphate insecticides and some mushrooms? What analyte can be tested to determine this?
20. What is the drug interaction between cimetidine and theophylline?
21. What is the spot test and reaction used in acetaminophen and salicylate suspected overdose?
22. What are the disadvantages of spot tests?
23. Name the 6 or 7 different classes of drugs analyzed in a limited drug screen.
24. Name the most frequently used method of analysis for drugs of abuse.
25. Name the most frequently used blood or urine test for lead analysis.
26. How do opiates and barbiturates affect respiration?
27. What is the legal limit for blood alcohol in Florida?
28. What is the sample preparation for a blood alcohol?
29. Why is ethanol infused in methanol poisoning?
30. What method can be used in small labs to rapidly determine the presence of an alcohol?

Principles of Immunochemical Techniques
1. Define the following terms: hapten, immunogen, monoclonal, polyclonal.
2. Describe gel diffusion, immunoelectrophoresis.
3. Define immunoassay.
4. List the labels used in nonisotopic immunoassays.
5. Compare competitive with noncompetitive immunoassays.
6. Describe enzyme immunoassay, enzyme-linked immunosorbent assay.
7. Define fluoroimmunoassay and fluorescence polarization immunoassay.
8. State the principle of immunocytochemistry.
9. How is a monoclonal antibody formed?
10. Immunoelectrophoresis is a two-stage procedure. Name the two stages.
11. In immunoelectrophoresis, three high-quality reagents are needed. Name them.
12. What is the most popular fluorochrome used?
13. What are the properties of a fluorochrome? In what state is light absorbed and emitted?
14. Fluoroimmunoassays require a _____________to obtain accurate readings.
15. Chemiluminescent assays require a _____________to obtain accurate readings.
16. Name several reasons indicator-labeled immunoassays have gained popularity.
17. Quantitative indicator-labeled immunoassays are used for which analytes?
18. What is an immunometric or sandwich assay?
**Principles of Competitive Binding Assays**

1. Nearly all competitive binding methods use ______ as the binding protein for small molecules.
2. What type of antibodies are these?
3. What is a hapten?
4. What are heterogeneous assays?
5. What are homogeneous assays?
6. Name several techniques used to separate protein-bound from free-labeled ligand.
7. Name several principles of separation and the method of separation.
8. Name the enzymes used as labels in immunoassay.
9. Give two examples of common competitive binding assay.
10. Define an immunometric assay.
11. What are some of the advantages and disadvantages of ELISA? Describe EMIT, CEDIA and FIA.
12. Explain the steps involved in Immunofixation.

**Hormones**

1. Define the following terms: steroid hormone, peptide hormone, amino acid-derived hormone, hormone receptor.
2. List the three physiological functions of hormones and discuss the mechanisms involved in the regulation of hormone secretion.
3. List the significance of free and bound hormone.
4. State the two types of receptor-hormone interaction and the specific effect each type produces in a cell.
5. List the hormones synthesized in the hypothalamus and anterior pituitary gland.
6. List the hormones stored in the posterior pituitary gland.
7. List six major causes of endocrine disorders.
8. Discuss three analytical techniques used to measure hormones in body fluids.
9. The chemical nature of hormones divides them into two broad classes. Name them.
10. All hormones act on their respective target glands and tissues through specific binding proteins called ________.
11. What are the target organs for androgens and estrogen?
12. Peptide hormones interact with receptors located on the target cell ________.
13. Steroid hormones interact with receptors located ________.
14. What effect does negative-feedback normally have on the hypothalamic-pituitary secretion.
15. Explain the pulsatile and circadian release of pituitary hormones.

**Pituitary Disorders**

1. State the structure and function of the pituitary gland.
2. List the hormones synthesized by the anterior pituitary and those stored in the posterior pituitary gland.
3. State the peripheral effects of normal hormone release for each pituitary hormone.
4. State the peripheral effects of increased and decreased hormone release for each pituitary hormone.
5. Define pituitary adenoma and describe its effect on hormonal activity.
6. List the laboratory tests used to assess pituitary function.
7. Name the two peptide hormones synthesized by the neurosecretory cells of the hypothalamus and stored in the neurohypophysis (posterior lobe of the pituitary).
8. Name the pathologic condition that occurs with diabetes insipidus.
9. Name the pathologic condition that occurs with acromegaly, and the provocative test to diagnose it.
10. Pituitary adenomas are more likely to cause an (excess or reduction) in a particular pituitary hormone?
11. A prolactin secreting pituitary adenoma manifests itself by causing ____________.
12. Describe the actions of arginine vasopressin.
13. Name several conditions that can cause inappropriate release or hypersecretion of AVP.
14. What happens to the sodium level in SIADH (syndrome of inappropriate secretion of ADH) and what are some of the clinical manifestations.
15. Pituitary adenomas hypersecreting ACTH lead to a condition known as ____________.
16. Name the test useful in the diagnosis of a tumor secreting ACTH.
17. What would be the test results in a non-pituitary tumor?
18. Since growth hormone is secreted in a pulsatile fashion, explain the use of an insulin challenge test or L-dopa challenge test.

**Catecholamines and Serotonin**

1. List the hormones synthesized by the adrenal medulla, as well as the physiological actions.
2. Define pheochromocytoma and the laboratory results obtained in the assessment of the disease.
3. Summarize the metabolic pathway of the catecholamines and state the clinical significance of the metabolites.
4. Discuss the clinical significance of serotonin and its metabolite; state the method of analysis.
5. List the serotonin metabolites. What diet restrictions apply?

**Thyroid**

1. List the hormones synthesized in the thyroid gland.
2. Describe the regulation of thyroid hormones using the terms primary, secondary and tertiary.
3. State the effects of increased and decreased concentrations of thyroid hormones on TSH levels.
4. List the laboratory tests used to assess thyroid gland function.
5. State the laboratory values associated with Hashimoto’s disease, Graves’ disease.
6. What is the function of TSH?
7. What is the function of TRH?
8. What effect does a pregnancy and Oral contraceptive pill have on TBG (thyroxine binding globulin)? How does this influence total T4 and T Uptake?
9. What effect does androgens, malnutrition and liver disease have on TBG?
10. How much T4 and T3 circulate in the bound form?
11. What is the active form of thyroid hormone in the serum?
12. Define the defect in primary hypothyroidism.
13. Define the defect in secondary hypothyroidism.
14. What level of TSH would be diagnostic of this disorder?
15. Define the defect in tertiary hypothyroidism.
16. Increased levels of thyroid hormone in blood result in what type of feedback to the pituitary?
17. How does malnutrition affect thyroid function?
18. Serum autoantibodies that bind to TSH receptors in the thyroid cell and stimulate the production and release of thyroid hormone are known as ____________.
19. What is Graves’ disease? What are the laboratory findings?
20. Name two different causes of thyroiditis.
21. Describe the pathologic defect in Hashimoto’s disease that is reflected clinically by the presence of an enlarged thyroid gland, hypofunction, and the presence in serum of antithyroid antibodies.
22. What are the antithyroid antibodies in Hashimotos’ disease called? Which antibody is most consistently found in Hashimoto’s disease?
23. What is the treatment of Hashimotos’ thyroiditis?
24. What types of conditions cause a goiter?
25. What is the most common risk factor for thyroid cancer?
26. What are two cell types that give rise to thyroid cancer?
27. What is the most frequently used therapy to treat hyperthyroidism?
28. What is the usual clinical course of this treatment?
29. A basal serum TSH level of less than 0.05 uU/mL indicates with virtual certainty that primary ________ exists.

30. Name 3 thyroid hormone transport proteins.

**Adrenocortical Function**

1. Describe the structure and function of the adrenal cortex.
2. Diagram the biosynthesis of adrenocortical hormones from cholesterol.
3. List the hormones synthesized by each specific zone of the adrenal cortex, and state their functions.
4. Describe the following adrenal disorders, Addison’s, Conn’s, Cushing’s, CAH.
5. List the laboratory tests used to assess adrenocortical function.
6. Explain the diurnal variation of cortisol levels.
7. Describe aldosteronism.
8. What is the function of renin?

**Reproductive Disorders**

1. Define the following terms: corpus luteum, Leydig cell, Sertoli cell.
2. Describe the structure of the female and male reproductive tracts.
3. List the hormones synthesized by the female and male reproductive tracts.
4. State the effects of increased and decreased GnRH, LH, and FSH release.
5. Diagram the female reproductive cycle.
6. List the laboratory tests used to assess reproductive function.
7. In the adult, testosterone is secreted by which cell type?
8. The ovaries actively synthesize and secrete two forms of estrogen. Name them.
9. The hypothalamus synthesizes gonadotropin releasing hormone (GnRH) and secretes it in pulses every 2 minutes. This stimulates the anterior pituitary to secrete two hormones. Name them.
10. The most biologically active ovarian estrogen is ________.
11. Progesterone is produced in large amounts during the ________ phase of the menstrual cycle.
12. A cause of primary ovarian hypofunction is ________ syndrome.
13. A cause of primary male hypogonadism is ________ syndrome.
14. A loss of pituitary hormones resulting in decreased thyroid, adrenal, and gonadal function is known as ________.
15. Primary dysmenorrhea is caused by myometrial contractions induced by ________.
16. What are 3 clinical laboratory tests available to evaluate hirsutism?
17. What two hormones are elevated in menopause? Is this primary or secondary ovarian failure?
18. What two hormones are elevated in Turner syndrome?

**Disorders of Pregnancy**

1. Define the following terms: preeclampsia, eclampsia, ectopic pregnancy, zygote, trophoblast, and embryo.
2. List the protein and steroid hormones produced by the placenta and state their functions.
3. Describe the function and composition of amniotic fluid.
4. State the clinical significance of chorionic gonadotropin, alpha-fetoprotein, and unconjugated estriol analyses in the assessment of maternal and fetal health.
5. List the methods of analysis in the assessment of fetal lung maturity.
6. Name the two fetal organs that assume the major role in the formation of amniotic fluid.
7. Another protein in amniotic fluid occurs with central neural tube defects and is known as _____.
8. Name the hormone found in the urine and serum of pregnant women which provides the basis of tests for the diagnosis of pregnancy.
9. Human chorionic gonadotropin is one of a family of closely related glycoprotein hormones that regulates
Clinical Laboratory Sciences Program

reproductive and metabolic functions. Name the other glycoproteins with alpha chains.
10. What is the “estrogen of pregnancy”? 
11. What is the fetoplacental unit and what is its function? 
12. Which organ synthesizes increased amounts of thyroxin-binding globulin (TBG)? 
13. Which hormone is responsible for this increase? 
14. T4 and T3 are also increased during pregnancy yet the mother remains euthyroid. These elevated levels are the result of an increased number of _______ _______. 
15. Which maternal antibody component is transferred to the fetus? 
16. Does fibrinogen increase or decrease during pregnancy. 
17. Does alkaline phosphatase increase or decrease during pregnancy? Why? 
18. A hydatidiform mole would be suspected when there is a high level of which hormone? 
19. Define kernicterus and give the clinical manifestations. 
20. What is the primary reason for glycosuria in pregnancy? 
21. Name the test to screen for gestational diabetes. 
22. Maternal hyperglycemia results in fetal hyperinsulinemia which after delivery may result in _____ glycermia in the newborn. 
23. Give 3 clinical manifestations of toxemia of pregnancy. 
24. Discuss the laboratory means of monitoring the toxemic pregnancy. 
25. High maternal serum alpha fetoprotein levels suggest what defect? 
26. Low maternal serum alpha fetoprotein levels suggest what defect? 
27. What other laboratory findings suggest Down’s syndrome? 
28. Surfactant is released by the pneumocytes beginning at about _____ weeks gestation. 
29. The absence of surfactant results in fetal lung immaturity known as _______ _______ _______. 
30. How does the lecithin-to-sphingomyelin ratio (LSR) correlate with lung maturity? 
31. Name another test for phospholipid which is a popular adjunct to LSR. 
32. Low or declining estriol levels carry an unfavorable prognostic significance. Name several conditions associated with chronically low serum estriol. 
33. Discuss the laboratory tests necessary for the diagnosis of ectopic pregnancy. 
34. Discuss the laboratory test used after amniocentesis to determine the severity of hemolytic disease in the fetus. 
35. What is a triple screen? Describe how the parameters are altered in Down syndrome and NTD. 
36. List 3 types of gestational trophoblastic disease. 
37. What is the purpose of the Liley Graph? 
38. What is a lamellar body? 
39. What unit is MS-AFP reported in? 
40. When is the appropriate time to do a triple screen (weeks in the pregnancy). 
41. Name two preanalytic conditions that may influence the results of the triple screen. 
42. During amniocentesis for NTD, two analytes can be assayed. Name them. 
43. Trisomy occurs because of a failure during _______________. 
44. When does hCG reach its peak during a pregnancy? 
45. How frequently does the hCG level double during early pregnancy? 

Newborn Screening

1. Define the following terms: inherited disease, inborn error of metabolism. 
2. Define the three types of genetic disorders. 
3. List five inherited diseases and the gene mutation involved in each. 
4. State the laboratory procedures utilized to assess inherited disease. 
5. True or False. One gene equals one polypeptide chain. 
6. What is meant by autosomal dominant? Recessive? Sex linked?
7. Which chromosome is primarily associated with Down’s syndrome? Differentiate between monosomy and trisomy. Name a disorder associated with each.
8. What is the significance of a Barr body? How sexual constitution is determined using a buccal smear?
10. What is the role of genetics in lysosomal storage diseases?
11. Which disease is caused by a deficiency of hexoaminidase A?
12. Name 2 substances excreted in the urine by persons with Hurlers syndrome.
13. Name a major aminoaciduria, organic aciduria, disorder of carbohydrate metabolism, disorder associated with transfer defects, mineral metabolism, receptor defects and purine metabolism.
14. What is the significance of an elevated level of alpha fetoprotein?
15. What organs are primarily affected by decreased alpha₁ antitrypsin levels?
16. What is genomic imprinting?
17. List the 5 congenital conditions that are tested for by the State of Florida.
Section 2
Hematology Rotation
Qualitative Student Competency Checklist: This form should be completed by the student to evaluate their performance early in the rotation.

Technical Competencies Checklist: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. The student should rate their ability to perform accurate and reliable testing in a timely manner in the areas listed on the Hematology internship checklist. The student’s time during each rotation will be spent observing and performing various procedures and reviewing theory and test principles. Performing tests in duplicate or performing tests under the direct supervision of the clinical instructor is encouraged. The checklists are provided as a guideline to ensure that routine procedures have been observed and performed. As a particular skill is performed, the student should indicate whether there was satisfactory or unsatisfactory performance. Otherwise, indicate whether the skill was only observed or discussed, or if it was not available (NA).

Quantitative Final Evaluation: This evaluation consists of 4 parts; rotation specific psychomotor skills, overall knowledge and skills, the student’s professional behavior, and summary comments. Please complete these forms by the last day of the student's rotation. The affiliate supervisor should review these forms with the student. The student and evaluator will sign the forms and return them to the Santa Fe College Internship Coordinator.

Part 1 Psychomotor Evaluation: This form is to be utilized by the clinical instructor to evaluate the student’s technical skills specific to the rotation.

Part 2 Evaluation of Knowledge & Skills: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. Please rate the student’s overall ability to perform accurate and reliable testing in a timely manner.

Part 3 Evaluation of Professional Behaviors: This form is to be utilized by the clinical instructor to evaluate the student’s professional behaviors.
- Please be honest in rating each of the professional characteristics of the student.
- Base your judgment on behavior which you feel is characteristic of the student during the period of evaluation
- Please comment on any rating in the Needs Improvement of Unsatisfactory category.

Part 4 Summary Comments: In this section please feel free to write a brief overview of the student’s performance. Any problems that you encountered with the student, as well as praise, should be noted here. This is very helpful to students so they will learn their strengths and weaknesses.

NOTE: If any problems or conflicts arise while the student is in your department, please bring them to the attention of the SF liaison as soon as possible so it can be resolved.

Forms are located in the appendix (printable versions).
COURSE NUMBER: MLS 4822L

TITLE: Hematology Internship

CREDIT: 4 credits

TEXT: Board of Registry Study Guide: Clinical Laboratory Certification Examinations

INSTRUCTOR: Myra Urso, Med, BSMT (ASCPCM), myra.urso@sfcollege.edu
Work phone: (352) 381-3750

COURSE DESCRIPTION: The student will attend a clinical internship in a well-equipped and properly staffed laboratory for technical experience in hematology.

Note: This course may begin and/or end after the official published semester dates in order to accommodate scheduling availability at our clinical affiliates.

COURSE OBJECTIVES: By the end of the clinical internship, the CLS student should be able to complete or explain all of the following objectives with 70% accuracy.

1. Apply theoretical knowledge to hematology laboratory procedures.
2. Perform an automated complete blood count with differential.
3. Perform differentials to include normal as well as abnormal specimens.
4. Evaluate red blood cell morphology and grade according to lab policy.
5. Perform a manual platelet count using either bright field microscopy or phase contrast microscopy.
6. Perform a manual WBC count to correlate with the automated analyzer’s result.
7. Perform a CSF cell count and differential to correlate with the instructor’s results.
8. Perform body fluid analyses to correlate with the instructor’s results.
10. Perform a fibrinogen test using an automated analyzer.
11. Perform a FDP latex agglutination test by diluting the specimen 1:2 and 1:8.
12. Perform a D-dimer latex agglutination test by diluting the specimen 1:2.
13. Perform a platelet estimate to correlate with the automated analyzes print-out.
14. Perform an ESR within 1 hour.
15. Perform a retic count by staining the RBCs with new methylene blue and then using a Miller’s disk.
16. Perform sickle cell screening procedures using both an AA and an AS control.
17. Perform a spun hematocrit to correlate with the automated analyzes result.
18. Observe a bone marrow.
19. Display initiative by performing routine assigned tasks.
20. Apply technical knowledge while performing basic laboratory procedures.
21. Display responsibility for one’s actions while at the clinical affiliate.
22. Accept constructive criticism to improve developing work habits.
23. Self-evaluate the interpersonal relationships with co-workers and other healthcare staff.
24. Follow standard operating procedure manual and admit to errors or mistakes when they occur.
25. Organize the workload, prioritizing STATs and reducing turn-around-times.
26. Display dependability by arriving to clinical at designated times and days.
27. Adapt to different teaching styles and workload without complaining.
28. Display confidence in one’s technical ability while at the same time, recognize one’s limitations.

METHOD OF TEACHING:
Laboratory Bench Instruction
Demonstration
Role modeling

EVALUATION METHOD:
Students will be evaluated in four areas:
1. Technical competency achieved by the end of the clinical internship in a specified laboratory procedure evaluated by the clinical instructor.
2. Professionalism demonstrated during the clinical internship evaluated by the clinical instructor(s).
3. Theoretical knowledge demonstrated by a written examination on the last day of the clinical internship given by the College.
4. Weekly discussion board posts documenting what you have learned at the clinical affiliate.

TECHNICAL COMPETENCY:
Your technical competency will be assessed at the end of your clinical rotation by the clinical faculty. This psychomotor evaluation is worth 30% of your total grade in this course. It is your responsibility to know what tasks are on the checklist and to ask your clinical instructor(s) to initial it on a weekly basis as the assigned tasks are completed. Completion of the checklist is scored as either 100% or 0%.

PROFESSIONALISM:
Your professionalism will be assessed at the end of your clinical rotation by the clinical faculty. This affective evaluation is worth 30% of your total grade in the course. Remember that from the first day of your clinical internship, you are being evaluated for potential employment opportunities. Take advantage of this opportunity and ask your clinical instructors if they would be willing to be one of your references when you start applying for open positions.

WRITTEN EXAMINATION:
There is one multiple choice question examination at the end of clinical rotation. This cognitive evaluation is worth 30% of your total grade in this course. A self-paced study guide is provided to assist you with your preparation for the examination. Material included on the examination will be taken directly from the study questions focusing on theory, methodology, and clinical significance of each chemistry analyte.

DISCUSSION BOARD:
The weekly discussion board posts are due every Friday by 5:00 p.m. The discussion board should include what instrument you trained on, what profiles were performed, what analytes were measured, the principles of the analytes, any critical results that were phoned, and any interesting patient results that you encountered. In addition, you are required to answer all of the instructor’s questions on the discussion board by Sunday evening at 12:00 midnight for full credit.
Clinical Laboratory Sciences Program

**GRADES:**

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**CALCULATION OF GRADE**

Technical Competency 30%
Professionalism 30%
Written examination 30%
Weekly blog 10%
Total 100%

The MLS student must pass this course with a “C” or better in order to continue in the MLS Program. There are no excused absences from the clinicals. The student must notify the clinical instructor if he/she is going to be late or absent before the time he/she is scheduled to be at the clinical facility. Make-up time is at the discretion of the clinical instructor.

**Americans with Disabilities Act (ADA) Student Rights**

If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations.

**Discrimination/Harassment Policy Statement**

Santa Fe College prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to the SFC Human Resources Policies website.

**College Academic Integrity Statement**

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.
Hematology Psychomotor Objectives

*By the end of the hematology internship, the student should be able to:

- Perform automated analyzer startup with the assistance of the instructor.
- Perform daily quality control and determine if the QC results are acceptable or unacceptable. If the results are unacceptable, propose corrective action.
- Given patient samples, perform automated cell counts and use the laboratory criteria to determine whether the results can be verified or whether the automated CBC/DIFF results must be reviewed using the peripheral blood smear.
- Perform slide scans to verify the accuracy of the automated CBC/DIFF results.
- Given a flagged WBC count, perform a WBC estimate to verify the accuracy of the automated WBC count. If interfering substances are present, suggest corrective action.
- Evaluate RBC morphology and quantitate it according to the SOP so that it correlates within 20% of the instructor’s RBC morphological findings.
- Given a flagged platelet count, perform a platelet estimate to correlate with the instructor’s platelet estimate.
- Perform manual differential counts to correlate with the instructor’s differential results.
- Review the laboratory’s criteria for ordering a manual platelet count and slides reviewed by the pathologist(s).
- Perform automated and manual reticulocyte counts.
- Observe a bone marrow procedure. Given the bone marrow aspirate, make slides.
- Make peripheral blood smears manually to the satisfaction of the clinical instructor.
- Stain peripheral blood smears by an automated method and back up method.
- Perform a 200 cell bone marrow differential and calculate the M:E ratio.
- Given positive and negative controls, perform sickle cell screening tests.
- Perform erythrocyte sedimentation rates by automated and manual methods.
- Using a hemacytomteter, perform manual body fluid cell counts.
- Perform automated CSF cell counts and differentials.
- Perform body fluid cell counts and differentials.
- Observe flow cytometry analyses.
- Given patient samples, perform automated PT/INR testing.
- Given patient samples, perform APTT testing.
- Given patient samples, perform fibrinogen assays.
- Given patient samples, perform D-dimer testing.
- Perform platelet function analysis.
- Observe PTAPTT mixing study assays.
- Perform factor assays.
Hematology Study Guide for Exam

**Question Set 1**

1. What methodology does the automated cell counter in your affiliates department employ?
2. What parts of the CBC does this counter provide?
3. How many levels of quality control are necessary in order to state that the analyzer is ‘in contro’ and able to be used for routine hematological testing?
4. What is the depth of the Neubauer hemacytometer including the size of the sides, # of large squares, # of small squares, volume of large square and volume of small square.
5. What square do you use for a manual white count?
6. What square do you use for a manual red cell count?
7. What square do you use for a manual platelet count?
8. When doing a blood dilution for loading the chamber, is it necessary to expel a few drops first? Why?
9. How do you calculate the results of a manual count given the # of cells counted?
10. When making a blood smear for manual interpretation, what angle is needed in order to make a readable, usable smear?
11. What are the normal values for RBC, WBC, and Plts used at your affiliate based on age and sex?
12. What are the components of a Wright stain?
13. What are the components of an eosinophil stain?
14. How do you calculate a corrected reticulocyte count?
15. What is the stain used in the reticulocyte staining process?
16. What clinical states would lead to an increased reticulocyte count?
17. What is the principle of the ESR test?
18. What parameters would affect the results of this test?
19. How is HCT calculated?
20. What correlation does the HCT have to the Hmg?
21. What principle is used to measure Hmg in the automated cell counter?
22. What is Hmg A1C? What clinical states would you find it associated?
23. What is the normal shape of an RBC? What determines the shape of the RBC?
24. What is the driving force behind the RBC’s energy potential?
25. Do hypotonic and hypertonic affect the shape of the RBC’s? If so, how?
26. How is heme synthesized?
27. If heme synthesis is blocked, what is the outcome?
28. In a normal hemoglobin molecule, what globin chains and heme molecules are present?
29. What is the composition of normal, adult hemoglobin?
30. What are the normal values and units of measurement for the MCV, MCH, MCHC and RDW of a CBC count? What calculations are used for each?
31. What is the difference between intravascular hemolysis and extravascular hemolysis?
32. What is the normal lifespan of an RBC? What system is responsible for the degradation of aged RBC’s?
33. What is a shift to the left? What is a shift to the right?
34. What is the composition of adult hmg?
35. How is hmg affinity for O2 controlled? What causes a hmg molecule to release O2 into the tissues?
36. How does the composition of methemoglobin differ from normal hmg? Does this affect the way it is delivered into the tissues? How do the compounds differ?
37. What is sulhemoglobin?
38. What is carboxyhemoglobin?

**Question Set 2**

1. What are the parts of the hematopoietic system?
2. Where does it occur in the adult and fetus?
Clinical Laboratory Sciences Program

3. What is the pluripotent stem cell?
4. What is the difference between yellow and red bone marrow?
5. What are the maturation stages of cells from rubriblasts to metarubricyte?
6. What is the size of a mature erythrocyte?
7. What are the common sites for bone marrow aspirations?
8. What is considered a ‘dry tap’ when performing a bone marrow aspirate?
9. What is the average M:E ratio?
10. What is anemia?
11. What two types of anemia would be classified as severe?
12. What anemias are classified as the following? Normocytic/normochromic, microcytic/hypochromic, macrocytic/normochromic.
13. What characteristics of cells would you expect to see following severe, hemorrhagic trauma, renal disease, DIC, liver disease, and cyanosis?
14. What type of anemia would you find in someone with a case of Hepatitis, HIV, CMV, WNV, IDA, or thalassemia, or severe nutritional deficiencies?
15. What is anisocytosis?
16. What is poikilocytosis?
17. What is osmotic fragility?
18. What are burr cells? What conditions contribute to burr cells?
19. What are stictocytes? What conditions contribute to stictocytes?
20. What is a Howell-Jolly body? What conditions contribute to Howell-Jolly bodies?
21. What are basophilic stipplings? What conditions contribute to basophilic stipplings?
22. What are siderocytic granules? What conditions contribute to siderocytic granules?
23. What are Pappenheimer bodies? What conditions contribute to Pappenheimer bodies?
24. What are Heinz bodies? What conditions contribute to Heinz bodies?
25. What is iron deficiency anemia?
26. What are the 3 stages of IDA?
27. What is the relationship of serum iron and TIBC in IDA?
28. What part of heme synthesis is affected by lead poisoning?
29. What heme precursor is used for diagnosing lead poisoning?
30. What is a hypersegmented neutrophil?
31. What is the intrinsic factor?
32. What autoantibody is present in pernicious anemia (PA)?
33. What is the primary cause of folic acid anemia?
34. What is a Shilling’s test? What two parts compose the Shilling’s test?
35. What is pancytopenia?

Question Set 3

1. What is another name for echinocyte?
2. What is the cause of the pancytopenia seen in paroxysmal nocturnal hemoglobinuria?
3. Why is PNH classified as a myeloproliferative syndrome?
4. What is the red cell defect in PNH?
5. Describe the characteristic red cell morphology and reticulocyte count in PNH. Are spherocytes present?
6. How can the pancytopenia of PNH be differentiated from that of aplastic anemia in the peripheral blood? In the bone marrow?
7. What are the common physical effects of PNH?
8. Is hemolytic anemia associated with increased red cell production or destruction?
9. Following red cell hemolysis, list 2 events that must take place prior to the appearance of hemoglobinuria.
10. What is the significance of renal tubular epithelial cells that stain with Prussian blue? In which hemolytic anemia is this of most concern?
11. What is the purpose of a $^{51}$Cr-labeled red cell test?
12. Describe the relationship of haptoglobin to intravascular hemolysis.
13. In addition to hemolytic anemia, what other anemic condition produces an elevated RPI?
14. What is the primary test used to identify an immunohemolytic anemia? How does this relate to the formation of spherocytes?
15. How does poikilocytosis relate to hemolytic anemia?
16. List the 4 main hemolytic anemias caused by membrane defects.
17. What is the primary inheritance pattern for hereditary spherocytosis?
18. Name the 4 protein deficiencies associated with spherocytosis.
19. Which of the red cell indices is most characteristic of hereditary spherocytosis? Why?
   a. Is this found in any other disorders?
20. Describe the principle of the osmotic fragility test.
21. State the normal initial and complete osmotic fragility results.
22. State 2 causes of false positive osmotic fragility tests.
23. Why is a splenectomy often performed on persons with hereditary spherocytosis and hereditary elliptocytosis?
24. What is the primary characteristic of hereditary pyropoikilocytosis? Describe the red cell morphology.
25. Differentiate between the appearance of the RBCs in hereditary stomatocytosis and xerocytosis. What mechanism causes these appearances?
26. Contrast the MCHC and osmotic fragility results seen in hereditary stomatocytosis and xerocytosis.
27. Why are the symptoms of G6PD deficiency usually more pronounced in males than in females?
28. In what populations is G6PD deficiency most prevalent?
29. What is the mechanism by which primaquine and fava beans affect persons with G6PD deficiency?
30. What metabolic pathway is affected by G6PD deficiency?
31. What is the composition of a Heinz body?
32. Why are bite and helmet cells frequently seen in peripheral smears in G6PD? Are Heinz bodies visible on a routine diff?
33. True or False. Heinz bodies are seen in G6PD deficiency and pyruvate kinase deficiency.
34. What metabolic pathway is affected by pyruvate kinase deficiency?
35. A person who consistently exhibits cyanosis may have a deficiency of ______________.
36. Is G6PD deficiency more noticeable in older or younger RBCs? How could this affect test results?
37. Differentiate between a hemoglobinopathy and a thalassemia.
38. Oxygenation or deoxygenation more conducive for sickle cell formation?
39. What is the mechanism by which sickle cells produce infarction?
40. Write the structural formula for sickle cell anemia and sickle cell trait. What does a. “6 glu-val” represent?
41. Name 4 types of red cells and 2 inclusions seen on a differential from a patient with SCA.
42. How is the reticulocyte count affected by SCA?
43. Describe the definitive test for Hb S.
44. Why is it difficult to screen newborns for hemoglobin S?
45. List the order of hemoglobin migration on cellulose acetate at pH 8.4 for hemoglobins, a. S, C, A, A2, F, H and Barts.
46. What is the only benefit for persons with hemoglobin S?
47. How can hemoglobin S be differentiated from hemoglobin D? Hb SS from Hb AS?
48. How does Hemoglobin C differ from Hemoglobin A?
49. Describe the appearance of a cell containing Hgb C crystals. Hgb SC crystals.
50. Describe the clinical symptoms of a person with Hgb C disease.
51. How does the presence of high oxygen-affinity hemoglobins affect a person’s red cell parameters?
52. Define methemoglobinemia. Describe the appearance of the blood and the patient.
53. What is the treatment for persons symptomatic for methemoglobinemia?
54. When should quantitation of Hgb F be performed?
55. Describe the genetics of the beta and alpha thalassemias.
56. What is the only benefit a person with thalassemia receives?
57. Why would the presence of beta thalassemia not be detected at birth?
58. What is the reason for the skeletal abnormalities in persons with thalassemia major?
59. Describe the red cell morphology associated with thalassemia major.
60. Describe the red cell morphology associated with thalassemia minor.
61. What is the composition of hemoglobin H? Hemoglobin Barts? With what disorder are they associated?
62. What is hydrops fetalis syndrome and what is the patient’s prognosis?
63. Supervital staining with brilliant cresyl blue reveals inclusions in the presence of Hgb ___.
64. With what 2 hemoglobin chains is hemoglobin Lepore associated?
65. In thalassemia, how are hemoglobins A2 and F affected?
66. How do the serum iron and TIBC levels differ between iron deficiency anemia and thalassemia? RBC indices?
67. What is the principle and diagnostic significance of the red cell acid elution test?
68. What is the primary complication associated with blood transfusions required in thalassemia major?
69. How do hemoglobins A and F differ when exposed to a strong alkali?
70. Why would a Prussian blue stain be performed on the urine sediment from a patient with PNH?
71. List 3 laboratory tests that are frequently elevated with intravascular hemolysis. Extravascular hemolysis.
72. Define 3 categories of immune hemolytic anemia.
73. What type of immunization is associated with a transfusion reaction?
74. The finding of increased erythroblasts in a newborn is indicative of ________________.
75. Which bilirubin fraction is elevated in WAIHA?
76. What are the three primary specificities of normal cold autoagglutinins?
77. When is a cold agglutinin pathologic?
78. What is the primary immunoglobulin class producing cold agglutinin syndrome?
79. Describe the distinguishing blood smear characteristics associated with CAS.
80. Name 3 disorders associated with CAS.
81. Describe the mechanism of the biphasic hemolysin present in PCH. What is its specificity?
82. What are the results of a positive Donath-Landsteiner test?
83. List the primary drugs producing immune hemolytic anemia, their mechanism and the expected DAT results.
84. What is the purpose of thick and thin smears for the diagnosis of malaria?
85. Describe the appearance of cells containing Plasmodium vivax.
86. List four primary microorganisms associated with hemolytic anemia.
87. Describe the RBC morphology associated with microangiopathic hemolysis. How does this differ from that of march hemoglobinuria?
88. Describe the RBC morphology of red blood cells collected immediately from a patient with extensive burns. The morphology three days later.
89. Why do the characteristic cells in sickle cell anemia have a decreased osmotic fragility?
90. What is the recommended anticoagulant for osmotic fragility testing?
91. What is the principle of the autohemolysis test? Name a hemolytic anemia in which hemolysis is decreased when glucose is present. Increased?
92. How does sucrose enhance hemolysis in PNH? How would the sucrose hemolysis and Ham’s test be affected if not performed on fresh blood?
93. What is the principle of the confirmatory test for PNH? What will be present in the tubes showing hemolysis?
94. What is the purpose of sodium metabisulfite in a sickle cell solubility test?
95. How is the solubility screening test for HbS using sodium dithionite performed?
   a. What condition could cause a false negative reading?

Question Set 4
1. Myelopoiesis is the proliferation and maturation of the neutrophil cell line. Know the progression.
2. All hematopoietic cells arise from a common, self-sustaining pool of __________ stem cells in the bone marrow.
3. In infancy the most numerous cells of the bone marrow are______________.
4. Know the range in expected white blood cell numbers at birth and in children up to 10 years.
5. What is the expected range of the white blood cell count in adults?
6. Give examples of the primary and secondary neutrophil granules.
7. The enzymatic contents of primary (azurophilic) granules include _________and_________.
8. What is the function of the different types of granules?
   1. Name the conditions that might cause basophilic stippling.
   2. Describe the function of the basophil.
3. What is the primary role of the monocyte? What is it called in the tissues?
4. Mature neutrophils are equally divided into two pools: __________and__________.
5. After they enter the tissues they are believed to remain for ____to ____ days.
6. What noninfectious condition might increase the WBC count from the pool in children?
7. The early release of metamyelocytes and bands from the bone marrow reserve is referred to as a shift to the _____.
8. List the 4 alterations in neutrophil morphology that may be observed in response to infection.
9. Dohle bodies are similar, but not identical, to the inclusions found in the hereditary leukocyte and platelet disorder known as ____-____ anomaly.
10. Describe toxic granulation.
11. The process of directional migration of neutrophils under the direction of chemoattractants is known as ______________.
12. In order for the migrating neutrophil to recognize and attach to the microorganism it must undergo a process, Greek word “to prepare for dining”, called____________.
13. What absolute neutrophil count is considered neutropenia in an adult?
14. What type of infections in children may induce neutropenia?
15. Which drugs are associated with causing neutropenia?
16. A congenital cause of neutropenia where the person may experience fever or infection every day is known as __________neutropenia.
17. What absolute neutrophil count is considered neutropenia in a child?
18. Describe the characteristic neutrophil finding in May-Hegglin anomaly.
19. Describe the characteristic neutrophil finding in Chediak-Higashi syndrome.
20. The most common congenital neutrophil disorder with a qualitative decrease in cytoplasmic granules is ______________ deficiency.
21. Chronic granulomatous disease, with lymphadenitis and deep tissue infections and abscesses, is the result of a defect in __________ may be diagnosed by means of the __________ test.
22. Hypersegmentation in the granulocytes may be an indicator of what type of anemia?
23. Hyposegmentation or ‘dumbbell’ appearance is found in which autosomal-dominant disorder?
24. Describe Alder-Reilly anomaly.
25. The granules of Alder-Reilly anomaly stain positively with ______________stains?
26. Describe Dohle bodies.
27. Explain the difference between reactive lymphocytes and resting small lymphocytes.
28. Name 4 viruses that often have reactive lymphocytosis.
29. Describe the clinical features of mononucleosis.
30. Describe the Monospot test. Describe other tests useful in the diagnosis of mononucleosis.
31. Heterophile negative mononucleosis may be cause by which virus?
32. Describe a myeloblast. Describe a lymphoblast.
33. 50-90% myeloblasts in peripheral blood sample is typical of which leukemia?
34. Auer rods are most likely present in which leukemia?
35. All stages of neutrophils are found in the peripheral blood of which type leukemia?
36. What is the significance of the peroxidase stain? The Sudan Blank stain?
37. Which of the above is used to stain neutral fats, phospholipid, and sterols?
38. Which stain identifies intracellular carbohydrate, glycogen and mucopolysaccharide?
39. Name the cell type that is stained by AS-D chloracetate esterase.
40. Describe the clinical applications of the Periodic acid-Schiff staining.
41. Of childhood leukemias, _____% are classified as ALL.
42. Compare the morphology and cytochemistry in AML and ALL.
43. Compare the clinical features of acute and chronic leukemia.
44. Know why cytogenetic analysis is so important in the classification of acute leukemia. Know the type of leukemia associated with the Philadelphia chromosome (t[9;22]).
45. Describe the peripheral smear in chronic lymphocytic leukemia.
46. Describe a leukemoid reaction.
47. What is a leukocyte alkaline phosphatase stain?
48. Surface marker analysis plays its most important in ALL or AML?
49. Know the FAB Classification of acute myeloblastic leukemia.
50. In the FAB Classification acute lymphocytic leukemia is divided according to __________.
51. In the FAB Classification myelomonocytic leukemia would be __________.
52. Describe the characteristic differential count in acute myelogenous leukemia and chronic myelogenous leukemia.
53. Which stain is used to differentiate acute myelocytic from acute lymphocytic leukemia?
54. Name the leukemia that is associated with a high incidence of DIC.
55. Know the type of leukemia associated with Auer rods.
56. Describe the peripheral smear in erythroleukemia (AML M6 type).
57. Describe the peripheral smear in megakaryoblastic leukemia.
58. What type of leukemia is hairy cell leukemia?
59. What is a useful test in the diagnosis of hairy cell leukemia?
60. The FAB Classification of acute lymphoblastic leukemia is based on the morphology of cells from the peripheral blood or bone marrow aspirate?
61. What two types of ALL are of B-cell origin?
62. The myelodysplastic syndromes occur predominantly in children or the elderly?
63. Name the type of anemia associated with the FAB classification of myelodysplastic syndromes.
64. What is meant by a “left shift”? 
65. With the addition of thrombocytosis, basophilia and eosinophilia to immature neutrophils, which type of leukemia would this morphology suggest?
66. Name 5 types of lymphoproliferative disorders.
67. Describe the peripheral smear with myeloid metaplasia with myelofibrosis.
68. Chronic lymphocytic is the most common leukemia in children or adults? Which cell type?
69. Name the leukemia that may be associated with altered immunity thus causing autoimmune disease including ITP and autoimmune hemolytic anemia.
70. Reed Sternberg cells are found in which disorder?
71. Describe the promyelocyte.
72. Describe the myelocyte.
73. What is a megakaryocyte?
74. List the 4 chronic myeloproliferative disorders.
75. What is the origin of MPDs?
76. Describe a neoplastic plasma cell.
77. Know the clinical features of the myeloproliferative disorders that are shared in common.
78. The M:E ratio in chronic granulocytic leukemia is usually high or low?
79. What are the 3 criteria for the diagnosis of polycythemia vera.
80. What is the safest and least expensive treatment for patients with polycythemia vera?
81. Discuss several causes of reactive thrombocytosis.
82. Which cytochemical procedure is primarily relied on to distinguish chronic myelogenous leukemia from leukemoid reactions and myeloproliferative disorders?
83. What disease is characterized by rouleaux formation?
84. Name the hematologic condition characterized by the triad of anemia, hypercalcemia, and elevated serum globulins.
85. What is the abnormality in the protein electrophoresis in multiple myeloma?
86. What is the abnormality in the protein electrophoresis in Waldenstrom’s macroglobulinemia?
87. Organomegaly and hyperviscosity are more common in which of the above.
88. What are the clinical features of Hyperviscosity syndrome?
89. Besides the monoclonal protein (M spike) what are the other two major criteria for multiple myeloma?
90. The type of leukemia most commonly seen as a terminal event in plasma cell myeloma is___.
91. The most widely used staging scheme for Hodgkin’s is the _______ Classification.
92. Know the most common mode of presentation of Hodgkin’s disease.
93. What do mycosis fungoides and Sezary syndrome have in common?
94. Tissue biopsy is required for the diagnosis and subcategorization of non-Hodgkin’s lymphoma. Name a few of the ancillary tests useful in the evaluation of lymph node biopsies.
95. Define immunophenotyping.
96. What is the “gold standard” in classifying lymphomas and leukemias?
97. Describe flow cytometry.
98. In immunophenotyping by flow cytometry the emitting fluorescence intensity is proportional to the ____________________.
99. Besides the monoclonal protein (M spike) what are the other two major criteria for multiple myeloma?
100. Name the enzyme deficiency seen in Gaucher’s disease.
101. Name the enzyme defect in Niemann-Pick disease, and Tay-Sachs disease.
102. Which cell type and which inclusion body may be found in Mucopolysaccharidoses?

Questions Set 5
1. Fill in the Blanks:

<table>
<thead>
<tr>
<th>Factor Number</th>
<th>Factor Name</th>
<th>Disease Association</th>
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<tbody>
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<td>I</td>
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<td>II</td>
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<td>VI</td>
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<tr>
<td>VII</td>
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</tbody>
</table>
2. List the factors in the order they enter the extrinsic pathway.
3. List the factors in the order they enter the intrinsic pathway.
4. What factors are in the common pathway?
5. Which pathway is measured by the Prothrombin (PT) time?
6. Which pathway is measured by the APTT?
7. What are the reagents used in the PT?
8. What are the reagents used in the APTT?
9. What anticoagulant is used for routine coagulation tests? What is the anticoagulant to blood ratio? In polycythemia, should there be more or less anticoagulant in the tube?
10. How does a fibrometer detect the endpoint?
11. How does a Stago analyzer detect the endpoint?
12. How does the MLA detect the endpoint? What can interfere with this?
13. Which coagulation factors are Vitamin K dependent?
14. How is the PT level associated with Vitamin K?
15. Coumadin and heparin are two anticoagulants given to prevent and limit thrombosis. Which result will be affected (PT or PTT) by heparin? Which by Coumadin? Which one is warfarin?
16. What is an INR, and why is it better than a PT?
17. What does activated protein C (APC) do? Why does a person with a protein C develop thrombosis?
18. There are diseases of coagulation and thrombosis. Complete the chart with lab values that will be abnormal. You will have to evaluate lab values on the exam and make a diagnosis.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Lab results (coag and platelets)</th>
<th>symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemophilia A</td>
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<tr>
<td>Hemophilia B</td>
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<tr>
<td>Von Willebrand's disease</td>
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<td>Glanzman's thrombasthenia</td>
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<td>Bernard Soulier</td>
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<tr>
<td>Primary fibrinolysis</td>
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<tr>
<td>DIC</td>
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</tr>
</tbody>
</table>

19. Name the anticoagulants associated with coagulation and their method of operation.
20. Discuss the appropriate ratio of blood to anticoagulant in normal and abnormal patients.
21. Describe the appropriate storage methods for blood for coagulation testing and name the factors and components affected by improper storage.
22. What precautions should be taken when collecting blood for coagulation studies? Under what conditions might a specimen be rejected?
23. What substances are used to prepare absorbed plasma and what factors are present in absorbed plasma?
24. What factors are present in serum and aged serum?
25. Name the factors present in aged plasma.
26. What is factor deficient plasma and how is it obtained?
27. Discuss the procedures to use when platelet clumping and satellitism are encountered.
28. State the principle of the prothrombin time test, the reagents used and the approximate normal values.
29. State the principle of the activated partial thromboplastin test, the reagents used and the approximate normal values.
30. What is the purpose of the soybean inhibitor present in collection tubes for FDPs?
31. State the principle of the fibrometer. What are the primary sources of error?
32. State the four major functions of the vascular system in the prevention of bleeding.
33. Describe the role of vascular endothelium in fibrinolysis.
34. State the mechanism causing Henoch-Schönlein purpura.
35. What is the principle of the tourniquet test?
36. State the anti-thrombic properties of the vascular endothelium.
37. Describe the appearance of normal platelets on a blood smear including the relationship of number of platelets per field to the actual platelet count and possible causes of a falsely decreased platelet estimate.
38. Discuss platelet factor 3 with regard to its composition, location and function in coagulation.
39. Describe the basic structure of platelets including the two types of granules and their contents.
41. Following a vascular injury list the events that take place in sequential order with a primary emphasis on the role of the platelets.
42. Explain the roles of Thromboxane A2 (TXA2) and Prostoglandin I2 (PGI2) in maintaining normal hemostasis.
43. Define: hemostasis, petechiae, purpura, thrombocytopenia and thrombocytosis.
44. Briefly describe the bleeding time test as performed in the Duke, Ivy and template procedures and state the normal values.
45. Discuss the significance of giant platelets and the disorders associated with them.
46. Explain the principle and significance of the glass bead retention test for platelet adhesion.
47. Explain the principle of platelet aggregation tests including instrumentation and the five most commonly used reagents.
48. State the expected platelet aggregation results in von Willebrand’s disease, Bernard Soulier disease, Glanzmans thrombasthenia and storage pool disease.
49. Describe the methods for performing and calculating manual platelet counts.
50. Name the most common qualitative and quantitative screening tests performed to evaluate platelets.
51. How does ingestion of aspirin affect tests associated with platelets?
52. State possible pathological causes of thrombocytopenia, thrombocytopenia and thrombocytosis.
53. Give the normal values for a platelet count and the amount of decrease that causes concern of spontaneous hemorrhage.
54. What is von Willebrand’s disease? When performing platelet aggregation studies, with which reagent does this disease show an abnormal response?
55. Name a platelet test and a coagulation test that when they are abnormal are most frequently associated with von Willebrand’s disease.
56. Describe the relationship between von Willebrand’s factor and Factor VIII.
57. List and describe the laboratory tests used to establish a diagnosis of von Willebrand’s disease and state the expected values.
58. Differentiate between Bernard-Soulier syndrome and von Willebrand’s disease.
59. Name the cells responsible for the production of von Willebrand’s factor.
60. What is the function of platelet Factor 4?
61. Describe the method of platelet counting used in the hematology instrumentation in your training laboratory.
62. List all the coagulation factors giving their Roman numeral and synonym.
63. Which of the above factors belong to the “contact” group? Name two non-numbered factors that enhance the contact factors. What other in vivo and in vitro surface agents aid in the activation of these
factors? Name three contact factors whose absence or deficiency will cause an abnormal APTT with no in vivo bleeding tendency.

64. Explain the extrinsic pathway of coagulation activation using a diagram and listing the factors involved.

65. Explain the intrinsic pathway of coagulation activation using a diagram and listing the factors involved.

66. Explain the common pathway of coagulation activation using a diagram and listing the factors involved.

67. Explain and diagram the fibrinolytic system and name and discuss the functions of the various components.

68. Name the coagulation factors that a deficiency of will prolong the PT.

69. Name the coagulation factors that a deficiency of will prolong the APTT.

70. Name the coagulation factors that a deficiency of will prolong the PT and APTT.

71. Discuss the action of heparin in the prevention of clotting and name the most common method to evaluate heparin therapy. What substance is added to a sample to neutralize heparin?

72. Discuss oral anticoagulants, such as coumadin, as to their mode of action and name the most common test used to monitor therapy with these agents. What coagulation factor is first affected by oral anticoagulants?

73. Name four natural inhibitors of coagulation present in the plasma.

74. State the principle of the thrombin time, the normal value and four causes of a prolonged thrombin time.

75. Discuss the relationship of the VIII:C, VIII:Ag and VII:vWF, the tests used to measure their concentration, normal values and the disorders associated with deficiencies.

76. Discuss the lupus anticoagulant. What is the major concern for the patient with the presence of lupus anticoagulant? What is the confirmatory test for its presence? What autoantibody is primarily associated with its presence?

77. Name the primary circulating inhibitors and the disorders in with which they are associated. What laboratory methods are used to detect the presence of these inhibitors and what routine laboratory tests are affected by their presence?

78. State the principle of the quantitative fibrinogen assay performed in your laboratory, the normal values and the minimum level necessary for coagulation.

79. List the conditions in which a low fibrinogen level is seen.

80. What is the principle of thrombin time test and what are the normal values? What conditions are associated with prolonged thrombin time?

81. Differentiate between factor assays and correction studies and be able to determine the status of a particular factor when presented with results of these studies.

82. Give the principle and explain the clinical significance of the euglobulin lysis test.

83. What is fibrin stabilizing factor and how is it measured?

84. Discuss the method and formation of D-dimers and fibrin degradation products. What substances cause their formation and in what order are they produced? How will a positive rheumatoid factor affect a D-dimer test?

85. What is DIC? Name four possible causes of DIC. Describe the effect of DIC on routine coagulation test results.

86. What is the principle of the ethanol gelatin test and what disorder is associated with a positive result?

87. What is primary fibrinolysis? Name four causes of primary fibrinolysis. What test results are different between primary fibrinolysis and DIC?

88. Describe the latex agglutination test for FDP’s and state the sensitivity values of the test and the normal values.

89. How does liver disease affect coagulation and what factors are affected?

90. What is the function of vitamin K in coagulation? Give the results of the following in vitamin K deficiency:
   a. Prothrombin time:
b. Activated partial thromboplastin time:

c. Corrected by normal plasma:

d. Corrected by adsorbed plasma:

91. Discuss the methods of activation of plasminogen and plasmin.

92. Describe the principle of the euglobulin lysis test. What is its primary purpose?

93. Name the three most commonly used thrombolytic agents. Which is a fibrin-specific agent? What methods are used to monitor these patients?

94. What is the purpose of the Stypven test? What is the other name for this test?

95. State the principle of the prothrombin consumption test. What is the significance of an abnormal result?

96. Why is the major function of the reptilase test? Why is reptilase added to the tubes used to collect FDP’s?

97. What role does antithrombin III play in coagulation? Why is it sometimes called the heparin cofactor? Discuss the differences in test results obtained when testing serum and plasma for antithrombin III.

98. Discuss the functions of Proteins C and S.

99. Differentiate between hemophilia A and Hemophilia B.

100. What are the common names for the Fletcher and Fitzgerald factors? Which of these will correct from a prolonged result to a normal result with an increased incubation time?

101. Define INR. What is its purpose and how is it calculated?

102. What is the significance of Factor V Leiden?
Section 3
Microbiology Rotation
Clinical Laboratory Sciences Program

Instructions for Evaluations for Students and Clinical Supervisors

Qualitative Student Competency Checklist: This form should be completed by the student to evaluate their performance early in the rotation.

Technical Competencies Checklist: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. The student should rate their ability to perform accurate and reliable testing in a timely manner in the areas listed on the Microbiology internship checklist. The student’s time during each rotation will be spent observing and performing various procedures and reviewing theory and test principles. Performing tests in duplicate or performing tests under the direct supervision of the clinical instructor is encouraged. The checklists are provided as a guideline to ensure that routine procedures have been observed and performed. As a particular skill is performed, the student should indicate whether there was satisfactory or unsatisfactory performance. Otherwise, indicate whether the skill was only observed or discussed, or if it was not available (NA).

Quantitative Final Evaluation: This evaluation consists of 4 parts; rotation specific psychomotor skills, overall knowledge and skills, the student’s professional behavior, and summary comments. Please complete these forms by the last day of the student’s rotation. The affiliate supervisor should review these forms with the student. The student and evaluator will sign the forms and return them to the Santa Fe College Internship Coordinator.

Part 1 Psychomotor Evaluation: This form is to be utilized by the clinical instructor to evaluate the student’s technical skills specific to the rotation.

Part 2 Evaluation of Knowledge & Skills: In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. Please rate the student’s overall ability to perform accurate and reliable testing in a timely manner.

Part 3 Evaluation of Professional Behaviors: This form is to be utilized by the clinical instructor to evaluate the student’s professional behaviors.

• Please be honest in rating each of the professional characteristics of the student.
• Base your judgment on behavior which you feel is characteristic of the student during the period of evaluation
• Please comment on any rating in the Needs Improvement of Unsatisfactory category.

Part 4 Summary Comments: In this section please feel free to write a brief overview of the student’s performance. Any problems that you encountered with the student, as well as praise, should be noted here. This is very helpful to students so they will learn their strengths and weaknesses.

NOTE: If any problems or conflicts arise while the student is in your department, please bring them to the attention of the SF liaison as soon as possible so it can be resolved.

Forms are located in the appendix (printable versions).
Clinical Laboratory Sciences Program

Santa Fe College Clinical Laboratory Sciences Program

**Microbiology Internship Syllabus**

**COURSE NUMBER:** MLS 4821L  
**TITLE:** Microbiology Internship  
**CREDIT:** 4 credits  
**TEXT:** Board of Registry Study Guide: Clinical Laboratory Certification Examinations  
**INSTRUCTOR:** Myra Urso, Med, BSMT (ASCP),  
myra.urso@sfcollege.edu  
Work phone: (352) 381-3750

**COURSE DESCRIPTION:** The student will attend a clinical internship in a well-equipped and properly staffed laboratory for technical experience in microbiology.

*Note: This course may begin and/or end after the official published semester dates in order to accommodate scheduling availability at our clinical affiliates.*

**COURSE OBJECTIVES:** By the end of the clinical internship, the CLS student should be able to complete or explain all of the following objectives with 70% accuracy.

1. Review microbiology lecture material before the beginning of clinical internship.  
2. Apply theoretical knowledge to clinical assignments.  
3. Assess your knowledge by completing the BOR microbiology study questions.  
4. Remediate in areas of weakness before the microbiology clinical examination.  
5. Ask for assistance from the instructors when procedural clarification is needed.  
6. Perform daily QC procedures, interpret and document results and troubleshoot if needed.  
7. Perform daily maintenance and document as directed by the clinical instructor.  
8. Perform staining procedures to include Gram’s stain and AFB stain.  
9. Set-up cultures by inoculating appropriate media and incubating them as determined by the standard operating procedure manual.  
10. Successfully isolate colonies for further evaluation and testing.  
11. Perform urine culture work-ups to correlate with the clinical instructor’s interpretation.  
13. Perform wound cultures, differentiating normal flora from pathogens.  
14. Perform blood cultures to correlate with the clinical instructor’s interpretation.  
15. Perform respiratory cultures, differentiating normal oral flora from pathogens.  
16. Perform anaerobic cultures to correlate with the clinical instructor’s interpretation.  
17. Perform bacterial serotyping using a strep typing kit and an unknown streptococcal organism.  
18. Perform susceptibility testing to include Kirby-Bauer, E-test, and microdilution.  
19. Operate automated microbiology instruments (Microscan, Vitek, Bactec, Tigris, etc).  
20. Display initiative by performing routine assigned tasks.  
21. Apply technical knowledge while performing basic laboratory procedures.  
22. Display responsibility for one’s actions while at the clinical affiliate.  
23. Accept constructive criticism to improve developing work habits.  
24. Self-evaluate the interpersonal relationships of co-workers and other healthcare staff.
25. Follow standard operating procedure manual and admit to errors or mistakes when they occur.
26. Organize the workload, prioritizing STATs and reducing turn-around-times.
27. Display dependability by arriving to clinical at designated times and days.
28. Adapt to different teaching styles and workload without complaining.
29. Display confidence in one’s technical ability while at the same time, recognize one’s limitations.

METHOD OF TEACHING:
- Laboratory Bench Instruction
- Demonstration
- Role modeling

EVALUATION METHOD:
Students will be evaluated in four areas:
1. Technical competency achieved by the end of the clinical internship in a specified laboratory procedure evaluated by the clinical instructor.
2. Professionalism demonstrated during the clinical internship evaluated by the clinical instructor(s).
3. Theoretical knowledge demonstrated by a written examination on the last day of the clinical internship given by the College.
4. Weekly discussion board posts documenting what you have learned at the clinical affiliate.

TECHNICAL COMPETENCY:
Your technical competency will be assessed at the end of your clinical rotation by the clinical faculty. This psychomotor evaluation is worth 30% of your total grade in this course. It is your responsibility to know what tasks are on the checklist and to ask your clinical instructor(s) to initial it on a weekly basis as the assigned tasks are completed. Completion of the checklist is scored as either 100% or 0%.

PROFESSIONALISM:
Your professionalism will be assessed at the end of your clinical rotation by the clinical faculty. This affective evaluation is worth 30% of your total grade in the course. Remember that from the first day of your clinical internship, you are being evaluated for potential employment opportunities. Take advantage of this opportunity and ask your clinical instructors if they would be willing to be one of your references when you start applying for open positions.

WRITTEN EXAMINATION:
There is one multiple choice question examination at the end of clinical rotation. This cognitive evaluation is worth 30% of your total grade in this course. A self-paced study guide is provided to assist you with your preparation for the examination. Material included on the examination will be taken directly from the study questions focusing on theory, methodology, and clinical significance of each chemistry analyte.

DISCUSSION BOARD:
The weekly discussion board posts are due every Friday by 5:00 p.m. The discussion board should include what instrument you trained on, what profiles were performed, what analytes were measured, the principles of the analytes, any critical results that were phoned, and any interesting patient results that you encountered. In addition, you are required to answer all of the instructor’s questions on the discussion board by Sunday evening at 12:00 midnight for full credit.
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**GRADES:**

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<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Description</th>
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<tr>
<td>S+</td>
<td>95</td>
<td>Exceeds expectations</td>
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<tr>
<td>S</td>
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<tr>
<td>S-</td>
<td>75</td>
<td>Needs Improvement</td>
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<td>Unsatisfactory</td>
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Grades are calculated as follows:

- 93-100: A
- 90-92: A-
- 87-89: B+
- 83-86: B
- 80-82: B-
- 77-79: C+
- 70-76: C
- 60-69: D
- 0-59: F

**CALCULATION OF GRADE**

- Technical Competency: 30%
- Professionalism: 30%
- Written examination: 30%
- Weekly blog: 10%

Total: 100%

The MLS student must pass this course with a “C” or better in order to continue in the MLS Program. There are no excused absences from the clinicals. The student must notify the clinical instructor if he/she is going to be late or absent before the time he/she is scheduled to be at the clinical facility. Make-up time is at the discretion of the clinical instructor.

**Americans with Disabilities Act (ADA) Student Rights**

If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations.

**Discrimination/Harassment Policy Statement**

Santa Fe College prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to the SFC Human Resources Policies website.

**College Academic Integrity Statement**

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.
Microbiology Psychomotor Objectives
(6 Weeks)

*By the end of the microbiology internship, the student should be able to:

**Specimen Processing**

- Familiarize yourself with the layout of the microbiology department including:
  - Work flow areas
  - Specimen processing
  - Gram stains
  - Quality control duties
  - Antimicrobial susceptibility test methods
- Perform routine sample processing for microbiology.
- Apply criteria for accepting/rejecting a specimen for the microbiology lab appropriately.
- Perform quality control procedures for reagents and media storage locations and temperatures.
- Perform daily QC procedures as assigned.
- Perform routine testing procedures including gram stain preparation and reading with technologist review.
- Perform Culture processing using various isolation techniques.

**Urine Cultures**

- Examine primary culture plates and quantify colony morphology.
- Identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC under direct supervision.
- Perform preliminary identification tests such as oxidase, catalase, spot indole, staph latex, PYR on appropriate isolates.
- Identify clinically relevant isolates and perform antimicrobial susceptibility testing as indicated.

**Blood Cultures**

- Operate blood culture instrumentation including routine maintenance and quality control procedures.
- Subculture positive blood cultures to correct media based on gram stain smears.
- Examine subculture plates provided and identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC independently.
- Perform preliminary identification tests such as oxidase, catalase, spot indole, staph latex, PYR on appropriate isolates.
- Identify clinically relevant isolates and perform antimicrobial susceptibility testing as appropriate.

**Stool Cultures**

- Examine primary culture plates provided for diagnosis of gastrointestinal infections and identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC independently.
- Perform immunological based test methodologies.
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- Perform preliminary identification tests such as oxidase, catalase, spot indole, staph latex, PYR on appropriate isolates
- Identify clinically relevant isolates and perform antimicrobial susceptibility testing as indicated.
- Perform rapid screening tests as directed.

**Respiratory Cultures**
- Examine primary culture plates and differentiate normal flora from pathogenic organisms.
- Identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC independently.
- Perform preliminary identification tests such as oxidase, catalase, optochin, staph latex, PYR, butyl esterase discs on appropriate isolates.
- Identify clinically relevant isolates and perform antimicrobial susceptibility testing as indicated.

**Wound Cultures**
- Examine primary culture plates and identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC under direct supervision.
- Perform preliminary identification tests such as oxidase, catalase, optochin, staph latex, PYR, butyl esterase discs on appropriate isolates.
- Identify clinically relevant isolates.
- Perform antimicrobial susceptibility testing as indicated.

**Anaerobic Cultures**
- Examine primary culture plates provided for diagnosis of anaerobes of clinical importance.
- Identify the colony types based on colony characteristics, gram stain and morphology, and reactions on differential media.
- Perform daily QC under direct supervision.
- Perform preliminary identification tests such as aerobe screens, oxidase, catalase, kanamycin-vancomycin- Colistin susceptibility, SPS, spot indole, staph latex, PYR on appropriate isolates.
- Identify clinically relevant isolates and perform antimicrobial susceptibility testing as indicated.

**Mycology, TB, and Parasitology**
- Examine primary culture plates provided for diagnosis of Mycobacteria and fungi of clinical importance and identify suspicious colony types based on colony characteristics, and reactions on various media.
- Demonstrate appropriate use of personal protective equipment and procedures for working with parasites, Mycobacteria and fungi.
- Perform daily QC independently as related to these areas.
- Perform tests used to identify parasites, Mycobacteria, and fungi.
- Identify clinically relevant isolates and perform susceptibility testing as indicated.
- Perform acid fast stains on specimen smears with review by technologist.
- Perform lactophenol blue stains with review by technologist.
- Perform diagnostic parasitology methods such as wet mounts, fecal concentrations, and permanent stain smears with review by technologist.
- Review smears for the presence of parasites, correctly identifying the parasites if present.
Microbiology Study Guide for Exam

Staphylococci
1. What are the predominant features of the Staphylococci? How are the major species distinguished?
2. What is clumping factor, and is it different from coagulase?
3. What is protein A? How does the Staphaurex (latex agglutination test) work?
4. How is a tube coagulase different from a slide coagulase? What caveats should be remembered when performing a tube coagulase?
5. List three disorders associated with Staph aureus toxins.
6. What tests distinguish Staph from Micrococci – list 3?
7. What is the major reason for penicillin resistance in Staph?
8. What is the pathological significance of Staph epidermidis?
9. Resistance to novobiocin is significant to differentiate which 2 Staph species?
10. Which Staph is commonly found as a UTI? How is it acquired?
11. Which Staph is associated with dog bites? How is it differentiated?
12. Compare the colony characteristics of Staph to Strep.
13. What causes toxic shock syndrome?
14. Which antibiotic is reserved for Methicillin resistant Staph?

Streptococcaceae
1. Review the flowcharts for Strep, one for alpha, beta and gamma hemolysis. What is the principle of each test on the flowchart? What does a positive look like? What organisms would make good quality control?
2. Distinguish the beta hemolytic Strep using biochemicals, and by disease.
3. Distinguish Strep pneumo from the viridans Strep.
4. What additional sensitivity testing should be done on Enterococcus?
5. What are the hemolysins of group A Streptococcus? How can they be distinguished or enhanced?
6. List the most well-known infections caused by, and alternate names (if any) of the following:
   a. Group A beta strep
   b. Group B beta strep
   c. Group D strep
   d. Strep pneumonia
   e. Strep viridans
   f. Enterococci
7. What is the unusual colony characteristic and gram stain for Strep pneumo?
8. What are the growth requirements for Abiotrophia?
9. Name 2 disorders that may occur after a Group A strep infection.
10. How does Gemella differ from Streptococci?
11. What is Leuconostoc?
12. What is the role of vancomycin in treating Staph and Strep?
13. How does Strep milleri appear on agar?
14. What is subacute bacterial endocarditis? What organism is associated with it? How does it access the heart?
15. What is HLAR associated with?
16. What antibiotic can be given for Strep throat without doing a sensitivity test?
17. What is “satellitism”?
Neisseria and Moraxella

1. Review the tests for differentiating Neisseria and Moraxella catarrhalis.
2. Describe the gram stain and morphology for Neisseria and Moraxella.
3. Which of these organisms are fastidious?
4. Name a presumptive test for Moraxella catarrhalis.
5. What is the appropriate transport and storage for GC samples?
6. What is the purpose of Thayer Martin and its antibiotic additives? What is the base, and what are the antibiotics?
7. List all of the selective media used for genital cultures.
8. Why is penicillin not the drug of choice for gonorrhea?
9. What type of media base is used in the sugar utilization tests for Neisseria?
10. What two factors does chocolate agar contain?
11. What is the oxidase test for Neisseria and Moraxella? What can cause a false result?
12. Distinguish the major Neisseria by carbohydrate utilization.
13. Which organism has a “hockey puck” like colony?
14. Which organism hydrolyzes tributyrin?
15. What is the oxidase reaction for Neisseria and Moraxella? What is the actual reagent used in the oxidase test?
16. What amino acid is required for Neisseria to grow?

Bacteria Cell Structure

1. What is the purpose of each of the following?
   a. 10% KOH
   b. calcofluor white
   c. Lugol’s iodine
   d. India Ink
   e. Darkfield microscopy
   f. Loeffler’s methylene blue
2. How do the cell walls of gram positive and negative organisms differ?
3. What are the 4 reagents and the order used in the Gram stain? What is the role of each reagent? What would happen if one reagent was omitted?
4. What is the major cell wall substance producing acid fastness?
5. How to the Ziehl Nelson and Kinyoun stains differ?

Control of Microorganisms

1. Name a substance sterilized by autoclaving, one by filtering, and how are proteins sterilized?
2. What is a BSC?
3. List the 4 safety levels of labs, and tell how they are different.

General Concepts

4. Define the terms aerobic, anaerobic, microaerophilic, facultative anaerobe, capnophilic and humidophilic.
5. Most cultures are incubated at what temperature?

Colonial Morphology

1. Distinguish alpha, beta and gamma hemolysis.
2. List the appropriate words used to characterize the shape of colonies, eg. Umbilicate.
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**Media**
1. Evaluate the following media, and determine whether it is selective and/or differential:
   a. PEA, CNA, MAC, Chocolate, Thioglycollate, Hektoen, XLD, selenite
2. What is meant by enrichment media?
3. What makes media selective?
4. For all organisms, describe the special media required.

**Blood Cultures**
1. Define bacteremia and septicemia.
2. Septic shock and DIC resulting from septicemia are most frequently caused by _______.
3. When is the finding of S. epidermidis in a blood culture significant? ________________.
4. Failure to administer antibiotics prior to dental surgery may result in ________________.
5. What is the most frequent anaerobe isolated from blood cultures?
6. State the recommended protocol for collecting blood cultures from a patient whose condition requires rapid administration of antibiotics.
7. What is the most common reason for contamination of blood cultures?
8. Describe the procedure for collecting a blood culture.
9. List 3 common skin contaminants. How is the decision made as to whether or not these organisms in a blood culture are pathogenic?
10. What is the recommended ratio of blood to culture media?
11. State the principle of automated blood culture detection by the Bac-Tec and Bacti-Alert.
12. What is the significance of finding Staph epidermidis in a blood culture?
13. List the various functions of SPS in blood culture bottles.
14. What is the proper incubation for a subculture of a positive blood culture of Campylobacter fetus?

**CSF And Respiratory Cultures**
1. What does the limulus lysate test detect?
2. Describe the CSF cells, glucose and protein in bacterial meningitis.
3. Name 3 organisms associated with neonatal meningitis in order of prevalence.
4. Name the organism primarily associated with meningitis in the ages 1 month to 6 years.
5. Name 3 prominent organisms associated with meningitis after age 6.
6. When CSF for Gram stain and culture is received in the laboratory, what is the first thing to do?
7. How should CSF for bacterial cultures be stored? Viral cultures?
8. What organism is detected by the India ink preparation?
9. Small, gram positive diphtheroid-like organisms cultured from CSF should be suspected to be...
10. On a spinal fluid gram stain, the presence of intracellular, gram negative, coffee-bean shaped diplococci should be suspected to be...
11. List the most common pathogens found in CSF. Distinguish them by gram stain and chief biochemical characteristics.
12. Why should a CSF specimen for culture be transported to the laboratory without delay?
13. What is the major pathogen found in throat cultures? What are its culture and biochemical characteristics?
14. Name the most common organism causing pneumonia in children, in young adults and in older adults. What are its culture and biochemical characteristics?
15. Bronchoalveolar lavage is used for the detection of ...
16. State the criteria for an acceptable sputum specimen.
**UTI Cultures**

1. What is meant by the clean catch method? What other methods are there? Which is the most sterile?
2. State the most common criterion for quantitative urine culture to be considered positive.
3. Differentiate between cystitis and pyelonephritis.
4. What is the most common nosocomial infection? Major cause?
5. What is the preferred method of preserving urine prior to culture?
6. Explain why urine cultures are plated on both blood and MacConkey agar.
7. A MacConkey plated streaked quantitatively with a .001 loop shows 45 lactose fermenting colonies. The colony count is _______.
8. How should a urine culture growing 3 organisms each less than 10,000 CFU be treated?
9. Is a colony count of 1,000 CFU significant from a suprapubic aspiration?
10. Name two gram positive cocci that are causative agents for UTI. How can they be differentiated?
11. The most common member of the Enterobacteriaceae causing UTI is ...

**Enterobacteriaceae**

1. State 5 biochemical characteristics that are common to members of the Enterobacteriaceae. Use a picture to remember them.
2. Which genera of Enterobacteriacea are non-motile? Determine if any species are motile.
3. List all of the customary biochemicals used to distinguish the Enterobacteriaceae.
4. List the Enterobacteriaceae by tribe. Which tribe is VP +? Which tribe is PDA and other amino acid deaminase +?
5. What sugars are in MacConkey and EMB agars?
6. What enzymes do bacteria need to utilize lactose?
7. Which Enterobacteriacea are H2S producers? Which are urease producers? Use a picture to remember them.
8. What are the constituents of a TSI slant, and how does it work?
9. How do Enterobacteriaceae appear on blood agar?
10. On MacConkey agar how do colonies of _______ bacteria appear and why?

   A. Lactose positive  
   B. Lactose negative

11. Describe the appearance of Salmonella and Shigella and E.coli on XLD and HE agar.
12. Certain differential and selective media contain ferric salts. Why?
13. Explain the principle and purpose of the ONPG test.
14. Explain each of the following reactions on TSI and give an example of an organism.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Example</th>
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<tbody>
<tr>
<td>acid butt / alkaline slant</td>
<td>acid butt / alkaline slant / black butt</td>
</tr>
<tr>
<td>acid butt / acid slant</td>
<td>alkaline slant / alkaline butt</td>
</tr>
<tr>
<td>gas bubbles in butt</td>
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</table>

15. What does IMViC stand for? Give the principle of each reaction and describe the color.

   Name the organisms associated with a +++-- and a +++++ reaction.

16. State the principle of the urease reaction and describe a positive reaction. How does urease along with TSI help to screen stool cultures? How is KIA different from TSI?
17. Explain the major uses of the lysine and ornithine decarboxylase reactions in the identification of Enterobacteriaceae.
18. What major group of organisms are phenylalanine deaminase positive?
19. Which members of the Enterobacteriaceae are H2S positive? Draw a picture to remember it.
20. State the principle of the indole test. For what organism is this a key identifying characteristic to distinguish species?
21. How can you distinguish Klebsiella oxytoca from Klebsiella pneumoniae?
22. What is the purpose for plating a stool culture on sorbitol agar?
23. What are the key identification characteristics that differentiate Shigella from Salmonella? Which Shigella species is ONPG positive? What is the most commonly isolated Shigella species?

24. Define “O”, “H”, “K” and “Vi” antigens. What should be done if an organism fails to agglutinate polyvalent typing sera? What is “Vi” antiserum?

25. State a unique culture characteristic of Serratia marcescens.

26. What is the principle of the citrate test?

27. What 2 biochemicals differentiate Salmonella from Citrobacter?

28. Describe the appearance of colonies of Klebsiella on blood agar. What test is used to differentiate Klebsiella pneumoniae from Klebsiella oxytoca? What key characteristic differentiates between Enterobacter and Klebsiella?

29. Which Enterobacteriaceae are characteristically resistant to ampicillin?

30. Describe the appearance of Proteus on blood agar. How do you differentiate between P. vulgaris and P. mirabilis?

31. How do you differentiate Shigella from Providencia?

32. What is the difference between a true nonlactose fermenter and a slow lactose fermenter?

33. Discuss the 4 genera of Enterobacteriaceae that produce gastrointestinal disorders, and list their biochemical profiles.

34. Describe the pathogenicity of Yersinia pestis. What is the vector? Name two major criteria that will distinguish this from Y. enterocolitica.

35. Why do Proteus and Providencia produce a red slant on lysine iron agar? How does LIA work?

36. Which Yersinia species is nonmotile at both 25 and 35 degrees and urease negative?

37. Find flowcharts and visual cues from class notes, and review them.

Fastidious Organisms

1. Review the table showing the Haemophilus differential.
   a. What are the chemical names for the X and V factors? If an organism requires X, what is it unable to make? What alternate test will be negative (there are two names for the test).
   b. What types of media are appropriate for Haemophilus species? What supplements will aid in their growth? Can these be provided by other organisms? What is satellitism?
   c. What are the diseases caused by Haemophilus spp? What demographic (age/sex/other) are more likely to get them?

2. For each of the following organisms, list the types of media, special growth conditions (eg cysteine), gram stain, biohazard caveats if any, and demographic that is likely to be affected:
   a. Legionella, Bordetella, Brucella. Francisella
   b. List the major species of Bordetella; what are the major tests that can tell them apart?
   c. List the major species of Brucella; what are the major tests that can tell them apart?
   d. Brucella can be cultured using biphasic blood culture bottles, those with media on paddles within the bottle itself. How long should blood cultures be kept? Are these capnophilic?

Vibrio and Other Non-Enterobacteriaceae

1. Review the flowchart of the Vibrio differential.
   a. What is TCBS? How is it used in the differential?
   b. What are the diseases of Vibrio? Who is more likely to get each kind? How can they be distinguished biochemically?
   c. What are the salt requirements for the Vibrio?
   d. What is the unusual gram stain and motility of Vibrio? What is Vibriostat?
   e. List three ways to distinguish the El-tor biotype from the classic form of Vibrio.

2. What is choleragen? How does it cause diarrhea?
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3. How can Vibrio be distinguished from Aeromonas and Plesiomonas? Why is it necessary to know this? Are these organisms fermenters?
4. What are the main species of Campylobacter, and how can they be distinguished from each other? How is Helicobacter similar to Campy?
5. What is Helicobacter known for, and list 3 ways that it can be detected without culture?
   a. H. pylori can also be detected in stool with EIA.
6. What is the gram stain of Campy and Helicobacter?
7. What are the special growth conditions for C. coli and C. jejuni?
8. What is the role for alkaline peptone water in the culture of these organisms?
9. How can you distinguish Plesiomonas shigelloides from Shigella?

Non-Fermenters and Miscellaneous Gram Negative Rods
1. Keep in mind the oxidase test for these organisms; this is the first test to be done when you find a gram negative rod.
   a. Review the flowchart that highlights Pseudomonas.
   b. What are the three major non-Enterobacteriacea that are on this chart? These are the major players in infection.
   c. How can you tell them apart?
   d. What are the main species of Acinetobacter? Which one is asaccharolytic?
   e. What is the gram stain of these organisms; always include the morphology when reporting gram stains.
2. What can you list about Stenotrophomonas maltophilia? How is the maltose utilized?
3. Does this organism utilize any other sugars?
4. Are any organisms on this flowchart nonmotile?
5. What are the pigment characteristics of the Pseudomonads? Temperature characteristics? Colony characteristics? Are they susceptible or resistant to most antibiotics?
6. How is OF media used with this group of organisms? Can you describe how it compares to TSI?
7. What non-fermenters grow on MacConkey? What is their oxidase result?
8. List the keywords and key biochemical tests that can be used to distinguish Pasteurella, and Eikenella.
9. Which organism is associated with meliodosis, pseudomallei, cat scratch fever, human bites, cystic fibrosis patients, rat bite fever, gastric ulcer, pitting.
10. What is the unusual gram stain morphology of Cardiobacterium hominis? What disease does it cause?
11. What is Streptobacillus moniliformis? What is the gram stain, and the keyword?
12. Which of the HACEK group produces swarming colonies and increased CO2?
13. What are the characteristics of Capnocytophagia? What organisms are similar to it by its growth requirements? How can its morphology be used to distinguish it?

GI Infections and Food Poisoning
1. List the major players in food poisoning. Review the characteristics of Salmonella and Shigella from the previous week. Be able to differentiate the four groups of Shigella, and to use their species names or group label. Which is the most common in the US? Which is associated with gay bowel syndrome? Which is ONPG positive? Which is mannitol negative? How do S&S grow on HEK, XLD, MAC?
2. What is CIN agar for? What is Skirrow?
4. Which Yersinia is associated with appendicitis like symptoms? What growth characteristics can distinguish it from plague? What is the interesting temperature information about Yersinia?
5. Which food poisonings work by producing toxins? How does that affect the fecal leukocyte test?
6. What is the role of selenite broth (or GN broth) in stool cultures? Which organism is the most fragile, and may die if a stool specimen is not promptly set up?
Aerobic Gram Positive Bacilli

1. Bacillus
   a. Examine the Bacillus differential table from the notes. What are the tests that distinguish anthracis from most other species? What is the only test that is positive for anthracis but negative for the others?
   b. What general characteristics do the Bacillus spp. have in common?
   c. Which Bacillus species is the most virulent for humans?
   d. What is the spectrum of disease (list the 3 forms) for Bacillus anthracis?
   e. What is the spectrum of disease for Bacillus cereus?
   f. Identify the characteristic colonial appearance on 5% sheep blood agar of Bacillus anthracis.
   g. Identify the significant biochemical results that confirm the diagnosis of Bacillus anthracis.
   h. What biochemical tests can differentiate Bacillus anthracis from Bacillus cereus?
   i. What is the drug of choice for Bacillus anthracis but not other Bacillus?
   j. What is the mode of transmission of B.anthracis?

2. Listeria, Corynebacterium, and Similar Organisms
   a. Review the flowchart for this group. What are the major discriminators? What organisms are on this chart?
   b. What do Listeria and Cornebacterium have in common?
   c. What is the primary spectrum of disease for Listeria monocytogenes?
   d. What is the primary spectrum of disease for Corynebacterium diphtheriae?
   e. What are the gram stain characteristics and group morphology for Corynebacterium which could allow direct detection?
   f. Describe the Elek test.
   g. Name the selective and differential media for C. diphtheriae? How does the organism appear on each type?
   h. What is the color and the colony appearance on these media?
   i. The toxin produced by Cornebacterium diphtheriae requires what other factor for virulence? What type of agar is used for the Nagler test? What enzyme does it detect?
   j. Describe the motility test and appropriate temperature for L.monocytogenes.
   k. L.monocytogenes is short gram-positive rod or coccobacilli occurring in pairs and can resemble streptococci. How can they be differentiated by biochemical tests? How are they similar? What disease do they have in common?
   l. Name the organisms that may be pathogenic to humans through animal exposure.
   m. Know the cause of bacterial vaginosis.
   n. Normal commensal bacteria in the vagina, giving the acid pH.
   o. A wet mount prepared in saline reveals characteristic “clue cells,” which are large, squamous epithelial cells with numerous attached small rods known as ____________.

3. Nocardia, Streptomyces, Rhodococcus, Oerskovia, and Similar Organisms
   a. Review the Table of Nocardia and Streptomyces.
   b. What distinguishes this group from other gram-positive bacilli? What is present in the cell wall of some of them?
   c. Describe the characteristic gram stain morphology of Norcardia asteroids.
   d. Which Norcardia spp. hydrolyzes casein and tyrosine? Which species does not hydrolyze substrates?
   e. Which Norcardia spp. is the predominant cause of skin infections in immunocompetent individuals?
   f. What is the chronic granulomatous skin infection called that is the result of non-acid fast aerobic actinomycetes?
   g. What is the gram stain color of all of these organisms?
   h. Which of these organisms are partially acid fast (Sue, Gordon and Rhoda).
Anaerobic Bacteria

1. Review the parts of an anaerobic chamber.
2. Review the flowchart of the gram positive strict anaerobes, and the gram negative strict anaerobes. Be able to place an organism on its correct chart based on name.
3. What is aerotolerance?
4. Which strict anaerobes are cocci? What is different about Veillonella?
5. What are the special media used to isolate and differentiate anaerobes? What are the antibiotic and biochemical disks?
6. As part of the normal skin flora what are the most common anaerobic contaminants of blood cultures?
7. Name the organisms most commonly encountered in anaerobic infections.
8. Cycloserine cefoxitin fructose agar (CCFA) is selective media for which organism?
9. Name the most frequent cause of gas gangrene.
10. Name the organism that produces a neurotoxic exotoxin that disrupts nerve impulse to muscles.
11. Name the organism that also produces a neurotoxin preformed in foodstuffs. How does it present differently in babies? What food should they avoid? (Really their parents!)
12. Describe the gram stain characteristics of Fusobacterium mortiferum and nucleatum.
13. Name two characteristics in the macroscopic examination of specimens sent to the lab that would strongly indicate the presence of anaerobes.
14. The clinical diagnosis of botulism is confirmed by recovery of the organism from the stool of patients as well as demonstration of botulinum toxin in which clinical specimens?
15. Describe how the toxin in C. difficile is detected.
16. What type of clinical manifestations would the patient have with C. difficile toxin and what is usually the precipitating event?
17. A crucial factor in the final success of anaerobic cultures is the ________ of the specimen to the laboratory.
18. List the non-selective and the selective media of choice for anaerobic specimens.
19. In addition, aerobic cultures are necessary because most anaerobic infections are _____microbic.
20. Describe the characteristics of Clostridium perfringens on anaerobic blood agar.
21. The reverse CAMP test, lecithinase production, and double zone hemolysis are useful criteria in the identification of ______________.
22. Name three antibiotic identification disks that aid in preliminary grouping of anaerobes and serve to verify the Gram stain, but do not imply susceptibility of an organism for antibiotic therapy.
23. With few exceptions, most gram-positive anaerobes are susceptible to which antibiotic?
24. What is the predominant anaerobic organism in clinical infections that is normal flora in the intestinal tract?
25. This same gram negative rod is resistant to penicillin......what is the drug of choice?
26. Name the common anaerobic bacteria species that are gram-positive, straight rods with spores subterminal resembling a tennis racket? Is this the only place spores can be found? What is the stain that can detect spores?
27. The only genus of anaerobic bacteria to form endospores is _____________.
28. Describe the gram stain morphology of Veillonella.
29. Describe the unusual colony characteristic of Bacteroides ureolyticus. How can this be distinguished from B. fragilis?
30. Presumptive diagnosis of a gram positive anaerobe, Peptostreptococcus anaerobius, is based on a sensitive or resistant disc of sodium polyanethol sulfonate?
31. What is the ‘characteristic’ on gram stain of Fusobacterium nucleatum?
32. What is the ‘characteristic’ on gram stain of Actinomyces israelii? In a clinical sample?
33. Peptostreptococcus infections from human bites are usually sensitive to which antibiotic?
34. What is the reason for the appearance of water on the inside of a GasPak jar? What is the catalyst? What is the oxygen indicator, and when does it change color?
35. The presence of sulfur granules is characteristic for which organism?
36. Which two media would you choose to isolate and then identify B.fragilis group?
37. What are the morphologic characteristics of Eubacterium lentum? What role does arginine stimulation play in the presumptive diagnosis?
38. Be able to make a presumptive diagnosis of Eubacterium lentum and Propionibacterium acnes.....both anaerobic, non-spore forming, gram positive bacilli. What role does indole play?
39. What is the ideal anaerobic environment after air is removed from the sealed jar?
40. What is the advantage of prereduced, anaerobically sterilized (PRAS) media and what is the shelf life?
41. Make a presumptive identification of gram-negative anaerobes that are pigmented (Prevotella spp. and Porphyromonas spp.) based on which is indole positive which has brick red fluorescence. Which antibiotics is each sensitive/resistant to? Are they bile sensitive?
42. What is the purpose for using PEA agar when culturing anaerobes?
43. Lecithinase from egg yolk agar is used in the presumptive identification of which gram-positive anaerobes.
44. An organism was isolated on kanamycin-vancomycin agar from a peritoneal abscess. The genus of this organism most likely is ____________.
45. Name the genera of anaerobic, gram-negative, nonsporulating bacilli. What is an ethanol spore test?
46. Name a strict anaerobe that produces terminal spores.
47. Name the organism that is anaerobic, spore-forming, nonmotile, gram-positive bacillus, and isolated from a deep wound of the leg.
48. List the forms of Clostridium by species, disease, and special means to distinguish them.

Skin and Soft Tissue Infections
1. List the most common organisms that are resident microbial flora of the skin.
2. Name the organism most responsible for folliculitis, furunculosis, and carbuncles.
3. How is erysipelas different than erysipeloid?
4. What organism causes toxic shock syndrome?
5. What is the agent that causes scarlet fever, rheumatic fever and glomerulonephritis?
6. Name the 2 organisms most common in impetigo.
7. The two anaerobic bacteria frequently involved in necrotizing fasciitis are_______and_______.
8. Recall the common aerobes and anaerobes causing infection in human bites and dog bites.
9. Name the flora of diabetic skin ulcers.
10. Name the anaerobes in infected decubitus ulcers.
11. Name the organism, common in chronic draining sinuses, that appears as a ‘lumpy jaw’.

Concepts in Antimicrobial Therapy
1. Draw a picture of a bacterium, and highlight the chromosome, ribosomes and subunits, and cell wall. Indicate where each of the major classes of antimicrobials work.
2. Antimicrobial agents that inhibit bacterial growth but generally do not kill the cell are known as ___ agents.
3. Antimicrobial agents that usually kill the target organisms are said to be _________ agents.
4. List the 4 modes of action of different antibacterial agents.
5. Peptidoglycan refers to what part of the bacterial cell? What is another name for this?
6. Which antimicrobial drug class comprises the largest group of antibacterial agents?
7. What is a beta-lactamase?
8. Which antimicrobial class target and inhibit cell wall synthesis by binding the enzymes involved in synthesis?
9. These enzymes anchored in the cell membrane are referred to as PBPs or ________________.
10. Which antimicrobial class also inhibits bacterial cell wall synthesis but does not bind to PBPs?
11. Name the antimicrobial agents most commonly used that disrupt bacterial cell membranes.
12. Name the mechanism of action of aminoglycosides, macrolides, chloramphenicol and tetracyclines.
13. Which group of antibiotics inhibits protein synthesis by binding to 30S ribosomal subunit?
14. Give 3 examples of macrolide antibiotics.
15. The primary antimicrobial agents that target DNA metabolism are the _______ and the ________.
16. What is the mechanism of action of sulfonamides and trimethoprim? What is trailing?
17. Explain the mode of beta-lactamase enzyme activity.
18. What is the difference between broad spectrum and narrow spectrum antibiotics?
19. Describe all of the standardized steps in setting up a Kirby Bauer sensitivity test.
20. Determine what would happen to the size of the zone of inhibition if those steps are not followed exactly with respect to set up time, incubation time, inoculum size, age of culture, depth of media.
21. What is an MIC? How is it different from MBC?
22. Draw an MIC that begins with 128 mcg/ml of ampicillin. Make 2 fold serial dilutions. Draw the sterility and growth control for this MIC. If there is growth in the 4th tube, what is the MIC?
23. How is an E test similar to an MIC? How is it similar to a Kirby Bauer?
24. Will an MIC have the same dilution as an MBC?
25. What is the Schlicter test? Why measure a peak level and a trough level? How is a Schlicter test different than an MIC?
26. What is meant by trailing? Skipped wells? How should you handle this?
27. Which organisms require special handling for Kirby Bauer testing? What are the plates, and the inoculum preparation? What incubations?
28. How is MRSA susceptibility different than a routine KB? Describe how it is different with respect to incubation, interpretation, and visualization of reading.
29. Zone sizes may be mistaken in the presence of swarming and hemolysis. How should these be interpreted?
30. What is HLAR? VRE? What is the use for an oxacillin plate?
31. Why does a lab do a beta lactamase test?
32. Name three distinct methods to perform a beta lactamase test.
33. What is the appropriate storage and quality control for antimicrobial disks?
34. What is the difference between iatrogenic and nosocomial infection?
35. Are there any methicillin resistant strains of Staph besides aureus? What hospital procedure is commonly at fault?

**Emergent Technologies**

1. Compare and contrast polyclonal and monoclonal antibodies; how are they produced? Which are more specific?
2. What is Staph coagglutination?
3. How is a direct fluorescent test different than an indirect fluorescent test?
4. What is FITC? What colors does it absorb, and transmit? What is the most commonly used flurophor in the clinical lab?
5. What is an EIA? What is the antibody sandwich?
6. What is the difference between acute and convalescent serum?
7. How is a Western blot like an EIA? How is it different? Which is more specific?
8. What is meant by hybridization?
9. List 5 types of labels for DNA probes.
10. What is the difference between PCR and LCR? Which one amplifies target? Which one amplifies probe?
11. What is the Gen-Probe method (PACE) for Chlamydia? How does it work?
12. In the hybridization protection assay, what gets protected? What instrument reads the result?
13. What does stringency refer to? How can one make a procedure with higher stringency? What is promiscuous binding? What conditions encourage it?
The Spirochetes
1. The spirochetes fall into genera based loosely on their morphology. Describe the differences in Treponema, Borrelia, and Leptospira.
2. How does Treponema pallidum enter the host?
3. What is Vincent’s disease?
4. What is Weil’s disease?
5. What is pinta?
6. Make a table of the leptospires and the Borrelia, with a column for the name of the disease (eg. Relapsing fever), a column for keywords, and a column for the vector and its common name or other modes of transmission.
7. Describe the characteristic lesion or clinical presentation in Primary syphilis.
8. Describe the characteristic lesion or clinical presentation in Secondary syphilis.
9. Describe the characteristic lesion or clinical presentation in Tertiary syphilis.
10. Describe the laboratory diagnosis of treponemes by direct detection.
11. Another promising method of direct detection is accomplished using ______technology.
12. Name the two most widely used nontreponemal serologic tests. Which one is does first? What do the initials stand for?
13. Can these tests be quantitated?
14. Name several other diseases known to produce reaginic antibodies.
15. Name the two specific treponemal serologic tests.
16. Which of the above tests is most definitive?
17. Name the drug of choice for all treponemal infections.
18. Name the etiologic agent for relapsing fever.
19. Name the etiologic agent for Lyme disease.
20. Name the vectors for these diseases.
21. The first stage of Lyme disease is characterized by_________.
22. The second stage of Lyme disease is characterized by_________.
23. The third stage of Lyme disease is characterized by_________.
24. Which treponeme can be diagnosed on direct observation in peripheral blood?
25. Describe the CDC’s two step approach for the serologic (antibody) diagnosis of Lyme disease
26. Name several other diseases known to give false positive serologic results in tests for Lyme disease.
27. Humans become infected with Leptospirosis through direct or indirect contact with the ______ or ______ of infected animals.
28. Name the organism that causes icteric leptospirosis.
29. What is the preferred serologic test for leptospirosis?
30. What type of specialized media is used to grow spirochetes? Can they be gram stained?

Chlamydia, Mycoplasma, and Ureplasma Species
1. Chlamydia are obligate cellular parasites. What are the two forms of Chlamydia within the cell? Which is the infectious particle?
2. What is TWAR?
3. Name the etiologic agent of the most common bacterial STD___________.
4. Name the etiologic agent for the most common cause of preventable blindness worldwide______.
5. Name the etiologic agent of a STD characterized by bubos.
6. Name the etiologic agent for a common cause of conjunctivitis and pneumonia in a newborn____.
7. Which Chlamydia species is the primary agent in pneumonia and bronchitis in children and adolescents?
8. Describe the morbidity of progressive nongonococcal urethritis due to C.trachomatis.
9. Positive direct detection methods for C.trachomatis can best be validated by which test?
10. What is MOMP, and how is it used in diagnosis of Chlamydia?
11. Which Chlamydia species is an endemic pathogen of all bird species?
12. What is the antibody prevalence of C.pneumoniae in adolescents?
13. Describe the serodiagnosis of C.pneumoniae.
14. What type of culture media can support the growth of Chlamydia?
15. How does Gen-Probe detect Chlamydia?
16. What characteristic distinguishes mycoplasmas from other groups of bacteria?
17. M.pneumoniae primarily is isolated from the ________tract.
18. U.urealyticum and M.hominis are isolated from the __________tract.
19. Which of the above organism are pathogenic in newborns?
20. What is the most promising direct detection method for mycoplasma?
21. Because mycoplasma have no cell wall, they are highly susceptible to_______ during transport.
22. Select the selective media of choice for mycoplasma.
23. What are the special transport requirements for the culture of mycoplasma and chlamydia?
24. Definitive diagnosis of M.pneumoniae on culture is detected by what technique?
25. Describe the characteristic appearance of M.hominis colonies.
26. Name the specific test ordered by physicians for the presumptive diagnosis of pneumonia caused by M.pneumoniae. How reliable is this test?
27. What is PPLO? How are cold agglutinins tested?

**Sexually Transmitted Diseases and Appendix A**

1. List the common sites of infection of gonorrhoeae. Why is it necessary to test a positive GC on an underage child with an alternate method?
2. What is PPNG?
3. What is the diagnostic gram stain for gonorrhoeae? When is this inaccurate?
4. Which of the common STDs is associated with arthritis?
5. How can you differentiate N. gonorrhoeae from N. meningitides?
6. What is sterile pyuria? Why is it associated with Chlamydia?
7. What agent causes bacterial vaginosis? Is this sexually transmitted? What are the symptoms?
8. Name the three stages of syphilis, and state the common manifestations.
9. What is FTA-ABS? What reduces cross-reactivity to other treponemes?
10. What is the difference between chancroid and chancre? What organisms?
11. What virus causes genital herpes?
12. What type of media will grow Neisseria and Haemophilus? Will it support Chlamydia trachomatis? Will it support Treponema pallidum? What type of media is selective for Neisseria, but prevents growth of other genital flora? What antibiotics are in this media? What other forms of selective media are there? What is V-agar? What is human blood tween agar and what is it used for?
13. Which organisms are the major causes of pelvic inflammatory disease in young women?

**Zoonotic and Rickettsial Infections**

1. Make a table of the common zoonotic diseases and match their organisms and common vectors.
2. What is erythema migrans? Which organism causes a bullseye pattern after a tick bite?
3. Cat and dog scratch fever are associated with which gram negative rod?
4. What biochemical result is associated with Erysipelothrix rhusiopathiae?
5. Rat bite fever is caused by what two organisms? Which one causes sodoku? Which one causes Haverhill fever? How are laboratory workers at risk?
6. What are the three forms of anthrax? What is the gram stain? Aerobic or anaerobic?
7. How do Rickettsia and Ehrlichia differ from other bacterial organisms?
8. Make a table of the Rickettsia and Ehrlichia, by genus and species. Include a column that has the common name. Memorize it.
9. Why is PCR a good method to identify Rickettsial infection?
10. What is the etiologic agent that causes human monocytic ehrlichiosis (HME)?
11. The most widely used serologic test for rickettsial disease is the _____ _____ reaction.
12. What is the etiologic agent in RMSF?
13. How is it transmitted?
14. What is the etiologic agent in Q fever?
15. What are the most common reservoirs?
16. What is the etiologic agent in granuloma inguinale, or donovanosis, a STD.?

Mycobacterium
1. Describe the unusual biochemical cell wall structure of Mycobacterium spp.
2. Describe the characteristic of acid-fastness.
3. Name the mycobacterial species that occur in humans and belong to the M. tuberculosis complex.
4. Organisms belonging to the M. tuberculosis complex are considered _______ growers and the colonies are _______ pigmented.
5. Discuss the pathogenesis of M. tuberculosis and the difference between acquisition of ‘infection’ and development of ‘disease’.
6. Mycobacteria are the classic examples of intracellular pathogens and the body’s response to BCG hinges on _____-_____ immunoreactivity.
7. What are some of the presenting symptoms of pulmonary tuberculosis?
8. Nontuberculous mycobacteria (NTB) can be classified into four Runyon groups or can be classified into four major groupings based on the clinical diseases they cause. Name them.
   a. Name the Runyon classification associated with the following:
      i. Colonies develop pigment following exposure to light.
      ii. Colonies are nonpigmented regardless of whether grown in the dark or light.
      iii. Colonies develop pigment in the dark or light.
   b. MAC has emerged as an important pathogen in immunocompromised and immunocompetent populations. MAC includes which two species?
   c. MAC and M. tuberculosis account for approximately ___% of mycobacterial infections in AIDS patients.
   d. What is the Runyon classification of MAC?
   e. What is the Runyon classification and spectrum of disease of M. kansaii and M. marinum?
   f. Name the 3 most commonly encountered rapidly growing NTM that are potentially pathogenic.
9. Leprosy is a chronic disease of the skin, mucous membranes, and nerve tissue. Name the organism. Can it be cultivated?
10. The classification of M. simiae in Bailey and Scott is not necessarily correct. Consult other texts.
11. Specimen processing for the recovery of acid-fast bacilli from clinical specimens involves several complex steps...explain them.
12. What is the (NALC)-NaOH method?
13. What types of specimens require decontamination prior to inoculation to media for mycobacterial culture?
14. Most mycobacteria are incubated at 37 degrees, which organisms have optimal incubation. At 30 degrees and 42 degrees?
15. Describe the two methods of acid fast stains.
16. One drawback associated with fluorochrome stains is that many __________ may not appear fluorescent with these reagents.
17. The overall sensitivity of an acid-fast smear ranges from ____% to ____%.
18. M. gordonae, a nonpathogenic __ commonly found in tap water, can cause a false-__ smear for TB.
19. What are the criteria needed to report an acid-fast smear as “No AFB seen”?
20. Record the distinctive biochemical tests for M. tuberculosis as positive or negative for niacin, nitrate reduction, catalase, and Tween hydrolysis.
21. Which biochemical test differentiates M. bovis from all other Mycobacteria?
22. Name two solid media used for the cultivation of mycobacteria.
23. What is the advantage of liquid media?
24. Name the media of choice for susceptibility testing.
25. Discuss the radiometric method to determine susceptibility of M. tuberculosis isolates.
26. Discuss the biochemical principle behind a positive test for niacin (nicotinic acid).
27. Most species of mycobacteria, except for certain strains of __________ produce catalase.
28. Discuss the clinical significance of the Tween-80 hydrolysis test.
29. Discuss the clinical significance of tellurite reduction.
30. Discuss the clinical significance of arylsulfatase.
31. What type of infection would you expect to be caused by the pathogen M. marinum?
32. What type of infection would you expect to be caused by the pathogen M. scrofulaceum?
33. What type of infection would you expect to be caused by the pathogen M. smegmatis?
34. What is the ‘critical concentration’ of a drug?

Mycology

1. How many species of fungi are recognized as pathogenic in humans?
2. The major factor responsible for the increase in number of fungal infections has been due to an alteration in the ________ system.
3. What type of colony would you expect to see with yeast?
4. What type of colony would you expect to see with filamentous fungi or molds?
5. Explain the concept of thermal dimorphism.
6. Name a few of the medically important dimorphic fungi.
7. In general yeasts reproduce asexually by formation of ____and sexually by the production of ____.
8. The basic structural units of molds are tubelike projections known as hyphae. What are the 3 types of hyphae that exist in the medically important fungi?
9. Name the 4 phyla into which fungi have been categorized.
10. Clinicians find value in placing the fungi into four categories of mycoses. Name them.
11. Tinea pedis (athlete’s foot), tinea capitus and tinea corporis (ringworm of the scalp and body) are known as ________phytes and infect keratinized tissues.
12. Describe the virulence factors for Histoplasmosis which are shared by other medically important fungi.
13. Many fungal infections are similar clinically to mycobacterial infections and the same specimen is sent to the laboratory for dual culture. This specimen is from ________tract secretions.
14. The procedure that often provides the first microbiologic proof of etiology in patients with fungal infections is direct microscopic exam or culture?
15. Define arthroconidia and give an example of that type of fungus.
16. Define chlamydospores and give a common example.
17. Explain the value of cornmeal-Tween 80 agar.
18. Define blastoconidia and give an example.
19. Explain macroconidia and microconidia and give an example.
20. Illustrate an example of antler hyphae, racquet hyphae and spiral hyphae.
21. Illustrate the spores of Aspergillus.
22. Identify the organism from a tissue sample in which spherules develop and ultimately segment into numerous endospores.
23. Identify the organism from tissue sample with pseudohyphae and budding yeast cells.
24. Identify the organism, the only pathogenic yeast, known to have a polysaccharide capsule. How is this capsule best identified in the CSF?
25. Identify the organism from tissue sample with spherical yeast-like cell with multiple buds attached to the parent cell with a narrow connection.
26. Identify the organism from tissue sample with a round yeast-like cell with a single bud attached with a broad base.
27. Describe the features necessary for the identification of Zygomycetes.
28. Describe the features necessary for the identification of Sporothrix (direct detection and culture).
29. How is sporotrichosis acquired? What is an occupational hazard?
30. Describe the features necessary for the identification of Histoplasma capsulatum. How is histoplasmosis acquired? What is an occupational hazard for this disease? What is the geographical distribution?
31. Describe the exoantigen test and the nucleic acid probe test for H. capsulatum.
32. How is coccidiomycosis acquired? What is the geographical distribution?
33. What special precautions should be taken with the culture of coccidioides immitis?
34. Describe the mycelial form and the yeast form of Blastomyces dermatitidis.
35. List some of the varied clinical manifestations of disseminated cryptococcosis. What is an occupational hazard for this disease? What other disease conditions might it be associated with?
36. Discuss the benefits of the cryptococcal latex test for antigen.
37. Discuss the benefits of the rapid urease test.
38. What is the clinical appearance of tinea versicolor?
39. Name the etiologic agent of tinea versicolor and describe its appearance by direct microscopic examination of skin scales.
40. What is the value of using potassium hydroxide preparations?
41. What is the value of using lactophenol cotton blue?
42. The most common species of dermatophytes recovered from clinical specimens is ________.
43. The genus most likely to affect nails is ________.
44. The genus most likely to fluoresce under UV light of a Wood’s lamp is ________.
45. The genus that does not fluoresce under the UV light of a Wood’s lamp is ________.
46. The genus that does not form microconidia.
47. Describe the characteristic appearance of Candida albicans on direct microscopic exam.
48. Describe the characteristic appearance of Trichophyton rubrum.
49. What organism is the most common cause of tinea capitis in school children?
50. What organism used to be the most common cause of tinea capitis?
51. What organism is the cause of ‘ringworm’ in animals?
52. What organism is a common cause of tinea cruris and tinea pedis?
53. List some of the disease processes caused by Aspergillus.
54. Describe dichotomous branching.
55. Penicillium is one of the most common organisms recovered by the clinical laboratory. Describe the characteristic colonies.
56. Describe the features necessary for the diagnosis of Trichophyton schoenleinii.

**Virology**

1. What are the two main structural components of a virion?
2. How are viruses classified?
3. Name 2 disease processes that are caused by adenovirus.
4. How are adenoviruses cultured?
5. Name several arbovirus diseases?
6. How are they transmitted?
7. Name the disease caused by HHV-6, HHV-7, and HHV 8.
8. List 3 methods used to identify herpesvirus in the laboratory.
9. How is HPV detected in cervical cells?
10. Describe how the laboratory detection of RSV is performed.
11. Discuss antigenic drift as applied to influenza virus.
Clinical Laboratory Sciences Program

12. How is influenza virus detected in the laboratory?
13. What is the risk of fifth disease to the fetus, child or adult with this disease?
14. How parvovirus infection confirmed in the laboratory?
15. Name two diseases caused by the retrovirus family.
16. How are retroviruses unique?
17. Specimens for the detection of virus should be collected as early as ___ days following the onset of disease.
18. Describe the technique for a nasopharyngeal aspiration for a specimen.
19. Name two viruses that can be detected from cutaneous vesicles by a Tzanck smear?
20. Rabies virus inclusions in brain tissue are called _______.
21. When should the convalescent serum specimen be collected?
22. What is considered a positive serologic result comparing an acute and convalescent serum?
23. Name two viruses cultured by shellvial assay.
24. Immunodiagnosis utilizes commercially available viral antibody reagents for the direct immunofluorescent antibody testing and enzyme immunoassay.
25. Describe the basis of the polymerase chain reaction (PCR) test.
26. Explain the diagnostic value of the cytopathic effect (CPE) in conventional cell culture.
27. Describe the value of each of the following HIV tests: ELISA, Western blot, HIV-1 p24 antigen, PCR.

Parasitology
1. Give two reasons why many organisms endemic elsewhere are now seen in the United States.
2. The identification of parasitic organisms depends on morphologic criteria; give the two most common reasons for misidentification.
3. Collection of fecal specimens for intestinal parasites should be performed before or after radiologic studies involving barium sulfate?
4. For the routine examination for parasites before treatment, how many fecal specimens should be submitted for identification?
5. Freshly passed specimens are mandatory to detect ___ or ___. They should be examined within ___ minutes of passage.
6. Stool specimens should not be held at room temperature but should be refrigerated at _______. At this temperature, eggs, larvae, and protozoan cysts remain viable for several days.
7. Name four preservatives used in collection kits.
8. What type of microscope should be used for parasite identification?
9. Name two concentration procedures in the examination of parasites from the stool.
10. _ stained smears are recommended for every stool sample submitted for a routine examination for parasites.
11. Name two organisms normally found in the duodenum which may not be detected after repeated fecal examinations.
12. Name the best diagnostic technique for the identification of Enterobius vermicularis.
13. Name the best diagnostic technique for the identification of Trichomonas vaginalis.
14. Name the organism which is best diagnosed by examination of aspirated material from lung or liver abscesses.
15. Name the organism which is best diagnosed by examination of specimens obtained from cutaneous ulcers.
16. Name the amoebic organism which is best diagnosed by examination of spinal fluid.
17. Name the parasitic organism that causes pneumonia and is identified from a bronchoalveolar lavage specimen or lung biopsy. Name the type of stain used for identification of these organisms.
18. Where are cryptosporidia organisms usually found?
19. How are Toxoplasma gondii infections usually identified?
20. Name the animal host of oocysts.
21. Name 4 parasitic organisms that are most commonly identified by immunodiagnostic procedures (antigen detection by EIA, DFA, and IFA formats).
22. Describe the utility of a ‘thick smear’ and that of a ‘thin film’ smear.
23. Name the stains most widely used for staining blood films for malaria.
24. Name the most common protozoan organism found in persons in the United States. Describe the range of clinical symptoms.
25. Name two parasitic diseases where the larvae forms are recovered from human muscle.
26. Name the disease that forms hydatid cysts in the liver, lung, and brain.
27. Name the disease that forms cysticerci in the muscle and brain.
28. What characteristics of Entamoeba histolytica would you expect to see in a fresh stool sample examined as a direct wet mount?
29. Name one of the most important criteria used for identification of genus Entamoeba.
30. Describe the invasive disease of E. histolytica.
31. Describe the diagnosis of E. histolytica.
32. Name two Coccidia that are reported to occur in AIDS.
33. In all four species of Plasmodium, humans become infected when the _____ are introduced into the blood from the salivary secretions of the infected mosquito. The early forms in the red blood cells are called ring forms, or young ____. During the next phase of the cycle mature schizonts are formed and called ______.
34. What causes the periodic fever in malaria?
35. Describe the diagnostic characteristics of the RBC in:
   a. Plasmodium malaria
   b. Plasmodium vivax
   c. Plasmodium falciparum
   d. Plasmodium ovale
36. Name three types of hemolytic anemia where people are carriers and have increased resistance to falciparum malaria.
37. How is babesiosis transmitted?
38. How can it be distinguished from Plasmodium on blood smear?
39. Name two blood and tissue flagellates that are medically important.
40. They exist in the ___________form in humans as an intracellular parasite in the cells of the reticuloendothelial system or in macrophages.
41. Name the parasite responsible for visceral leishmaniasis.
42. How is this diagnosis made?
43. Differentiate the diseases caused by the three pathogenic trypanosomes.
44. Name the vectors of these hemoflagellates.
45. Name the organism and the pathogenesis of the disease in sleeping sickness and Chagas’ disease.
46. Intestinal helminths consist of _______worms and _______worms.
47. Nematodes are diagnosed by characteristic eggs in the stool. Describe the characteristic findings of ‘hookworm’, Strongyloides stercoralis, and pinworms.
48. How is Trichinella spiralis identified in the laboratory?
49. How is Diphyllobothrium latum acquired?
50. Describe the diagnostic characteristics of Cestodes.
51. The easiest trematode eggs to identify are those of the schistosomes. Describe the characteristics.
52. What is the cause of ‘swimmer’s itch’ in the Great Lakes area?
53. What is the intermediate host for Schistosoma mansoni?
54. Describe the pathogenesis of Schistosoma haematobium.
55. Name the giant intestinal fluke, the sheep liver fluke, the lung fluke, and the Chinese liver fluke.
56. Describe the appearance of Trichomonas vaginalis; where is it found?
Section 4
Immunohematology Rotation
Instructions for Evaluations for Students and Clinical Supervisors

**Qualitative Student Competency Checklist:** This form should be completed by the student to evaluate their performance early in the rotation.

**Technical Competencies Checklist:** In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. The student should rate their ability to perform accurate and reliable testing in a timely manner in the areas listed on the Immunohematology internship checklist. The student’s time during each rotation will be spent observing and performing various procedures and reviewing theory and test principles. Performing tests in duplicate or performing tests under the direct supervision of the clinical instructor is encouraged. The checklists are provided as a guideline to ensure that routine procedures have been observed and performed. As a particular skill is performed, the student should indicate whether there was satisfactory or unsatisfactory performance. Otherwise, indicate whether the skill was only observed or discussed, or if it was not available (NA).

**Quantitative Final Evaluation:** This evaluation consists of 4 parts; rotation specific psychomotor skills, overall knowledge and skills, the student's professional behavior, and summary comments. Please complete these forms by the last day of the student's rotation. The affiliate supervisor should review these forms with the student. The student and evaluator will sign the forms and return them to the Santa Fe College Internship Coordinator.

**Part 1 Psychomotor Evaluation:** This form is to be utilized by the clinical instructor to evaluate the student’s technical skills specific to the rotation.

**Part 2 Evaluation of Knowledge & Skills:** In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. Please rate the student’s overall ability to perform accurate and reliable testing in a timely manner.

**Part 3 Evaluation of Professional Behaviors:** This form is to be utilized by the clinical instructor to evaluate the student’s professional behaviors.

- Please be honest in rating each of the professional characteristics of the student.
- Base your judgment on behavior which you feel is characteristic of the student during the period of evaluation
- Please comment on any rating in the Needs Improvement of Unsatisfactory category.

**Part 4 Summary Comments:** In this section please feel free to write a brief overview of the student’s performance. Any problems that you encountered with the student, as well as praise, should be noted here. This is very helpful to students so they will learn their strengths and weaknesses.

**NOTE:** If any problems or conflicts arise while the student is in your department, please bring them to the attention of the SF liaison as soon as possible so it can be resolved.

*Forms are located in the appendix (printable versions).*
Clinical Laboratory Sciences Program

Santa Fe College Clinical Laboratory Sciences Program

**Immunohematology Internship Syllabus**

**COURSE NUMBER:** MLS 4823L

**TITLE:** Immunohematology Internship

**CREDIT:** 4 credits

**TEXT:** Board of Registry Study Guide: Clinical Laboratory Certification Examinations

**INSTRUCTOR:** Myra Urso, Med, BSMT (ASCP), myra.urso@sfcollege.edu

Work phone: (352) 381-3750

**COURSE DESCRIPTION:** The student will attend a clinical internship in a well-equipped and properly staffed laboratory for technical experience in microbiology.

**Note:** This course may begin and/or end after the official published semester dates in order to accommodate scheduling availability at our clinical affiliates.

**COURSE OBJECTIVES:** By the end of the clinical internship, the CLS student should be able to complete or explain all of the following objectives with 70% accuracy.

1. Review immunohematology lecture material before the beginning of the clinical practicum.
2. Apply theoretical knowledge to technical procedures.
3. Assess your immunohematology knowledge by completing the BOR blood bank study questions.
4. Remediate in areas of weakness before the clinical immunohematology examination.
5. Perform daily quality control.
6. Perform ABO typing, forward and reverse, and interpret results.
7. Identify and resolve ABO discrepancies using the standard operating procedure manual.
8. Perform Rh(D) typing to include weak D (Du) typing.
9. Perform an antibody screen and interpret results.
10. Identify a single antibody with 95% confidence using the Rule of Three.
11. Identify multiple antibodies.
12. Select cells to use in a selected cell panel in order to rule out clinically significant antibodies.
13. Phenotype specimens as well as select appropriate positive and negative controls for the antisera.
14. Perform a direct antiglobulin test.9999
15. Perform an immediate spin crossmatch.
16. Perform an extended crossmatch.
17. Work up a transfusion reaction.
18. Perform a prenatal screen to include ABO/Rh and antibody screen.
19. Perform a cord blood workup to include ABO/Rh and DAT.
20. Perform a fetal screen to detect a fetal maternal hemorrhage.
22. Apply technical knowledge while performing basic laboratory procedures.
23. Display responsibility for one’s actions while at the clinical affiliate.
24. Accept constructive criticism to improve developing work habits.
25. Self-evaluate the interpersonal relationships with co-workers and other members of the healthcare team.
26. Follow standard operating procedure manual and admit to errors or mistakes when they occur.
Clinical Laboratory Sciences Program

27. Organize the workload, prioritizing STATs and reducing turn-around-times.
28. Display dependability by arriving to clinical at designated times and days.
29. Adapt to different teaching styles and workload without complaining.
30. Display confidence in one’s technical ability while at the same time, recognize one’s limitations.

METHOD OF TEACHING: Laboratory Bench Instruction
Demonstration
Role modeling

EVALUATION METHOD: Students will be evaluated in four areas:
1. Technical competency achieved by the end of the clinical internship in a specified laboratory procedure evaluated by the clinical instructor.
2. Professionalism demonstrated during the clinical internship evaluated by the clinical instructor(s).
3. Theoretical knowledge demonstrated by a written examination on the last day of the clinical internship given by the College.
4. Weekly discussion board posts documenting what you have learned at the clinical affiliate.

TECHNICAL COMPETENCY:
Your technical competency will be assessed at the end of your clinical rotation by the clinical faculty. This psychomotor evaluation is worth 30% of your total grade in this course. It is your responsibility to know what tasks are on the checklist and to ask your clinical instructor(s) to initial it on a weekly basis as the assigned tasks are completed. Completion of the checklist is scored as either 100% or 0%.

PROFESSIONALISM:
Your professionalism will be assessed at the end of your clinical rotation by the clinical faculty. This affective evaluation is worth 30% of your total grade in the course. Remember that from the first day of your clinical internship, you are being evaluated for potential employment opportunities. Take advantage of this opportunity and ask your clinical instructors if they would be willing to be one of your references when you start applying for open positions.

WRITTEN EXAMINATION:
There is one multiple choice question examination at the end of clinical rotation. This cognitive evaluation is worth 30% of your total grade in this course. A self-paced study guide is provided to assist you with your preparation for the examination. Material included on the examination will be taken directly from the study questions focusing on theory, methodology, and clinical significance of each chemistry analyte.

DISCUSSION BOARD:
The weekly discussion board posts are due every Friday by 5:00 p.m. The discussion board should include what instrument you trained on, what profiles were performed, what analytes were measured, the principles of the analytes, any critical results that were phoned, and any interesting patient results that you encountered. In addition, you are required to answer all of the instructor’s questions on the discussion board by Sunday evening at 12:00 midnight for full credit.
Clinical Laboratory Sciences Program

**GRADES:**

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**CALCULATION OF GRADE**

- Technical Competency: 30%
- Professionalism: 30%
- Written examination: 30%
- Weekly blog: 10%

Total 100%

The MLS student must pass this course with a “C” or better in order to continue in the MLS Program. There are no excused absences from the clinicals. The student must notify the clinical instructor if he/she is going to be late or absent before the time he/she is scheduled to be at the clinical facility. Make-up time is at the discretion of the clinical instructor.

**Americans with Disabilities Act (ADA) Student Rights**

If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations.

**Discrimination/Harassment Policy Statement**

Santa Fe College prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to the SFC Human Resources Policies website.

**College Academic Integrity Statement**

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.
Immunohematology Psychomotor Objectives

*By the end of the immunohematology internship, the CLS student should be able to complete the following objectives with 70% accuracy.

- Familiarize yourself with the layout of the blood bank department including the receiving area, component area, and issuing area, specimen receiving area, and testing area.
- Determine proper sample collection for the blood bank and the criteria for accepting a specimen into the blood bank for testing.
- Perform daily QC procedures for reagents.
- Perform routine testing procedures including:
  - ABO typing
  - Rh typing
  - Direct Antiglobulin Test (DAT)
  - Type and Screen
  - Crossmatch
- Interpret and validate QC results
- Prepare able to prepare a 2-5% cell suspension
- Interpret ABO forward typing results.
- Interpret ABO reverse typing results.
- Differentiate the subgroups of A using A2 cells and A lectin.
- Perform both DAT and IAT in the lab.
- Perform AHG testing using monospecific AHG, polyspecific AGH, anti-IgG, and anti-C3d.
- Differentiate the causes of a false positive and false negative reactions in antiglobulin testing.
- Perform Rh testing.
- Perform weak D testing and the steps involved in resolving a weak D.
- Describe the appropriate criteria for blood transfusion selection of RBC, Platelets, FFP, and Cryoprecipitate.
- Explain the different storage locations of blood products and what their storage date and storage temperatures need to be in order to be in compliance with regulatory agencies.
- Perform daily QC independently
- Perform ABO, Rh, and Screen procedures independently
- Perform antibody identification procedures on known positive samples
- Identify antibody specificity using red blood cell panels
- Perform antigen typing procedures on sample or antigens other than the ABO and Rh groups
- Select the appropriate RBC component for a routine type and crossmatch procedure
- Select the appropriate RBC component for a routine positive antibody screen identified
- Perform the functions necessary in the Blood Bank LIS for identifying, crossmatching, labeling, releasing and insuring that the component selected is usable
- Perform a transfusion reaction workup procedure
- Perform a workup for a positive DAT
- Perform an elution study
- Perform crossmatch procedures on your specimens that are negative screen and positive screens
- Perform an incompatible crossmatch
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- Interpret antibody screen and panel results and be able to discuss reaction temperature, reaction strengths, enhancement media, and results
- Perform an antibody rule out on a set of screen cells
- Perform an antibody rule out on a set of panel screens
- Perform antibody identification using the following techniques:
  - Selected cell panels
  - Enzymes
  - Neutralization
  - Adsorption
- Perform an antibody titration and be able to calculate a titration score.
- Perform the tests involved in the investigation of a hemolytic anemia:
  - Collection of blood if cold antibody is suspected
  - Direct antiglobulin test
  - Elution and identification of the antibody
  - Screen the serum for the presence of the antibody
  - Cold agglutinin titer and confirmation of anti-1 specificity
  - Warm autoabsorption and determination of warm autoantibody specificity
- Perform a transfusion reaction work up
- Perform daily QC independently.
- Perform ABO, Rh, and Screen procedures independently.
- Perform antibody identification procedures on known positive samples.
- Identify antibody specificity using red blood cell panels.
- Identify multiple antibodies in one specimen using the known antibody identification procedures.
- Perform enzyme panels where indicated.
- Perform an inventory of the blood supply for the department.
- Perform product irradiation.
- Perform a RBC cell washing.
- Perform a platelet washing (if applicable).
- Perform a product filtration.
- Prepare an aliquot and a split product.
- Perform daily QC independently
- Perform ABO, Rh, and Screen procedures independently
- Interpret antibody screen and panel results.
- Perform an antibody rule out on a set of screen cells
- Perform an antibody rule out on a set of panel screens
- Perform antibody identification using the following techniques:
  - Selected cell panels
  - Enzymes
  - Neutralization
  - Adsorption
- Identify the storage conditions, shelf life, quality control requirements, and indications for blood products
- Perform daily preventative maintenance on Ortho Provue Analyzer
- Perform daily quality control (QC) procedures on Ortho Provue Analyzer
- Perform ABO, Rh, Antibody Screen on Ortho Provue Analyzer
- Review automated results.
- Observe Platelet Antibody procedure (if applicable)
- Receive specimens into the bb department using the specimen criteria established by the bb SOP’s
- Log specimen into the bb LIS
- Process specimen for bb testing
- Perform prenatal testing
- Perform neonatal testing on cord bloods
- Perform workup on positive DAT’s from cord blood (where applicable)
- Evaluate prenatal and cord blood results in order to determine the need for Rh Immune globulin administration
- Perform a fetal screen procedure
- Perform fetal/maternal bleed calculations
- Prepare a dose of RhIg for administration
- Perform the quality assurance measure for startup and shut down, including reagent preparations and analyzer cleaning
- Perform QC and interpret data for accuracy and perform all necessary documentation
- Perform the tests that are used in determining and diagnosing HDN: TS, Cord, Fetal Screen
- If available, observe blood donor procedures to include donor selection, blood collection and component processing.
Immunohematology Study Guide for Exam

Question Set One

1. What are the 5 primary classes of immunoglobulins?
2. What are the primary functions of the FAB and Fc regions of an immunoglobulin molecule?
3. List the components of the classic complement pathway in order of attachment to the RBC.
4. Differentiate between an alloantibody and an autoantibody.
5. Differentiate between avidity and affinity. Differentiate between an antigen and an immunogen.
6. Define hapten.
7. What immunoglobulin class is present at the beginning of the primary response to antigen?
8. What immunoglobulin class is present in the Secondary response? Why is the secondary response faster than the primary response? Describe the 2 stages of agglutination.
9. Differentiate between a prozone and a postzone reaction.
11. Define zeta potential.
12. What is red cell sensitization?
13. For a person to develop antibodies against a red cell antigen, what must be the composition of the person’s RBCs?
14. Name the antibodies contained in polyspecific AHG and monospecific AHG.
15. What is the difference between a DAT and an IAT?
16. Why is incubation time important in the IAT? Can the time be shortened? How? How does washing affect your results?
17. Describe Coombs control cells. When are they used?
18. Why is specimen tube an issue in blood bank specimens? What is the tube of choice?
19. Describe the primary characteristics of the “naturally occurring” A and B antibodies.
20. List the sugars responsible for the H, A and B antigens. Which antigen is formed first?
21. Which ABO blood group has the highest concentration of H antigen? Why?
22. How does the regulatory activity of the Sese and Zz systems differ? How does the Sese system relate to laboratory testing for ABO?
23. Name all the lectins and their uses.
24. What is the phenotype of Bombay cells? What antigens are present on the RBCs? In routine ABO typing what blood group would be assigned to a Bombay individual? Would this blood be compatible for the individual?
25. How does anti-H in a Bombay person differ from that of other persons?
26. What “naturally occurring” antibodies are present in the serum of a Bombay person? How would reverse grouping of this person be affected?
27. How do plasma proteins and Wharton’s jelly affect ABO typing?
28. List the most common Rh genotype in the white population using both Fisher Race and Wiener nomenclature. What antibody could be produced by these individuals?
29. Which of the 6 major Rh antigen designations does not exist as a gene product on the RBC?
31. What type of blood should be routinely transfused into persons who type as weak D? Under what circumstances would this change?
32. What Ig class are the Rh antibodies? How does laboratory testing for Rh differ from ABO testing?
33. How do individuals develop anti-D? How could the presence of anti-D affect the typing of an individual for the D antigen?
34. Discuss the different types of D reagents.
35. What are the control requirements when using the different D reagent? Describe the RBC
characteristics of an Rh\textsubscript{null} individual. What type of blood must these persons receive?
37. How can anti-D be distinguished from anti-LW?
38. At what temperature must blood be maintained in the blood bank refrigerator? Fresh frozen plasma?
39. What routine blood bank tests must be performed on all donor units? If blood is received from an outside collection center, what tests must be repeated by the receiving blood bank prior to making the unit available for transfusion? Why is Rh positive blood not rechecked?
40. Under what conditions might an abbreviated (immediate spin) crossmatch be acceptable? Why would previous patient testing and transfusion history be important in this situation?
41. What important tests are part of the prenatal testing?
42. What cord blood testing is routinely performed on all babies born to Rh negative mothers?
43. What 3 genes are required for Lewis antigen production? What does each contribute?
44. Why is Lewis a system rather than a blood group?
45. Fill in the following chart:

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<th>GENES PRESENT</th>
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46. How will red cells that are Le (a-b-) phenotype when suspended in plasma containing Le\textsuperscript{a}? Le\textsuperscript{a} and Le\textsuperscript{b}?
47. What is the primary substance associated with Lewis that is added to precursor substance?
48. Discuss Lewis antigens on cord blood cells and in infant plasma and serum.
49. What is the most common phenotype producing Lewis antibodies?
50. To what immunoglobulin class do most Lewis antibodies belong?
51. Will a person who is Le (a-b+) make anti Le\textsuperscript{a}? Why or why not?
52. Describe a reaction between Lewis positive red cells and Lewis antibody with regard to temperature, hemolysis, and enzymes.
53. How can the Lewis antibodies be neutralized?
54. Describe the significance of Lewis antibodies in the serum of a patient needing a transfusion.
55. Can Lewis antibodies cause HDN? Why or why not?
56. What Lewis phenotype (s) may be found in a person with a Bombay phenotype?
57. What is the phenotype of persons producing the antigens Le\textsuperscript{c} and Le\textsuperscript{d}?
58. Define a blood group system.
59. Differentiate between a high frequency antigen and a low frequency antigen. To which group are antibodies most frequently encountered in routine blood bank screening?
60. Define dosage. How can knowledge of an antigen’s ability to exhibit dosage aid in antibody identification?

61. Why are the M and N antigens often associated with paternity testing? Can a mother who is MM and a father who is NN produce a child that is MM?

62. Which antigens of the MNSs system are associated with GPA and which with GPB? Which antigen requires methionine at aa position 29?

63. Are red blood cells positively or negatively charged? What substance produces this charge?

64. How are the MN antigens affected by routine blood bank enzymes? ZZAP? DTT? AET?

65. Which MNSs antigen will not be present on red cells treated with bleach?

66. Which of the MNSs antibodies bind complement? Are saline reactive?

67. How can the reactivity of a weak anti M be enhanced?

68. Why may anti M be sometimes detected in plasma and not in serum?

69. Why is anti N frequently found in dialysis patients? Is it significant? Why or why not?

70. Would a person of Caucasian or Black race be more likely to produce anti U?

71. What is the phenotype of an En(a-) person with regard to M, N and Wr?

72. Relate the P system to the ABO system. How can it cause an ABO discrepancy?

73. Why is ant P₁ difficult to detect in a panel identification?

74. State the antibodies found in the serum of persons with the phenotypes P₂, p and P⁴. Which is a potent hemolysin? Associated with spontaneous abortion? Found in pigeon droppings? Associated with PCH?

75. What substance can be used to neutralize anti P₁?

76. Differentiate between the I and I antigens in newborns.

77. What microorganism is frequently associated with the presence of anti I? anti-I? Under what conditions is I antigen increased on the cells?

78. How does anti-I interfere with crossmatches? How can the interference be prevented?

79. Why can blood be safely transfused in its presence?

80. What is the purpose of including cord cells in an identification panel?

81. Is K or k a high frequency antigen? Kp⁺ or Kp⁻? Js⁺ or Js⁻? What is the frequency of the Kell antigen?

82. What is the most reliable method for detecting anti-K?

83. Why is it difficult to identify anti-k, anti-Js⁷ and anti-JKb?

84. Why are K⁺ cells useful in identification of Kell system antibodies?

85. If a person has an antibody to a high incidence antigen, what is the source of the most likely compatible blood?

86. Describe the red cell morphology, commonly abnormal laboratory tests and diseases associated with the McLeod phenotype. From what chromosome is this gene inherited?

87. Of what benefit is the phenotype Fy(a-b-) ? In what race is it most frequently seen?

88. Describe the reactivity of anti Fy⁺ and Fy⁻ in LIS, with enzyme treated cells and with AHG.

89. Are blacks or Caucasians more likely to be Jk⁺ positive?

90. Why are the Kidd antibodies difficult to detect and identify? How can their reactivity be enhanced?

91. What is the best way to rule out the presence of Jk⁺ and Jk⁻ antibodies when performing an antibody ID? Why?

92. Why would a pre-transfusion sample be negative for Jk antibodies and a post-transfusion sample test positive? How can this be avoided?

93. What antibodies are the most frequent cause of delayed transfusion reactions?

94. What is the most common Lutheran phenotype?

95. What 3 classes of immunoglobulins are represented by Lutheran antibodies?

96. Describe the appearance of a positive Lutheran antibodies?

97. How does the reactivity of Lu⁺ differ from that of Lu⁻? Which is more clinically significant?

98. What phenotype is produced by the In(Lu) gene?
99. Create an antibody chart similar to the one found in the inside cover of the textbook.

**Question Set Two**

1. What ABO group is used for reagent red blood cells in antibody screens and panels? Why?
2. Why are homozygous cells preferred for antibody screening cells?
3. How does LISS enhance antibody detection? Albumin?
4. What is the advantage of monospecific AHG? Polyspecific?
5. How will failure to adequately wash cells prior to adding AHG affect the reaction?
6. How will the Coombs control cells react in this case? If AHG is not present, how will Coombs control cells react?
7. What is the composition of an autocontrol? What can cause a positive autocontrol?
8. How can the presence of rouleaux affect test results? How is it detected?
9. How does a delayed transfusion reaction occur?
10. Why is knowledge of a patient’s transfusion history and pregnancy history helpful in antibody identification?
11. When performing a panel how is the presence of a particular antibody in the patient’s serum ruled out? Why is reaction grading important? Do questions 7 - 10 in Chapter 11.
12. How can antigen typing confirm antibody identification?
13. Why is it necessary to run an untreated panel in conjunction with an enzyme panel?
14. How can the identification of an antibody causing a positive DAT be determined? State 3 methods used in performing this procedure.
15. What are the scoring values assigned to reaction strengths when performing an antibody titration? How can you ensure an accurate comparison between titers performed at different times on the same person?
16. When multiple antibodies are encountered in a patient’s serum, how many cells are necessary for confirmative testing? Can the cells have more than one of the suspected complimentary antigens? What is the final confirmation?
17. When should the presence of an antibody to a high frequency antigen be suspected?
18. What are the 3 most common cold autoantibodies? Explain the principles of the 4 methods used to avoid detection of cold autoantibodies of no clinical significance.
19. Why may a person with a positive warm antibody DAT have a negative antibody screening test? How can the presence of an alloantibody be detected and it identifies in the presence of a warm autoantibody?
20. What could be the cause of a patient showing positive results with all screening and panel cells and yet have a negative DAT?
21. What is the major cause of transfusion fatalities?
22. A recently transfused patient is scheduled for surgery on Friday. Blood for a crossmatch for a possible transfusion during surgery is drawn on Monday. Is this acceptable? Why or why not?
23. Why are hemolyzed samples not satisfactory for crossmatches?
24. What tests should be performed on a donor unit by the facility using the unit for transfusion?
25. What is the most critical pretransfusion test performed in the Blood Bank? Why? How will an incorrect result affect the crossmatch?
26. What is a “clinically significant” antibody?
27. Why can monospecific AHG be used in the crossmatch procedure?
28. Explain why Group O blood can be given to any blood group and a Group AB person can receive any blood group. What blood component should be given when nongroup specific blood is transfused?
29. What are the components of the major crossmatch?
30. Differentiate between the immediate spin crossmatch and the antiglobulin crossmatch.
31. How will the autocontrol in the crossmatch react if a patient has an alloantibody?
32. An autoantibody? Abnormal serum proteins? Reagents are contaminated?
33. How will a patient with a Positive DAT affect crossmatch results? A donor with a positive DAT?
34. Can Rh positive blood be given to an Rh negative patient? If so, when?
35. Following transfusion of Group O blood to a Group A patient, what should be done if additional units are needed the next day?
36. Why is it not necessary to perform antibody screens on autologous donations? What tests must be run on these units?
37. Following release of blood from an immediate spin crossmatch, what should the technologist do next?
38. If an unused unit of blood is returned to the blood bank, what conditions must be met to permit reissuing of the unit?
39. What is the advantage of performing the type and screen procedure in a presurgical workup instead of a crossmatch and hold for 2 units?
40. Define polyagglutination. What 3 major ways does it occur?
41. What is the underlying cause of T, Th, Tk and Tx polyagglutination? Acquired B?
42. How do CAD, Hempas and NOR cause polyagglutination?
43. How do polyagglutinable cells interfere with ABO typing?
44. How is the presence of polyagglutination confirmed? What reactions will occur?
45. List several disorders associated with polyagglutination.
46. What is the recommended blood product for transfusing a patient with polyagglutination?
47. How will the hemoglobin change following the transfusion of 1 unit of packed cells?
48. How will the platelet count change following the transfusion of 1 unit of random donor platelets?
49. What is the purpose of irradiation? Of leuko-depletion? Why are single donor plateletpheresis units better than pooled random donor platelets?
50. What happens to stored RBC with respect to 2,3-DPG?
51. What happens to potassium?
52. Indicate 2 conditions in which the patients need washed RBCs for transfusion
   A. _________________________________________________________
   B. _________________________________________________________
53. Transfusion of one unit of RBC's to an adult should raise the hematocrit approximately _______g/dL by 48-72 hours post transfusion
54. Give one indication and one major contraindication for the use of whole blood for transfusion
   A. _________________________________________________________
   B. _________________________________________________________
55. Universal application of leukocyte-reduced RBC preparations for transfusion is currently underway because donor leukocytes may cause ___________. Give 3 transfusion associated (non-infectious) conditions.
   A. _________________________________________________________
   B. _________________________________________________________
   C. _________________________________________________________
56. What is the choice blood component for treating a patient with multiple coagulation factor deficiencies?
57. What is the main purpose of irradiation of cellular blood components prior to transfusion?
58. Platelet concentrates are primarily used to transfuse patients with thrombocytopenia due to ____________?
59. Transfusion of one unit of Red Blood Cells to an adult should raise the hemoglobin concentration approximately ________________?
60. Currently, what is the most significant step taken to reduce transfusion-transmitted CMV infection? ________________
Question Set Three

1. Define massive transfusion:
2. A patient who received massive transfusion and is now stabilized, may need to be followed with transfusion of which blood components?
3. Leukocyte reduced poor red blood cells is the component of choice for patients who repeatedly experience which type of transfusion reaction?
4. Indicate the blood component that is most appropriate for patients in the following situations/conditions:
   - A patient with advanced liver disease, showing a progressively increasing prolongation of PT and APTT _____________________________
   - A 26-year-old woman, diagnosed as having Von Willebrand's disease, is bleeding after childbirth. _____________________________
   - A patient with chronic anemia, whose hemoglobin level is normally around 9gm/DL is scheduled for major surgery _____________________________
5. What is the expected increment in the patient’s platelet count following transfusion of one unit of random donor platelet concentrate?
6. Following transfusion of 10 units of random donor platelet, a patient with an original platelet count of 20,000/uL would be expected to have a platelet count of approximately: __________
7. What is the expected increment in the patient’s platelet count following transfusion of one unit of single donor platelet concentrate?
8. Differentiate between a high frequency antigen and a low frequency antigen. To which group are antibodies most frequently encountered in routine blood bank screening?
9. Define dosage. How can knowledge of an antigen’s ability to exhibit dosage aid in antibody identification?
10. Why are the M and N antigens often associated with paternity testing? Can a mother who is MM and a father who is NN produce a child that is MM?
11. Which antigens of the MNSs system are associated with GPA and which with GPB?
12. Which antigen requires methionine at aa position 29?
13. Are red blood cells positively or negatively charged?
14. What substance produces this charge?
15. How are the MN antigens affected by routine blood bank enzymes? ZZAP? DTT? AET?
16. Which MNSs antigen will not be present on red cells treated with bleach?
17. Which of the MNSs antibodies bind complement? Are saline reactive?
18. How can the reactivity of a weak anti M be enhanced?
19. Why may anti M be sometimes detected in plasma and not in serum?
20. Why is anti N frequently found in dialysis patients? Is it significant? Why or why not?
21. Would a person of Caucasian or Black race be more likely to produce anti U?
22. What is the phenotype of an En(a-) person with regard to M, N and Wr?
23. Relate the P system to the ABO system. How can it cause an ABO discrepancy?
24. Why is ant P\(_1\) difficult to detect in a panel identification?
25. State the antibodies found in the serum of persons with the phenotypes P\(_2\), p and P\(^k\).
26. Which is a potent hemolysin?
27. Which is associated with spontaneous abortion?
28. Which is found in pigeon droppings?
29. Which is associated with PCH?
30. What substance can be used to neutralize anti P\(_1\)?
31. Differentiate between the I and I antigens in newborns.
32. What microorganism is frequently associated with the presence of anti I? Anti-I?
33. Under what conditions is I antigen increased on the cells?
34. How does anti-I interfere with crossmatches? How can the interference be prevented?
35. Why can blood be safely transfused in its presence?
36. What is the purpose of including cord cells in an identification panel?
37. Is K or k a high frequency antigen? Kp\textsuperscript{a} or Kp\textsuperscript{b}? Js\textsuperscript{a} or Js\textsuperscript{b}?
38. What is the frequency of the Kell antigen?
39. What is the most reliable method for detecting anti-K?
40. Why are K\textsubscript{o} cells useful in identification of Kell system antibodies?
41. If a person has an antibody to a high incidence antigen, what is the source of the most likely compatible blood?
42. Describe the red cell morphology, commonly abnormal laboratory tests and diseases associated with the McLeod phenotype. From what chromosome is this gene inherited?
43. Of what benefit is the phenotype Fy\textsubscript{a-b-}? In what race is it most frequently seen?
44. Describe the reactivity of anti Fy\textsuperscript{a} and Fy\textsuperscript{b} in LIS, with enzyme treated cells and with AHG.
45. Why are the Kidd antibodies difficult to detect and identify?
46. How can their reactivity be enhanced?
47. What antibodies are the most frequent cause of delayed transfusion reactions?
48. What 3 classes of immunoglobulins are represented by Lutheran antibodies?
49. Match the following blood group systems with their primary characteristics
   •  Xg\textsuperscript{+}  A. Found in the Mongolian population
   •  Cartwright  B. May be missed by some AHG reagents
   •  Diego  C. Alleles are Sm and Bu\textsuperscript{a}
   •  Dombrock  D. Inherited on the X chromosome
   •  Wright  E. Yt\textsuperscript{a} and Yt\textsuperscript{b}
   •  Scianna  F. May cause severe transfusion reactions and AIHA
50. Describe the HTLA antibodies. Why may they be difficult to detect?
51. Why must their presence be determined?
52. Describe the recommended procedure for detecting HTLA antibodies.
53. How are their reactions affected by dilution?
54. How do HTLA antibodies differ from Bg antibodies in panels?
55. State 2 unique characteristics of anti-Chido and Rogers.
56. Which blood group system is primarily associated with WBC antigens?
57. Anti-Sd\textsuperscript{a} can be identified by neutralizing with ____________________

**Question Set Four**

1. What ABO group is used for reagent red blood cells in antibody screens and panels? Why?
2. Why are homozygous cells preferred for antibody screening cells?
3. How does LISS enhance antibody detection? Albumin?
4. What is the advantage of monospecific AHG? Polyspecific?
5. How will failure to adequately wash cells prior to adding AHG affect the reaction?
6. How will the Coombs control cells react in this case? If AHG is not present, how will Coombs control cells react?
7. What is the composition of an autocontrol? What can cause a positive autocontrol?
8. How can the presence of rouleaux affect test results? How is it detected?
9. How does a delayed transfusion reaction occur?
10. Why is knowledge of a patient’s transfusion history and pregnancy history helpful in antibody identification?
11. When performing a panel how is the presence of a particular antibody in the patient’s serum ruled out? Why is reaction grading important? Do questions 7 - 10 in Chapter 11
12. How can antigen typing confirm antibody identification?
13. Why is it necessary to run an untreated panel in conjunction with an enzyme panel?
14. How can the identification of an antibody causing a positive DAT be determined?
15. What are the scoring values assigned to reaction strengths when performing an antibody titration?
16. How can the presence of an antibody to a high frequency antigen be suspected?
17. State methods used in performing this procedure.
18. When multiple antibodies are encountered in a patient’s serum, how many cells are necessary for confirmative testing?
19. Explain the principles of the 4 methods used to avoid detection of cold autoantibodies of no clinical significance.
20. Why may a person with a positive warm antibody DAT have a negative antibody screening test?
21. How can the presence of an alloantibody be detected and it identifies in the presence of a warm autoantibody?
22. What is the major cause of transfusion fatalities?
23. A recently transfused patient is scheduled for surgery on Friday. Blood for a crossmatch on Monday. Is this acceptable?
24. Are hemolyzed samples satisfactory for crossmatches?
25. What tests should be performed on a donor unit by the facility using the unit for transfusion?
26. What is the most critical pre-transfusion test performed in the Blood Bank? Why?
27. How will an incorrect result affect the crossmatch?
28. What is a “clinically significant” antibody?
29. What is the universal blood donor and universal plasma donor. Why? What are the components of the major crossmatch?
30. Differentiate between the immediate spin crossmatch and the antiglobulin crossmatch.
31. How will the autocontrol in the crossmatch react if a patient has an alloantibody?
32. An autoantibody? Abnormal serum proteins? Reagents are contaminated?
33. How will a patient with a Positive DAT affect crossmatch results? A donor with a positive DAT?
34. Can Rh positive blood be given to an Rh negative patient? If so, when?
35. Following transfusion of Group O blood to a Group A patient, what should be done if additional units are needed the next day?
36. Why is it not necessary to perform antibody screens on autologous donations? What tests must be run on these units?
37. Following release of blood from an immediate spin crossmatch, what should the technologist do next?
38. If an unused unit of blood is returned to the blood bank, what conditions must be met to permit reissuing of the unit?
39. What is the advantage of performing the type and screen procedure in a presurgical workup instead of a crossmatch and hold for 2 units?
40. Which type of transplantation requires blood products to be irradiated prior to transfusion?
41. A healthy adult receiving RBC transfusion from a blood relative should receive an irradiated blood component: True or False
42. Why should the blood used in neonatal transfusion should be (as fresh as possible) less than 5 days old?
43. What is the choice component for transfusion to treat a patient with Factor I deficiency?
44. A premature baby, weighing 1100 g, needs transfusion to treat anemia and hypoxia. Indicate the specifications required in choosing blood for transfusion of this infant.
45. Currently Cryoprecipitated AHF is primarily used for the treatment of?
48. What is the principle of Western Blot method for confirmation of the EIA screening test for HIV antibody?
49. Define polyagglutination. What 3 major ways does it occur?
50. What is the underlying cause of T, Th, Tk and Tx polyagglutination? Acquired B?
51. How do CAD, Hempas and NOR cause polyagglutination?
52. How do polyagglutinatable cells interfere with ABO typing?
53. How is the presence of polyagglutination confirmed? What reactions will occur?
54. List several disorders associated with polyagglutination.
55. What is the recommended blood product for transfusing a patient with polyagglutination?
56. There are several adverse events that can happen following a transfusion. Your book lists several, from inducing new antibodies to transmission of disease, to hemolytic reaction. List each of the events, and write a brief summary about each. Explain how leuko-depleted RBC can prevent some forms of transfusion reaction. Be sure that you include hemolytic reaction, TRALI, allergic, anaphylactic, transmission of disease, febrile.
57. What is the most likely cause of hemolytic transfusion reaction? How much blood can cause this reaction? What would you expect to see in the patient serum and urine following a hemolytic transfusion reaction?
58. Of all the possible adverse reactions to blood transfusion which situation is most life threatening, even with a transfusion of incompatible RBC as low volume as 100 ml?
59. In blood transfusion practice, elderly patients with cardiac problems and patients with chronic anemia may develop pulmonary edema and heart failure because of circulatory-volume overload, when transfused with ?
60. Transfused plasma constituents resulting in immediate erythema, itching and hives best typify which type of transfusion reactions?
61. If a death occurs as a consequence of transfusion FDA should be notified within?
62. In anaesthetized patients, symptoms of immediate hemolytic transfusion reaction may present only as __________________ and __________________
63. What are the 2 major adverse transfusion complications, from which the patients are guarded through donor blood screening and pre-transfusion testing?
   A. __________________
   B. __________________
64. Fatal HTRs caused by errors in patient identification are usually associated with what incompatibility?
65. An undefined temperature increase greater than 1°C during or hours after transfusion is called?
66. What may cause the transfusion associated Graft versus Host (TAGVH) disease?
67. What electrolyte may fall in level as a result of citrate toxicity from massive transfusion?
68. Transfusion Associated Acute Lung Injury (TRALI) is most frequently attributed to?
69. Anaphylactic type of immediate adverse transfusion reaction is seen following transfusion of blood in patients with?
70. List the steps that should be taken to investigate a suspected transfusion reaction, in the order of priority (for effective gathering of information regarding the probable cause of investigation).
71. What is the most common cause of a hemolytic transfusion reaction?
72. What is the most frequently reported adverse effect of transfusion?
73. List the characteristic findings in a patient experiencing an acute intravascular transfusion reaction immediately following transfusion of incompatible blood.
Question Set Five
Component therapy

<table>
<thead>
<tr>
<th>Component</th>
<th>Condition or disease state</th>
<th>Shelf life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packed red cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irradiated red cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autologous blood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albumin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 8 concentrate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reason to transfuse**

<table>
<thead>
<tr>
<th>Massive hemorrhage</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received 6 units of PC</td>
<td></td>
</tr>
<tr>
<td>Had previous febrile reactions and has low Hemoglobin now</td>
<td></td>
</tr>
<tr>
<td>Chemotherapy has caused thrombocytopenia</td>
<td></td>
</tr>
<tr>
<td>VonWillebrand</td>
<td></td>
</tr>
<tr>
<td>Coumadin overdose/Vitamin K deficient/liver disease</td>
<td></td>
</tr>
<tr>
<td>Hemophilia A</td>
<td></td>
</tr>
<tr>
<td>Low Fibrinogen (Factor I)</td>
<td></td>
</tr>
</tbody>
</table>

1. How are western blot and ELISA used to screen donor units?
2. Components are tested for blood borne pathogens. List all of the tests required for a unit of donor blood. What is the procedure if a unit tests positive for HIV?
3. Universal application of leukocyte-reduced RBC preparations for transfusion is currently underway because donor leukocytes may transmit viral diseases. Name 4 microorganisms.
4. Which are potentially harbored in donor leukocytes and cause transfusion transmitted viral diseases?
   A. ________________________________
   B. ________________________________
   C. ________________________________
   D. ________________________________

5. Of all the possible risks of infection from blood or blood component transfusion, which is currently considered by AABB to be the most significant infectious threat? Name 3 transfusion-associated Protozoan parasites, in which the donors may be asymptomatic carriers.
   A. ________________________________
   B. ________________________________
   C. ________________________________

6. Currently which test is used in donor screening to reduce the window period in HIV infection by detecting the virus earlier than other available tests? _________________________

7. A prospective donor whose blood has tested positive for HBs-Ag may transmit the virus to a recipient of his/her blood and cause post-transfusion hepatitis in a patient who does not have the disease. True or False?
8. Parvovirus B19 enters the red cells via the ____________ antigen and replicates in the ____________ cells.
9. Since 1987 components for replacement of coagulation factors have become very safe with the implementation of a variety of virus inactivation steps. However, this process is not effective with non-lipid enveloped viruses such as?
10. Which transfusion transmitted virus may cause transient aplastic crisis and severe illness in individuals with chronic hemolytic anemia and severe red cell aplasia or chronic anemia in chronic or acquired immunodeficiency, malignancies or organ transplant patients?
11. A process mandated by the FDA that directs collection facilities to notify donors who test positive for viral markers, to notify prior recipients of components of the possibility of infection, and to quarantine or discard implicated components currently in inventory is called?
12. A donor unit tested as reactive in EIA HIV antibody test. The test was repeated in duplicate and one of these tests was positive I positive.
13. What is the protocol regarding the donor status and use of his/her blood in the future?
14. What further testing should be done on this blood?
15. According to AABB standards, is a sample of blood from each donation tested for CMV antibodies?
16. What are the indications for the requirement of CMV negative blood in transfusion/transplant medicine? List at least 4.
   A. _________________________________________
   B. _________________________________________
   C. _________________________________________
   D. _________________________________________
17. If a donor unit is found to be reactive in the EIA screening test for HIV antibodies, what should be done next? If a negative result is obtained at this next step what is the protocol regarding the donor status and use of his/her blood in the future?
18. Which tests are routinely performed on donor blood to prevent transmission of transfusion-associated Hepatitis?
19. What is the purpose of using ALT in screening blood donors? Why has this been discontinued?
20. Give 2 reasons why donor blood is routinely tested for anti-HTLV I antibodies?
21. Hemolytic disease of the newborn can be fatal to the fetus/newborn. Rhogam is used to prevent development of HDN due to anti-D.
22. Maternal blood: If a woman is Rh negative and weak D negative, she will received Rhogam once during her pregnancy to prevent anti-D. This is called antenatal or antepartum Rhogam. After the baby is born, if it is Rh positive, she will require more Rhogam. What 2 tests are done (and in what sequence) to determine how much Rhogam she needs? One vial of Rhogam (Rho (D) immunoglobulin) will neutralize how much Rh+ (baby) blood?
23. How does the fetal screen work? How does the Kleihauer Betke work? Is there a condition when the KB won’t work? Why?
24. Cord Blood: What tests are done for a cord blood work up? Is it necessary to do a reverse type on cord blood? Why or why not? What are the most common causes of a positive DAT on cord blood (name 3). How can you tell what antibody is causing the positive DAT? How can a positive DAT block a result and give an erroneous blood type?
25. Determine which mother/infant pair will require Rhogam:
   A. Mother D+/Infant D+
   B. Mother D-/Infant D+
   C. Mother D-/Infant D-
   D. Mother D+/Infant D-
26. How will this change if the mother has anti-D in her serum?
27. Why is an antibody titer done during pregnancy? Does Rhogam ever cause a positive antibody screen?
28. If a fetus or newborn requires a transfusion, what blood type should be chosen? Why is it more important for the donor unit to be compatible with the mother than the infant? What special conditions must be imposed on the unit (name 3)? What if no compatible blood can be found, where might you look for a donor? What is an exchange transfusion?

29. Antibodies other than anti-D can cause HDN. Look at the front and back cover of your textbook and make a list of the antibodies that cannot cause HDN. What temperature range do they have in common?

30. Mother is Gp A, D negative and the father is Gp O, D Positive. Their newborn baby has a positive DAT with 4+ agglutination and severe anemia, requiring transfusion. Which of the pretransfusion tests done for typing and crossmatch on this baby’s cord blood would be potentially suspect (of being a false result)?

31. State the 3 criteria for post-partum administration of Rh Immunoglobulin (Rho GAM)

32. Give 4 possible reasons for the inconsistency in mother’s D testing.

33. In an Rho (D) negative woman who gave birth to a D Positive baby there was a significant feto-maternal bleed at the time of delivery.
   A. Explain the problems / discrepancies which may be encountered in D typing of the
   B. Why is it necessary to do a microscopic examination of the weak D test results?

34. Name the antibodies which may frequently be encountered in pretransfusion testing, but have not been known to cause HDN.

35. Name the antibodies which are well known as being capable of causing HDN.

36. A newborn showed a strongly positive DAT. The mother’s antibody as well as the antibody in the eluate prepared from this baby’s cells reacted with all reagent red cells tested. The incompatibility was due to an unidentified antibody. If the baby urgently needs transfusion what could be the source for compatible blood in this case?

37. In cases of severe Rh-HDN due to mothers anti-D the cord blood may be 4+ DAT positive, but the RBC may type as D negative. Explain the possible reason for this phenomenon.

38. An Rh (D) negative mother gave birth to a D negative baby. A Rho GAM work up showed that the mother has a positive antibody screen and the antibody was identified as a low titer anti-D (1:2). What is the most likely reason for this finding?

39. A D negative mother gave birth to a D positive baby. Her post-partum D typing showed a weak D Positive result, with MF agglutination under the microscope. A screening test for FMH was done, which was positive. It was followed by a Kleihauer-Betke stain of the maternal blood smear. If 32 fetal cells are counted in a total of 100 maternal cells how many vials of RhIG should be administered?

40. Name 3 tests which must be performed on the cord blood specimen of a neonate requiring transfusion.

41. Indicate the expected results on a cord blood specimen, in a severe case of hemolytic disease of the newborn.

42. The regular dose of (one vial) of Rho-GAM contains how much Rh Immunoglobulin?

43. What volume of fetal cells, entering maternal circulation through FMH, is made ineffective by one vial of regular dose of Rho-GAM?

44. In case of a severe HDN, suspected to be due to ABO incompatibility, how can the ABO compatibility may be confirmed?

45. Which drug is well known to cause warm autoimmune hemolytic anemia, with the production of an IgG, warm reactive antibody, directed against the red blood cell antigens?

46. What is the principle of the Kleihauer-Betke acid elution stain for the determination of the volume of a feto maternal hemorrhage at the time of delivery?

47. What is the most significant test that should done first the investigation of autoimmune hemolytic anemia, HDN and transfusion reactions?

48. What procedure should be done when high titers (strong) of cold auto-agglutinins are detected during early phase of pre-transfusion testing, and prewarmed testing is not clearing up the interfering reactions?
49. One week prior to the date of delivery the physician asks the laboratory to have blood on hand for exchange transfusion. In each of the following cases chose the most appropriate type of blood, to have it ready for immediate transfusion after delivery:
   a. Mother Gp B with anti-D titer of 1:512
   b. Mother Gp A, D positive, with Anti-K titer of 1:32
   c. Mother Gp AB, D negative with anti-U

50. A warm reactive auto-antibody which reacts with all normal cells except R₂ R₂ cells is said to have a simple anti-__________ specificity.

51. What is the most clinically significant of the non-Rh system antibodies in the ability to cause HDN?

52. Name 3 tests which should be included in prenatal serologic tests (in blood bank lab) for obstetric patients during the first trimester of pregnancy.
   A. _______________________
   B. _______________________
   C. _______________________

53. Name 3 tests which should be performed on neonatal (cord) blood to establish a diagnosis of HDN.
   A. _______________________
   B. _______________________
   C. _______________________

54. What is the single most important serologic test to be done on cord blood for the diagnosis of HDN?

55. Indicate the interpretation of amniotic fluid Δ OD 450 values plotted on a Liley graph:
   A. Zone I: _______________________
   B. Zone II: _______________________
   C. Zone III: _______________________

56. List 4 requirements for selection of blood for intrauterine transfusion
   A. _______________________
   B. _______________________
   C. _______________________

57. List 3 criteria for RhIG administration following delivery
   A. _______________________
   B. _______________________
   C. _______________________

58. Microspherocytes and increased RBC fragility in the infant are characteristic of RH HDN, but not ABO HDN (Hint, find a table) True or False?

59. ABO antigens are not fully developed until after the first year of life. Gp A infant RBCs are serologically similar to A₂ adult cells, with Gp A₂ infant’s RBC much weaker. The weakened antigen on fetal and neonate RBCs is much more readily demonstrable with monoclonal anti-A reagents than human Anti-A reagents. True or False

60. What is WAHA? What drugs are commonly implicated in positive DAT? What is the “specificity” that is usually seen in WAHA – an auto-antibody. What is paroxysmal cold hemoglobinuria? What antibody can cause this?

61. The common antibody specificity in both benign and pathologic cold agglutinins is?

62. Answer the following questions regarding Paroxysmal Cold Hemoglobinuria.
   A. The antibody is also called: _______________________
   B. It has the specificity of auto anti-? ___________________
   C. Immunoglobulin class of the antibody: ______________
   D. Special characteristic of the antibody: ______________

63. List 5 disease conditions in which Autoimmune Hemolytic Anemia may be a secondary development.
64. In pre-transfusion testing, what techniques may be used to overcome the effect of strong cold agglutinins and detect clinically significant allo-antibodies?

65. In warm autoimmune hemolytic anemia the specificity of the warm autoantibody is mainly directed against which blood group system antigens?

66. A patient who is given massive doses of Penicillin has developed a positive DAT. Testing with both serum and eluate showed negative antibody screens and compatible crossmatches. A drug induced Hemolytic anemia is suspected.
   A. How do you confirm the specificity of this antibody?
   B. What is the mechanism of autoimmune induction in Penicillin type drug induced AIHA?

67. An event of acute intravascular hemolysis is characterized by certain indicators in the serum and urine of the patient. Indicate the nature of change and approximate time frame for the change in each of the following
   A. Hemosiderinuria __________________________
   B. Serum Haptoglobin ________________________
   C. Hemoglobinuria __________________________

68. Warm reactive autoantibodies usually have the specificity within the _______________ blood group system.

69. When transfusing a patient with warm autoimmune hemolytic anemia what is the primary concern on the part of the bloodbank technologist?

70. In each of the following cases of drug induced hemolytic anemia give the mechanism of antibody formation and hemolysis:
   A. Cephalosporins: _____________________________
   B. Methyl Dopa (Aldomet): _________________________
   C. Quinidine or Phenacetin: _________________________
   D. Penicillin, Streptomycin: _________________________

71. In which of the 4 types of drug induced hemolytic anemia, both the patient’s serum and RBC eluate will give positive results in routine (pretransfusion) serologic tests (Ab Screen, Ab ID and Crossmatches)?

72. In a patient who is experiencing drug induced hemolytic anemia, which type of drug induced mechanism and drugs are indicated by the following results:
   1. DAT is positive with anti-IgG, but not with anti-complement.
   2. Antibody Screen on serum and eluate are negative.
   3. Crossmatches are compatible.
   4. Serum and eluate gave positive results when tested with drug (the drug patient is on) coated cells.

73. Warm reactive autoantibodies can interfere with most routine bloodbank tests. False positive Rh typing can be a problem. In an extreme situation of a patient with positive DAT due to warm autoantibodies what can you do to remove the coating of IgG from the RBC, so the cells can be typed for D or weak D?

74. Should mono-specific anti-complement reagent be used as the standard procedure for AGT in routine pretransfusion testing? Why or why not? Explain.

### Common Blood Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Shelf life</th>
<th>Storage temp.</th>
<th>Indications for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red cells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washed RBC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frozen RBC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled platelets (after pooling)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh frozen plasma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryoprecipitate</td>
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<td></td>
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</tbody>
</table>
Section 5
Specials Rotation
Serology, Urinalysis, Phlebotomy
Instructions for Evaluations for Students and Clinical Supervisors

**Qualitative Student Competency Checklist:** This form should be completed by the student to evaluate their performance early in the rotation.

**Technical Competencies Checklist:** In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. The student should rate their ability to perform accurate and reliable testing in a timely manner in the areas listed on the **Serology, Urinalysis and Phlebotomy** internship checklist. The student’s time during each rotation will be spent observing and performing various procedures and reviewing theory and test principles. Performing tests in duplicate or performing tests under the direct supervision of the clinical instructor is encouraged. The checklists are provided as a guideline to ensure that routine procedures have been observed and performed. As a particular skill is performed, the student should indicate whether there was satisfactory or unsatisfactory performance. Otherwise, indicate whether the skill was only observed or discussed, or if it was not available (NA).

**Quantitative Final Evaluation:** This evaluation consists of 4 parts; rotation specific psychomotor skills, overall knowledge and skills, the student’s professional behavior, and summary comments. Please complete these forms by the last day of the student’s rotation. The affiliate supervisor should review these forms with the student. The student and evaluator will sign the forms and return them to the Santa Fe College Internship Coordinator.

**Part 1 Psychomotor Evaluation:** This form is to be utilized by the clinical instructor to evaluate the student’s technical skills specific to the rotation.

**Part 2 Evaluation of Knowledge & Skills:** In each area of rotation, the student will participate in the activities of the section while performing tests on patient samples. Please rate the student’s overall ability to perform accurate and reliable testing in a timely manner.

**Part 3 Evaluation of Professional Behaviors:** This form is to be utilized by the clinical instructor to evaluate the student’s professional behaviors.

- Please be honest in rating each of the professional characteristics of the student.
- Base your judgment on behavior which you feel is characteristic of the student *during the period of evaluation*.
- Please comment on any rating in the Needs Improvement of Unsatisfactory category.

**Part 4 Summary Comments:** In this section please feel free to write a brief overview of the student’s performance. Any problems that you encountered with the student, as well as praise, should be noted here. This is very helpful to students so they will learn their strengths and weaknesses.

**NOTE:** If any problems or conflicts arise while the student is in your department, please bring them to the attention of the SF liaison as soon as possible so it can be resolved.

**Forms are located in the appendix (printable versions).**
Santa Fe College Clinical Laboratory Sciences Program

Serology Internship Syllabus

COURSE NUMBER: MLS 4824L
TITLE: Serology Internship
CREDIT: 4 credits
TEXT: Board of Registry Study Guide: Clinical Laboratory Certification Examinations
INSTRUCTOR: Myra Urso, Med, BSMT (ASCP CM), myra.urso@sfcollege.edu
Work phone: (352) 381-3750

COURSE DESCRIPTION: The student will attend a clinical internship in a well-equipped and properly staffed laboratory for technical experience in hematology.

Note: This course may begin and/or end after the official published semester dates in order to accommodate scheduling availability at our clinical affiliates.

COURSE OBJECTIVES: By the end of the clinical internship, the CLS student should be able to complete or explain all of the following objectives with 70% accuracy.

1. Review immunology/serology lecture material before the beginning of the clinical internship.
2. Apply theoretical knowledge to technical procedures.
3. Assess immunology/serology knowledge by completing the BOR immunology study questions.
4. Remediate in areas of weakness before the serology clinical internship examination.
5. Perform syphilis testing to include RPR testing on serum samples and VDRL testing on CSF samples so that the results correlate with the instructor’s results.
6. Perform HIV testing using ELISA so that the results correlate with the instructor’s results.
7. Perform HTLV testing using ELISA so that the results correlate with the instructor’s results.
8. Perform hepatitis B testing so that the results correlate with the instructor’s results.
9. Perform hepatitis C testing so that the results correlate with the instructor’s results.
10. Perform C-reactive protein testing so that the results correlate with the instructor’s results.
11. Perform anti-nuclear antibody testing using a fluorescent microscope so that the student can recognize the characteristic types of patterns seen.
12. Perform H. pylori testing so that the results correlate with the instructor’s results.
13. Perform an ASO titer so that the results correlate with the instructor’s results.
14. Perform IM testing so that the results correlate with the instructor’s results.
15. Perform cryptococcal antigen testing to correlate with the results obtained by the clinical instructor.
16. Perform antigen testing so that patient results correlate with the clinical instructor’s results.
17. Perform anti-nuclear capsid antigen testing so that the patient results correlate with the results obtained by the clinical instructor.
18. Perform rheumatoid factor testing so that the patient results correlate with the instructor’s results.
19. Perform CMV testing so that the patient results correlate with the clinical instructor’s results.
20. Observe other serology testing not listed as an entrance level competency.
22. Apply technical knowledge while performing basic laboratory procedures.
23. Display responsibility for one’s actions while at the clinical affiliate.
Clinical Laboratory Sciences Program

24. Accept constructive criticism to improve developing work habits.
25. Self-evaluate the interpersonal relationships with co-workers and other allied health staff members.
26. Follow SOP manual and admit to errors or mistakes when they occur.
27. Organize the workload, prioritizing STATs and reducing turn-around-times.
28. Display dependability by arriving to clinical at designated times and days.
29. Adapt to different teaching styles and workload without complaining.
30. Display confidence in one’s technical ability while recognizing one’s limitations.

METHOD OF TEACHING: Laboratory Bench Instruction
Demonstration
Role modeling

EVALUATION METHOD: Students will be evaluated in four areas:
1. Technical competency achieved by the end of the clinical internship in a specified laboratory procedure evaluated by the clinical instructor.
2. Professionalism demonstrated during the clinical internship evaluated by the clinical instructor(s).
3. Theoretical knowledge demonstrated by a written examination on the last day of the clinical internship given by the College.
4. Weekly discussion board posts documenting what you have learned at the clinical affiliate.

TECHNICAL COMPETENCY:
Your technical competency will be assessed at the end of your clinical rotation by the clinical faculty. This psychomotor evaluation is worth 30% of your total grade in this course. It is your responsibility to know what tasks are on the checklist and to ask your clinical instructor(s) to initial it on a weekly basis as the assigned tasks are completed. Completion of the checklist is scored as either 100% or 0%.

PROFESSIONALISM:
Your professionalism will be assessed at the end of your clinical rotation by the clinical faculty. This affective evaluation is worth 30% of your total grade in the course. Remember that from the first day of your clinical internship, you are being evaluated for potential employment opportunities. Take advantage of this opportunity and ask your clinical instructors if they would be willing to be one of your references when you start applying for open positions.

WRITTEN EXAMINATION:
There is one multiple choice question examination at the end of clinical rotation. This cognitive evaluation is worth 30% of your total grade in this course. A self-paced study guide is provided to assist you with your preparation for the examination. Material included on the examination will be taken directly from the study questions focusing on theory, methodology, and clinical significance of each chemistry analyte.

DISCUSSION BOARD:
The weekly discussion board posts are due every Friday by 5:00 p.m. The discussion board should include what instrument you trained on, what profiles were performed, what analytes were measured, the principles of the analytes, any critical results that were phoned, and any interesting patient results that you encountered. In addition, you are required to answer all of the instructor’s questions on the discussion board by Sunday evening at 12:00 midnight for full credit.
Clinical Laboratory Sciences Program

**GRADES:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S+</td>
<td>95</td>
</tr>
<tr>
<td>S</td>
<td>85</td>
</tr>
<tr>
<td>S-</td>
<td>75</td>
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<td>00</td>
</tr>
</tbody>
</table>

93-100  A
90-92   A-
87-89   B+
83-86   B
80-82   B-
77-79   C+
70-76   C
60-69   D
0-59    F

**CALCULATION OF GRADE**

- Technical Competency: 30%
- Professionalism: 30%
- Written examination: 30%
- Weekly blog: 10%

Total 100%

The MLS student must pass this course with a “C” or better in order to continue in the MLS Program. There are no excused absences from the clinicals. The student must notify the clinical instructor if he/she is going to be late or absent before the time he/she is scheduled to be at the clinical facility. Make-up time is at the discretion of the clinical instructor.

**Americans with Disabilities Act (ADA) Student Rights**

If you are a student with a disability: In compliance with Santa Fe College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the semester (except for unusual circumstances) so arrangements can be made. You must be registered with Disabilities Resource Center (DRC) in S-229 for disability verification and determination of reasonable academic accommodations.

**Discrimination/Harassment Policy Statement**

Santa Fe College prohibits any form of discrimination or sexual harassment among students, faculty and staff. For further information, refer to the SFC Human Resources Policies website.

**College Academic Integrity Statement**

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore SFC has adopted a Code of Student Conduct that outlines general guidelines. Students are encouraged to discuss issues related to academic integrity with instructors.
Serology Psychomotor Objectives

- Perform instrument startup and shutdown procedures as scheduled
- Perform daily maintenance on automated analyzer
- Perform the daily quality control and determine acceptability; troubleshoot is needed
- Perform syphilis testing to include EIA, RPA, and VDRL
- Perform hepatitis testing to include HBsAg, HBsAb, HBCab, and HCV
- Perform Helicobacter pylori antibody testing
- Perform herpes simplex virus antibody testing
- Perform Lyme disease antibody testing
- Perform mumps antibody testing
- Perform Mycoplasma pneumoniae antibody testing
- Perform parvovirus antibody testing
- Perform rubella antibody testing
- Perform varicella zoster virus antibody testing
- Perform West Nile virus antibody testing
Serology Study Guide for Exam

Immunology and Serology in Laboratory Medicine, by MB Turgeon, Mosby Elsevier, 4th ed. 978-0-323-04382-3

Chapter 1 Overview of Immunology

Chapter 2 Antigens and Antibodies

1. List 5 components of the body’s first line of defense against disease.
2. Differentiate between active and passive immunity and natural and artificial immunity. Give an example of each.
3. How does delayed hypersensitivity differ from cell-mediated immunity?
4. Define the term antigen. Describe the role of proteins, lipids and carbohydrates in antigen structure. Describe 5 physical characteristics of a good antigen.
5. What is a substance with a low molecular weight that binds to a carrier molecule to cause antibody production called?
6. List the 5 immunoglobulin classes and state the major characteristics/functions of each and the normal plasma levels.
7. Draw an immunoglobulin molecule and label: FAB, Fc, CH1, CH2, CH3, light and heavy chains and constant and variable regions. Into what 3 fragments does papain split an Ig molecule? How many molecules are present in each Ig class?
8. Do Ig molecules usually have more kappa or lambda chains?
9. Differentiate among an allotype, isotype and idiotype.
10. Draw a graph representing the primary and secondary responses of IgM and IgG to antigen.
11. How do the 2 responses differ? What is another term for anamnestic?
12. What basically determines the avidity and affinity of antigen-antibody reactions? Which is associated with noncovalent bonding? With multivalency?
13. What is a monoclonal antibody? Name the 2 components of a hybridoma and the contribution of each to the production of monoclonal antibodies.

Chapter 3 Cells and Cellular Activities of the Immune System: Granulocytes and Mononuclear

Chapter 4 Cells and Cellular Activities of the Immune System: Lymphocytes and Plasma Cells

Chapter 5 Soluble Mediators of the Immune System

1. What is the primary granulocyte associated with phagocytosis?
2. Failure to reduce the dye NBT due to a defect in superoxide production is seen in ________.
3. Describe 3 functions of monocyte/macrophages stressing the role of phagocytosis. What is the primary source of IL-1?
4. List and describe the 6 steps in phagocytosis. What is the respiratory burst? What substance is necessary for it to occur?
5. Is the ESR or CRP more sensitive and specific for inflammation? In general, are either of these tests definitive diagnostic tools? Why or why not?
7. Why is CRP the test of choice when screening for inflammatory disease? Besides screening for inflammation what other valuable patient information can be provided by the CRP?
8. Does the latex agglutination test for CRP detect antigen or antibody in patients’ serum?
9. What is the latex particle coated with?
10. How should a CRP reaction that is negative in the undiluted specimen and positive in the 1:5 dilution be reported? What follow up testing should be done?
11. How does the thymus protect the body against autoimmune disorders? Cancer?
12. What are the T cell surface markers that separate them into helper and suppressor cells?
13. State 4 surface markers associated with B cells. What is the primary marker of cytotoxic T cells?
14. What is the ratio of T helper to T suppressor cells?
15. Why is immunoglobulin class switching necessary?
16. List the basic steps in the activation of B cells, T cells and NK cells.
17. Would a patient with an 8,000 WBC of which 30% are lymphocytes have a probable T cell deficiency? Why or why not?
18. What is the current method for measuring T cells?
19. What substances are used to test the functional ability of T cells? B cells?
20. Differentiate between a primary and secondary immune disorder.
21. What is the primary defect in the disorders: DiGeorge's syndrome, SCID and Bruton's disease? Which has the best prognosis?
22. Describe the symptoms and immune deficiency in Wiskott-Aldrich syndrome and hereditary ataxia telangiectasia.
23. How do lymphomas, sickle cell, metabolic disorders, splenectomy, corticosteroids and radiation affect the immune system?
24. List the order of activation of the components in the classic complement pathway.
25. Which components are in the recognition stage? Enzymatic activation stage? Membrane attack group?
26. Which component is present in the highest concentration?
27. What classic pathway components are missing from the alternate pathway?
28. What 2 additional components are present in the alternate pathway?
29. How does the presence of immune complexes affect serum complement levels? Why?
30. What is the principle of the CH 50 assay? What results would be expected in autoimmune disorders? Disorders with an elevated CRP?
31. Which group of cytokines is primarily associated with lymphocytic function? Defense against viruses?

Chapter 6 Safety and Basic Techniques in the Immunology-Serology Laboratory

Chapter 10 Agglutination Methods

Chapter 11 Electrophoresis Techniques

1. How is the solution used to decontaminate countertops exposed to HBV or HIV prepared? How quickly does it kill HBV and HIV?
2. What are the legal requirements for containers used for disposal of infectious waste?
3. Why do some serological tests require inactivation of complement in the patients’ serum?
4. How is this accomplished with a fresh specimen? How is reinactivation performed?
5. Differentiate between the acute and convalescent phases of a disease. What is the significance of a 2 tube or 4 fold rise in an antibody titer between the acute and convalescent phases?
6. Define the terms antibody titer and serial dilution. What are the 2 steps performed in a titer?
7. What is the end point of a titer and how is it reported?
8. If 0.5 mL of serum is added to 2 mL of saline, what is the dilution? How much serum is present in 100 mL of a 1:500 dilution?
9. Two mL of saline are placed in Tubes 1 - 6 then 1 ml of serum is added to Tube 1 and mixed and 1 ml of this mixture is transferred to Tube 2 and mixed. If this transfer is continued through Tube 6, what is the dilution in Tube 5?
10. How do you prepare 5 mL of a 1:25 dilution? How do you prepare 10 mL of a 2% RBC suspension?
Clinical Laboratory Sciences Program

11. When performing a titer, how would you recognize a prozone reaction? How can a prozone reaction affect tests that are not performed using serial dilutions? How can this be avoided?

12. Describe the antigens used in agglutination and precipitation reactions. How can a precipitation reaction be changed to an agglutination reaction?

13. Differentiate between a direct and a passive or indirect hemagglutination technique.

14. How is agglutination affected by the antigen - antibody ratio, pH, temperature, ionic strength and steric hinderance? How does zeta potential affect agglutination?

15. Describe 4 methods for enhancing agglutination.

16. How does the presence of rouleaux affect agglutination reactions? How can it be confirmed?

17. Why is hemagglutination inhibition useful for detection of viral antibodies such as in Rubella titers? Is failure of the patients' serum mixed with viral antigen to agglutinate RBCs considered a positive or negative reaction?

18. What is the advantage of performing precipitation reactions in agarose gel? Why are equivalent antigen and antibody concentrations critical in precipitation reactions? Define a postzone reaction?

19. In the double diffusion Ouchterlony technique, what is the significance of a precipitation band forming close to the well containing the patients' serum? Sketch the reactions of identity, non-identity and partial identity.

20. What is the primary advantage of RID over double diffusion? In RID does the agarose contain antigen or antibody? What is the significance of the diameter of the precipitation ring?

21. How does performance of the Fahey and Mancini methods of RID differ? Why is the Fahey method plotted on semilog paper? What is the recommended specimen for RID?

22. What should be done if the diameter of the patient's sample is larger than the diameter of the highest RID standard? How would damaged agar and inadequate filling of the wells affect RID results?

23. What substances are frequently measured by RID?

24. What is the advantage of CIE over double diffusion? Is an antigen with a positive charge suitable for CIE? Why or why not?

25. What is the advantage of rocket electrophoresis over RID?

26. State the 2 steps in immunoelectrophoresis. What does a precipitin arc in IEP represent?

27. How do arcs appear when the concentration of a protein is abnormally high?

28. Differentiate between a monoclonal gammopathy and a polyclonal gammopathy. How does IEP aid in this differentiation? What other tests should be performed?

29. How does IEP differ from IFE?

Chapter 12 Labeling Techniques in Immunoassay

Chapter 13 Automated Procedures

Chapter 14 Molecular Techniques
11. State the 2 components of complement fixation and name the reactants in each.
12. Define hemolysin as it relates to complement fixation.
13. Describe a positive complement fixation reaction.
15. List the 3 steps in PCR. What is the enzyme responsible for new DNA synthesis?

Chapter 15 Immune Response in Infectious Diseases

Chapter 17 Streptococcal Infections

*Streptococcus pyogenes*, or Lancefield Group A Strep is a common cause of pharyngitis, and causes skin infections such as impetigo. The organism produces a number of enzymes and hemolysins S and O that can lead to severe disease, such as necrotizing fasciitis, rheumatic and scarlet fever, glomerulonephritis and other complications. The organism is a gram positive beta hemolytic coccus. The serology department is involved when the patient has glomerulonephritis or rheumatic fever or other complication, to determine if a recent Strep infection has occurred. The patient serum is tested for the presence of antibodies to bacterial enzymes and hemolysins. Enzymes that are produced are hyaluronidase, DNases A, B, C, D, Streptokinase, NADase, and erythrogenic toxins.

Rheumatic fever occurs when anti-Strep antibodies cross react with patient heart muscle. Glomerulonephritis occurs when anti-strep antibodies cross react to glomerular basement membrane and form immune complexes, causing further inflammation.

- The **ASO test** measures antibody to Streptolysin O, by its ability to neutralize the activity of reagent Streptolysin O (SLO). Reagent SLO will lyse red blood cells, but in the presence of patient ASO, there is no hemolysis. The concentration of ASO is measured by a titration, and expressed as a Todd unit. Up to 160 Todd units is normal for an adult, and young children have lower values.
- The **Streptozyme** test is a rapid agglutination test. The reagent is sheep red blood cells coated with Streptococcal antigens. Patient antibodies such as anti-hyaluronic acid, anti-DNase, anti-NAD, ASO, and anti-streptokinase will cause the red cells to agglutinate. It is non-specific.
- The **ADN-B** test detects patient antibody to DNase-B. The test is done in patients with rheumatic fever and glomerulonephritis, along with the ASO. If both tests are negative, the patient is most likely negative. If both are positive, well, you get the picture. The reagents are a substrate: calf thymus DNA and an enzyme: DNase B. Together the substrate and enzyme will produce a color. Anti-DNase B in the patient serum will block (neutralize) this reaction.
## Serologic tests for Group A Streptococcus

<table>
<thead>
<tr>
<th>Test</th>
<th>Tests for</th>
<th>Effect in vitro</th>
<th>Measured as</th>
<th>Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASO</td>
<td>Tests for antibodies to SLO – Streptolysin O, the oxygen labile hemolysin produced by the bacteria</td>
<td>Patient with antibodies to SLO will neutralize the ability of SLO reagent to lyse red blood cells</td>
<td>Todd units. Up to 160 is normal for an adult. Small children values are lower.</td>
<td>8-85% of patients with rheumatic fever will have increased ASO. Not usually elevated in skin infections. False positives from beta-lipoprotein, contamination of serum by bacterial growth products, oxidation of ASO.</td>
</tr>
<tr>
<td></td>
<td>SLO + rbc → hemolysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASO + SLO → neutralization. Then + rbc → no hemolysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADN-B</td>
<td>Tests for antibodies to DNase-B</td>
<td>Most reliable measure of recent skin Strep infection (eg impetigo). Skin infections of Strep pyogenes may be the source of glomerulonephritis.</td>
<td></td>
<td>Patients with glomerulonephritis may have a normal ASO, so ADN-B is more reliable for skin infections (which can lead to glomerulonephritis). If ASO is normal, but infection is still suspected, do the ADN-B.</td>
</tr>
<tr>
<td>Strepto-zyme</td>
<td>Tests for antibodies to SLO, hyaluronidase, NADase, DNase, Streptokinase</td>
<td>This is a rapid screening test, and positives should be tested further</td>
<td>Sheep red cells agglutinate if positive</td>
<td>See if your lab does this. Read the procedure.</td>
</tr>
<tr>
<td>The name says enzymes of Strep</td>
<td>Anti-Strep A antibodies are the reagent to detect Strep A antigens in patient throat swab sample</td>
<td>NA</td>
<td>Positive or negative</td>
<td>An OIA is available for GBS, too, and done on women in their 3rd trimester of pregnancy.</td>
</tr>
</tbody>
</table>
Clinical Laboratory Sciences Program

1. Complete Study Questions Turgeon 4th edition Chapter 17 (3, 4, 7, 14-19)
2. List the extracellular substances (enzymes and hemolysins) produced by pathogenic streptococci that may be pathogenic as well as antigenic
3. List the laboratory tests available for the detection of antibodies to those antigens
4. Give the principle of the following tests:
   a. antistreptolysin O, define Todd Unit
   b. antihyaluronidase
   c. anti Dnase
   d. streptozyne
5. Discuss the use of these tests in diagnosing acute glomerulonephritis and rheumatic fever
6. Describe the procedure performed in your laboratory to detect streptococcal antigens
7. Name the 2 primary disorders that may result from an untreated group A streptococcus infection. What cell membrane component is a major virulence factor?
8. Differentiate between Streptolysin O and Streptolysin S. Which is useful in serological testing?
9. What other streptococcal enzymes are useful in serological testing?
10. How is the neutralization test used to detect and quantify the presence of antibodies to group A strep?
11. Briefly state the principle of the ASO test. What substance is the antigen?
12. What is the primary error that can result in no hemolysis in an ASO titer? How can this be prevented? What other sources of error are possible?
13. How is an ASO titer interpreted and in what units? What is considered a normal adult titer? Are children's titers usually higher or lower? Why?
14. What are the advantages of the Streptozyme test over the ASO?
15. When performing a rapid test for Group A strep and a culture, how should the specimen be collected and handled?

Chapter 18 Syphilis

The spirochete *Treponema pallidum* causes the sexually transmitted infection syphilis. Syphilis can also be contracted by a blood transfusion (blood less than 3 days old), and by kissing the lesion, and to a fetus during pregnancy. The organism is not culturable, although a primary chancre and secondary rash is teeming with the organism. It is possible to view the spiral shaped bacteria with dark field microscopy. The typical lab method, though, is to use patient serum to detect antibodies. There are 4 stages to syphilis. The disease can be treated with penicillin. It appears to resolve after the primary and secondary stages, but it may persist latently.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptom</th>
</tr>
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<tbody>
<tr>
<td>Primary</td>
<td>Chancre persists for 1-5 weeks and heals</td>
</tr>
<tr>
<td>Secondary</td>
<td>2-8 weeks after primary chancre. Generalized illness, rash, adenopathy. CNS involvement in 1/3 of patients. Resolves in 2-6 weeks</td>
</tr>
<tr>
<td>Latent</td>
<td>1/3 will eventually develop late (tertiary) syphilis. Serologic methods will be positive, but no symptoms</td>
</tr>
<tr>
<td>Late (Tertiary)</td>
<td>3-10 years later. Granulomas (gummas), cardiovascular manifestations, stroke, neurosyphilis possible</td>
</tr>
<tr>
<td>Congenital</td>
<td>Transplacental transmission. Rash, condyloma, bone changes, etc. Deafness, keratitis, and Hutchinson’s teeth (Hutchisonian triad) neurosyphilis, other symptoms</td>
</tr>
</tbody>
</table>

As with any immune response, IgM is the first ab seen, followed by IgG. Patients can produce specific antibodies to T. pallidum, and nonspecific antibodies to protein antigen common to other spirochetes, too.
Nontreponemal antibodies (aka reagin antibodies) are produced against the patients’ own damaged tissue. Reagin is also produced in measles, chickenpox, hepatitis, IM, leprosy, TB, leptospirosis, malaria, rickettsia, trypanosomes and lymphogranuloma venereum, so this is a non-specific finding. Autoimmune disorders, old age, pregnancy, drug addiction and recent immunization may also cause the production of reagin.

The most commonly used screening test for syphilis looks for reagin production. It is therefore a non-treponemal method, called a rapid plasma reagin (RPR) test. It is a flocculation method, and charcoal in the reagent makes the reaction macroscopically visible. The VDRL procedure is also a non-treponemal method, a flocculation test in which soluble antigen particles coalesce to form larger particles in the presence of antibody. These are visible as clumps, but require a microscope to see them.

Two tests specific for treponemes are the Fluorescent treponemal antibody adsorption (FTA-ABS) and the Microhemagglutination for Treponema pallidum (MHA-TP) test. These are termed the Treponemal methods.

There are 4 major tests used to diagnose syphilis. (Refer to table on next page.)

Standardized procedure for RPR: Needles for dispensing RPR reagent are 18 gauge, and deliver 60 +/- 2 drops per ml. 50 ul of sample + 1 drop of reagent. Stir, and spread out to the size of the circle. Rotate at 100 rpm for 8 minutes in a humid box. Retest the positive samples quantitatively, using a serial dilution. If the 1:16 dilution is reactive, prepare a 1:50 dilution with non-reactive serum and saline, and use this for further dilutions.

It is possible for the RPR and FTA-ABS results to contradict each other. If the RPR is negative and the FTA-ABS is positive, it may mean that the patient had been successfully treated for syphilis. Once a patient is FTA-ABS positive, they will remain so for life.

In neurosyphilis, the FTA-ABS on CSF will be positive, but this is not a specific test. The VDRL on CSF is specific for neurosyphilis. Caution must be taken to prevent red cell contamination in the CSF, as a patient with syphilis (non-neurosyphilis) will have a positive VDRL in his/her serum.

Yaws, pinta and bejel are also caused by Treponemes. Be able to match them to their species.

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample</th>
<th>Method</th>
<th>Reagent</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPR</td>
<td>Unheated serum</td>
<td>Flocculation, Sensitive</td>
<td>Serum is mixed with a carbon-particle cardiolipin</td>
<td>Screening test. Must be confirmed if positive.</td>
</tr>
<tr>
<td></td>
<td>Not for CSF</td>
<td>for primary and secondary,</td>
<td>antigen. Reagent ready to use, includes: Cardiolipin,</td>
<td>False positives from measles, chickenpox, hepatitis, IM, leprosy, TB,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>but not late syphilis.</td>
<td>lecithin, cholesterol, EDTA, Na₂HPO₄, KH₂PO₄,</td>
<td>leptospirosis, malaria, rickettsia, trypanosomes and lymphogranuloma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>thimerosal, charcoal, choline chloride, water</td>
<td>venereum.</td>
</tr>
<tr>
<td>VDRL</td>
<td>Serum and CSF</td>
<td>Flocculation, CSF</td>
<td>Cardiolipin, lecithin and cholesterol, choline</td>
<td>CSF VDRL is diagnostic of neurosyphilis.</td>
</tr>
<tr>
<td></td>
<td>Serum must be inactivated by heat to destroy complement</td>
<td>VDRL is diagnostic of neurosyphilis. *Caveat: blood</td>
<td>chloride in alcohol base. Reagent must be reconstituted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSF should not be heated prior to testing</td>
<td>contamination of CSF during collection can cause a false positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reaction must be read</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>microscopically</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTA-ABS</td>
<td>Patient serum or CSF</td>
<td>Indirect Fluorescent</td>
<td>Endpoint is the lowest dilution showing 4+ fluorescence.</td>
<td>Confirmatory test</td>
</tr>
<tr>
<td></td>
<td>is mixed with non-T.pallidum treponemes to absorb out the non-specific antibodies. Serum is reacted with a slide having T. pallidum (Nichols strain) on it. After washing, anti-human IgG-(FITC) is added. Treponemes will be green if test is positive.</td>
<td>Antibody, Sensitive for all stages</td>
<td>Controls should be a 4+ positive, a 1+ positive, and a non-specific serum control.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSF FTA-ABS has a good</td>
<td>FITC is a fluorophor that absorbs blue light and</td>
<td>FITC is a fluorophor that absorbs blue light and fluoresces green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>negative predictive value</td>
<td>fluoresces green</td>
<td>A patient with fluorescence less than 1+ is borderline, and should be</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for neurosyphilis</td>
<td></td>
<td>repeated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MHA-TP</td>
<td>Sheep RBC coated</td>
<td>Hemagglutination, Sensitive</td>
<td>Coated sheep RBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with treponemal</td>
<td>for all stages of syphilis,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>antigens + patient</td>
<td>producing a flat mat in the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>serum → RBC</td>
<td>microdilution well</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 19: Vector-Borne Diseases
1. Name the etiologic agent of Lyme disease
2. Name the vector of Lyme disease
3. What visible symptom is diagnostic of Lyme disease?
4. Name 2 body systems that may be affected by Lyme disease
5. Compare Lyme disease with syphilis
6. Describe the antibody test for Lyme disease associated with severe arthritis

Chapter 20: Toxoplasmosis
1. Name the etiologic agent of Toxoplasmosis
2. Name the likely host of Toxoplasmosis
3. Describe how Toxoplasmosis may be transmitted by transfusion
4. Describe how Toxoplasmosis may be acquired congenitally
5. List preventive measures used in preventing transmission
6. Describe the antibody test for Toxoplasmosis
7. Discuss the disadvantages of the test for Toxoplasmosis

Chapter 21: Cytomegalovirus
1. List the five recognized human herpes viruses
2. Name the populations at greatest risk for CMV infection
3. Describe how the virus is transmitted
4. Discuss viral latency and list the factors associated with reactivation
5. Discuss the incidence of primary maternal infections during pregnancy
6. Describe the effects of congenital infection on the newborn
7. Discuss the characteristic antibody responses associated with infections
8. Describe the antibody tests for CMV
9. Discuss the disadvantages of the test
10. Name other laboratory tests used in identification of CMV
11. Discuss preventive measures in limiting exposure to CMV in blood transfusions

Chapter 22: Infectious Mononucleosis
1. Describe the etiology of mononucleosis
2. Explain which age groups are most affected
3. Discuss the signs and symptoms
4. List the characteristics of the heterophil antibodies
5. List the variety of “new” antigens encoded by the virus and their significance
6. Compare the serologic procedures and clinical applications of the Paul-Bunnell, Davidsohn differential test, and mono spot tests
7. Discuss the hematology findings associated with IM
8. Which antibodies remain elevated indefinitely
Chapter 23: Viral Hepatitis

There are 3 forms of viral Hepatitis that we can measure in the Serology department: A, B and C. B and C are blood borne pathogens, and we know a lot about them. Memorize the table below, which is amended from Turgeon 4th edition.

<table>
<thead>
<tr>
<th></th>
<th>Hep A (Travelers)</th>
<th>Hep B (Hospital personnel)</th>
<th>Hep C (Post transfusion)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent</strong></td>
<td>picoRNAvirus</td>
<td>DNA HepDNAvirus</td>
<td>RNA virus, <strong>hepacivir</strong></td>
</tr>
<tr>
<td></td>
<td>small RNA virus</td>
<td></td>
<td>virus of flaviviridae</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(flavi means yellow)</td>
</tr>
<tr>
<td><strong>Blood tests</strong></td>
<td>Anti-HAV IgM –</td>
<td>HBsAg, HBeAg, Anti-HBs,</td>
<td>Anti-HCV, Western Blot</td>
</tr>
<tr>
<td></td>
<td>acute infection</td>
<td>anti-HBc, anti-HBe</td>
<td>RIBA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RT-PCR for viral load,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and NAT for donor testing</td>
</tr>
<tr>
<td><strong>Epidemiology</strong></td>
<td>Fecal oral</td>
<td>Parenteral, blood</td>
<td>Parenteral and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>transfusion, sexual</td>
<td>nonparenteral, IV drug</td>
</tr>
<tr>
<td></td>
<td></td>
<td>contact, IV drug</td>
<td>sharing, health care</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sharing, health care</td>
<td>exposure.</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>Expect complete</td>
<td>5% May lead to cirrhosis</td>
<td>10% become chronic.</td>
</tr>
<tr>
<td></td>
<td>recovery</td>
<td>and hepatocellular</td>
<td>May lead to hepatocellular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>carcinoma (BTW, AFP is a</td>
<td>carcinoma (BTW, AFP is a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>marker for that.)</td>
<td>marker for that.)</td>
</tr>
<tr>
<td><strong>Other names</strong></td>
<td>Infectious</td>
<td>Australia antigen</td>
<td>Non-A, non-B</td>
</tr>
<tr>
<td></td>
<td>hepatitis</td>
<td>Dane particle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Short incubation</td>
<td>Long incubation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>hepatitis</td>
<td>hepatitis</td>
<td></td>
</tr>
<tr>
<td><strong>Blood borne?</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Most common</strong></td>
<td>Enzyme Immunoox</td>
<td>EIA</td>
<td>EIA</td>
</tr>
<tr>
<td>method of detection</td>
<td>assay EIA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We know a lot about Hepatitis B. Symptoms of hepatitis are an enlarged liver, jaundice, urine bilirubin, elevated ALT and AST, malaise. Hepatitis is typically diagnosed by enzyme immunoassay. There are 5 different serology tests for HepB. This figure from Turgeon is so detail rich, that I’d like you to use it to analyze the different components. There are 2 versions, the book version, and the version I colored. I’ll put Turgeon first. Allow me to orient you to the figure.
This is a timeline from exposure to recovery, and you can see the graph is over 8 months long. Look at the very bottom. It shows a narrow window of symptoms, and spanning that time ALT is elevated. So the patient is fatigued, their bilirubin is elevated, and ALT is elevated. Do they have Hepatitis B? Look above the symptoms, and you’ll see that HBsAg is elevated even before the symptoms begin. A smaller curve shows that HBeAg shows up a little later, and resolves sooner. HBeAg is an indicator of the infective stage, so this is a really important indicator. It drops at 4 months. The peak that comes after it, is anti-HBe. I don’t like this graphic, because it does not clearly indicate which is antigen and which is antibody. Look at my color drawing, and then make your own (do this 4 times) . I used a solid line for the presence of the antigen, and a dotted line for the antibodies.

HBsAg is an antigen on the virus coat, and it is seen during the incubation period. HBe is somewhere, don’t know where, but it is related to the core, and its antigen indicates an infectious stage. HBc is a core antigen, and the presence of anti-HBc indicates a later stage of disease. Look at how anti-HBc peaks at a time when HBsAg and anti-HBs are very low. If we tested only for the surface antigen and antibody, it might be negative during this window. This is called the anti-core window – notice that no other antibodies are seen yet. This is why anti-HBc is used in blood donor testing to prevent transfusion related HepB ((BTW, the other test for blood donors is HBsAg). Testing for Anti-HBc will be positive here. anti-HBc IgM antibody indicates a recent infection. Anti-HBc is a marker of recovery and immunity. Look at the scale above the figure. This shows the progression from HBsAg to anti-HBc. Anti-HBs is a marker of recovery and immunity.
Hepatitis B has been linked to health care personnel, and the virus is very hardy. It can survive for a long period of time on a counter top. Students and employees should be vaccinated against Hepatitis B. This 3-shot series is not killed/attenuated virus at all, it is a recombinant HepB protein. You can’t catch the disease from it. If you’ve been vaccinated, you may make anti-HBs, but you won’t have anti-HBc, since the vaccine does not include those proteins. People who have been exposed to HepB will be treated with Hepatitis Immune Globulin, which consists of anti-HBs.

A patient with chronic HBV infection may have a positive HBsAg AND anti-HBs, something you don’t see with acute infection. In chronic infection, the viral DNA integrates into the patient liver cell DNA, and contributes to development of hepatocellular carcinoma.

**Hepatitis C** (HCV) is a fairly recent discovery. For many years, patients had symptoms of viral hepatitis, but the tests for Hep A and Hep B were negative. NANB Hepatitis stands for non-A non-B Hepatitis; many of those NANB cases were caused by Hepatitis C. HCV can cause end stage liver disease, so it is a major reason for liver transplants. We screen donor blood for HCV two ways: anti-HCV is tested, and HCV NAT (nucleic acid testing). Hep C can be spread by percutaneous contacts, mother-infant, shared IV drugs, and some sensational news in 2008-2010 where reusing medical needles spread the disease to patients undergoing surgery and colonoscopy.

Make a matching game for yourself of the different hepatitis antigens and antibodies. Play it until you get 100 four times in a row. Use the table below to get ready.

<table>
<thead>
<tr>
<th>Anti-HAV</th>
<th>HCV NAT</th>
<th>Anti-HCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBsAg</td>
<td>HBeAg</td>
<td>HBcAg</td>
</tr>
<tr>
<td>Anti-HBs</td>
<td>Anti-HBc</td>
<td>ALT</td>
</tr>
<tr>
<td>Bilirubin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Describe the etiologic agent of Hepatitis A.
2. Discuss the transmission of HAV.
3. State the average incubation period of HA.
4. Describe the relationship between viremia, fecal shedding, and onset of jaundice.
5. State the outcome of HA.
6. Describe the diagnostic evaluation of HA in regards to acute infection and past infection.
7. Describe the etiologic agent of Hepatitis B. How does it differ from HA?
8. Discuss the transmission of HBV.
9. State the average incubation period of HB.
10. Discuss the significance of the double-shelled particle.
11. Discuss the broad-spectrum of disease seen with HB.
12. Describe persistent infection and its marker and its possible outcome.
13. Explain the significance and sequence of the three antibodies to HB (anti-HBc, anti-HBe, anti-HBs).
14. Explain the serologic and clinical pattern observed during acute HB (incubation and prodromal).
15. Discuss the progression of healthy HbsAg carriers through chronic active hepatitis and cirrhosis.
16. Name the type of the hepatitis B vaccine.
17. Name the marker associated with hepatocellular carcinoma.
18. Describe the viral characteristics of HC.
19. Discuss the transmission of HC.
20. Discuss the likely outcome of HC.
21. Name the laboratory test for HC.

Chapter 24: Rubella Infections

1. List other names for rubella infection
2. Describe the transmission of rubella
3. List the characteristics of acquired infection
4. List the characteristics of congenital infection (Rubella Syndrome)
5. Discuss in utero infection and the effects in early pregnancy
6. Name the laboratory test for diagnosing congenital rubella in the neonate
7. Name the laboratory that is the reference method for the detection and quantitation of rubella antibody
8. Discuss the optimal timing for paired serum testing for the diagnosis of recent infection
9. Describe the testing necessary to detect recent rubella infection in pregnant women
10. Discuss the benefits of rubella immunization

Chapter 25: Acquired Immunodeficiency Syndrome

HIV is the predominant etiologic agent of AIDS. It is a retrovirus. Both types I and II cause AIDS. The viral genome codes for pol, gag (p24) and env (gp41, gp120) proteins.

The virus is spread by body fluid exchange, eg. sexual contact, IV drug use needle sharing, breast milk, etc. Not all body fluids are infectious.

HIV virus targets T lymphocytes, specifically CD4+ subset. The gp 120 protein on the viral envelope binds to the protein receptor CD4 on the T lymphocytes. This is shown in figure 25-1 of Turgeon, 4th edition.

Draw this for yourself and make the connection obvious and in color. Other cells that express CD4 will also be infected by the virus. Co-receptors are involved in the binding, and people with mutations in the co-receptors may have a high tolerance or immunity to the HIV virus. Normally, the virus penetrates the T cell, sheds its envelope, reverse transcribes to DNA, and the DNA is integrated into the host T cell genome. New viral particles
are produced, which bud out of the infected cell, and infect other cells. Infection of CD4+ lymphocytes leads to their eventual decline.

In the lab, we’re concerned with the diagnosis and monitoring of HIV, and the diagnosis of AIDS. Each of these will be discussed separately.

**Diagnosis of HIV:** The populations that we are concerned about here are
- general population (should be screened annually) & those at risk by risky behavior
- blood donors

The general population and those at risk are tested by EIA (ELISA) methods. Patients exposed to the virus will produce antibodies within a window period of (6-12 weeks or longer), and the EIA detects these antibodies. The EIA test is very sensitive, and may produce false positive results. All new positives should be repeated before further testing. A repeatedly positive sample should be confirmed by a more specific method. Western Blot is used as this method, and it is specific in that a positive band will be compared to a standard, and so antibodies to p24 and gp41 can be identified. Antibodies to gp41 will persist through the disease. A sudden decrease in anti-p24 is poor prognosis, as it indicates that the antibody is being complexed (and consumed) to increased amounts of p24 core virus. RIBA is a substitute for a western blot. RIBA is recombinant immunoblot assay.
- The window period for a positive EIA is 6-12 weeks or longer. This window is unacceptable for screening blood donors. NAT (nucleic acid testing) is done on blood donor blood. NAT is a molecular approach that actually looks for the viral genes, not patient antibodies. There is a small window period.

**Monitoring for patients with HIV:** The purpose of monitoring these patients is to see if drug therapy is working, and to diagnose the stage when a person goes from HIV positive to AIDS. Patients can be monitored by doing CD4 cell counts. They can also be monitored by testing viral loads. Since the virus is an RNA virus, it will be RT-PCR’d quantitatively to determine the number of viruses. Alternately, bDNA can be used to quantify the virus. bDNA does not amplify the virus (target), it amplifies the signal.

**Diagnosis for AIDS:** The CDC established guidelines to define a case, and a patient must be HIV positive AND have a low CD4 cell count (<200/ul) OR have an AIDS defining illness, such as candidiasis, coccidiodomycosis, CMV, Kaposi’s sarcoma, etc. Google CDC AIDS case definition for a complete list. Not all infections qualify, they must be on the list.

The performance characteristics of a test include sensitivity and specificity. Use TP to mean True positives of the test being evaluated, and use TN for true negative. Sensitivity is the TP/all patients with the disease. Specificity is TN/all patients without the disease. Be careful when you see questions referring to these characteristics.

- Evaluate the denominator. The two other performance characteristics are positive predictive value and negative predictive value. Positive predictive value is TP/all positives (false positives and true positives). Negative predictive value is TN/all negatives.

1. Do the chapter problems 1, 2, 5, 8, 21, 22, 23, 25.
2. Describe the etiologic agent of AIDS.
3. List the two distinct HIV viruses.
4. Name two oncoviruses in the Retroviridae family.
5. Describe the biologic properties of HIV (remember the R’s).
6. Name the biochemical component of the following structures:
   a. Membrane
   b. Knoblike structures and anchor
   c. Core
   d. Enzymes
   e. Genes
7. Name the target cell of HIV and the early process of infection.
8. Describe the stages of HIV infection and the development of AIDS.
9. Explain the CDC classification for the diagnosis of AIDS.
10. List some of the AIDS-Defining diseases (Opportunistic Infections).
11. Name 3 modes of transmission.
12. Name the body fluids that have been implicated in the transmission of HIV.
13. Describe the viremia that occurs with early infection, latency, and late stage AIDS.
14. Describe the stage of prolonged clinical latency.
15. Name some of the co-factors that influence the progression of disease.
16. Describe the process of lysis or loss of CD4 cells and the alterations in the immune system.
17. Explain syncytia formation.
18. Explain the “window” period of seronegativity.
19. Name the order of antibodies first detected as serologic markers.
20. List 4 diagnostic evaluations for identification of HIV infection.
21. Explain the benefit of resistance testing.
22. Describe the benefit of new third-generation serologic assays.
23. State the percentage of HIV infected individuals that are unaware of their serologic status.
24. Name the confirmation test for HIV infection.
25. Name the antibody specificities of this test.
26. Name some of the reasons for indeterminate results.
27. Describe the process of PCR/DNA amplification.
28. List the benefits of determining free viral load.
29. Describe leukocyte and lymphocyte counts in the patient with AIDS.
30. Name the process of enumeration of lymphocyte subsets.
31. Discuss the CDC recommendations for prevention of HIV.
32. Describe the risk and benefit of PEP of exposed health care workers (HCW).
33. Name the 4 major classes of FDA-approved medications and explain the mechanism of action of each.

Chapter 26: Hypersensitivity Reactions

1. Define anaphylaxis.
2. Name the antibody and the cell types involved.
3. List the common chemical mediators of anaphylaxis and type I reactions.
4. Describe the signs and symptoms of anaphylaxis.
5. Describe the laboratory evaluation of allergy (type I reactions).
6. Define cytotoxic reaction.
7. Name the antibody and cell types involved.
8. Define transfusion reaction.
9. List the types of transfusion reaction.
10. Define immune complex reactions.
11. Name the antibody and cell type involved.
12. List examples of type III reactions.
14. Name the cell type involved (no antibody).
15. List the immunologic events associated with type IV reactions and give an example of each.
<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Symptoms</th>
<th>Example</th>
<th>Lab Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Anaphylactic IgE</strong></td>
<td>Rhinitis, asthma, hay fever, food allergy, urticaria, angioedema</td>
<td>Bee sting</td>
<td>Skin testing RAST-IgE Chemiluminescent enzyme immunoassay for allergens</td>
</tr>
<tr>
<td>II</td>
<td><strong>Cytotoxic IgG</strong></td>
<td>Antibody dependent, complement or cell mediated cytotoxicity</td>
<td>Transfusion reaction Graft rejection HDN May be antibody dependent or independent</td>
<td>DAT AHG</td>
</tr>
<tr>
<td>III</td>
<td><strong>Immune complex IgG, IgM</strong></td>
<td>Deposits of immune complexes in blood vessel walls and tissues</td>
<td>Arthus (localized), post streptococcal glomerulonephritis SLE Serum sickness</td>
<td>Specific testing for disease, eg RA</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Delayed hypersensitivity Cell mediated</strong></td>
<td>Antigen sensitized T cells</td>
<td>Contact sensitivity Rejection of transplants Immunity to intracellular organisms Elimination of tumor cells Contact dermatitis (metals) Latex sensitivity</td>
<td>PPD skin test Antigen skin tests</td>
</tr>
</tbody>
</table>

Atopic refers to immediate hypersensitivity mediated by IgE.

Circulating IgE binds to mast cells with fixed IgE, crosslinking, causing them to release granules of heparin, histamine. These biochemicals have an effect on coagulation and vascular changes.

Anaphylactoid reactions are similar to anaphylaxis but are not antigen-antibody in nature. The substances directly act on mast cells, releasing mediators.

**Chapter 27: Immunoproliferative Disorders**
1. Describe characteristics of monoclonal gammapathies.
2. Describe characteristics of polyclonal gammapathies.
3. Discuss the cause of multiple myeloma.
4. Discuss the cause of Waldenstrom’s macroglobulinemia.

**Chapter 28: Autoimmune Diseases**
1. Define autoimmune disease.
2. Discuss the action of specific autoantibodies and their use in medical diagnosis.
   a. Anticardiolipid antibody
   b. Anticentromere antibody
   c. Anti-DNA antibody
d. Antimitochondrial antibody
e. Antineutrophil antibody
f. Antinuclear antibody
g. Antiparietal cell antibody
h. Antismooth muscle antibody
i. Anti-SS-A and Anti-SS-B antibody
j. Antithyroglobulin and antithyroid microsome antibody

3. Discuss HLA B27 antigen and its use in medical diagnosis.

Chapter 29: Systemic Lupus Erythematosus

1. Describe the etiology of SLE.
2. Describe the incidence of SLE.
3. Name the most common presenting manifestation.
4. Discuss the complications of renal disease.
5. Describe the laboratory evaluation of antinuclear antibodies (emphasis on indirect immunofluorescent technique, speckled pattern, anticentromere antibody).
6. Discuss the role of complement in autoimmune disorders.

Chapter 30: Rheumatoid Arthritis

1. Describe the etiology of RA.
2. Describe the incidence of RA.
3. Describe the signs and symptoms of RA.
4. Discuss the prognostic markers for the diagnosis of RA.
5. Discuss the two pathogenic mechanisms that have been hypothesized in RA.
6. What is the most common composition of rheumatoid factor? What is its specificity?
7. What are the characteristics of persons most susceptible to rheumatoid arthritis? What is the significance of the HLA-DR4 antigen?
8. Name 4 disorders other than RA in which rheumatoid factor may be elevated.
10. Describe Still’s disease.
11. In the latex agglutination RA test, what is the antigen and what is the antibody? How is the serum prepared prior to testing? Why?
12. When should a quantitative RA procedure be performed? If the RA reference preparation has a value of 1000 and is positive at a 1:160 dilution and the patient’s serum is positive at a 1:80 dilution, how many IU/mL are in the patient’s serum?
Urinalysis Psychomotor Objectives

- Discuss the different types of specimens collected for urinalysis
- Perform the daily startups including the qc for all manual tests performed
- Perform the daily qc and startups for the automated urinalysis analyzer
- Perform daily, preventative, and any other maintenance needed for work day
- Accurately perform the routine urinalysis, including reagent strip testing and microscopic evaluations
- Perform the Acetest
- Perform the Clinitest
- Perform the Ictotest
- Perform the sulfosalicylic acid test
- Perform automated and manual cerebrospinal fluid counts and differentials
- Perform synovial fluid cell counts and differentials
- Perform synovial fluid crystal identification
- Perform urine pregnancy tests (qualitative)
Urinalysis Study Guide for Exam

1. List the major organic components of urine. How would you determine if an unknown specimen is urine?
2. State the normal daily volume of urine and the volumes and clinical correlations associated with polyuria, oliguria, anuria and polyuria.
3. State a similarity and a difference in the urine from patients with diabetes insipidus and diabetes mellitus.
4. List 10 changes that will take place in urine that remains unpreserved for over 1 hour.
5. What is the most routinely used method of urine preservation?
6. State an advantage and a disadvantage of preserving urine for routine analysis using, formalin, thymol, chloroform, toluene and sodium fluoride.
7. What is the preferred specimen for routine urinalysis? Why?
8. State the purpose and method of collection for timed or 24 hour specimens and midstream clean catch specimens.
9. How would you collect a fasting urine specimen?
10. Define the terms, diuresis, polydipsia, azotemia and uremia.
11. State the normal color of urine and the pigment responsible for this color.
12. Name a pathological condition and its associated pigment that produces dark yellow or amber urine.
13. What is signified by the presence of yellow foam when urine is shaken?
14. Describe the color and clarity of specimens in cases of hematuria, hemoglobinuria and myoglobinuria.
15. Name three pathological substances that will produce black urine.
16. What is the appearance of urine containing amorphous urates? How can these be dissolved?
17. What is the appearance of urine containing amorphous phosphates? How can these be dissolved?
18. Define specific gravity. What is the normal range for urine specific gravity and the specific gravity of the glomerular filtrate?
19. Differentiate between the measurement of specific gravity and osmolarity.
20. State the principle of the refractometer when determining specific gravity.
21. How is the refractometer calibrated and quality control performed?
22. What is the major nonpathologic cause of variation in a patient’s urine specific gravity?
23. What is the major nonpathologic cause of a specific gravity greater than 1.035?
24. A urine specimen diluted 1:3 has a specific gravity of 1.015, what is the actual specific gravity?
25. Describe the correct technique for performing urine reagent strip testing.
26. Name four things that can cause deterioration of reagent strips. Where should reagent strips be stored?
27. Give two reasons for discarding unused reagent strips and two times when quality control must be performed on the strips.
28. State the principle of automated reagent strip readers.
29. What is the normal urine pH? What is the significance of a urine pH of 9.0?
30. State the principle of the reagent strip test for pH. Does anything interfere with the reagent strip test for pH? If so, what?
31. What is the relationship between urinary pH and urinary crystals?
32. What is the normal urinary protein concentration and the major protein found in urine?
33. How do glomerular damage and impaired renal tubular reabsorption affect urinary protein concentration? What proteins are involved?
34. What is the disease associated with Bence Jones protein? What is the origin of BJP and how does it differ from other proteins?
35. How do you determine if a person is producing orthostatic proteinuria? What is the clinical significance of this?
36. What is the principle of the reagent strip test for protein and the primary reagent?
37. State the major cause of false positive reagent strip protein readings? How can this be remedied?
38. What is the primary confirmatory test for urinary protein? Briefly describe how the test is performed. How does the presence of radiographic dye affect this test?
39. What is the clinical significance of microalbuminuria?
40. What is the major pathological cause of glycosuria? Name three other causes?
41. With what condition would you expect to find a normal blood glucose and glycosuria?
42. State the principle of the reagent strip test for glucose and name two enzymes incorporated into the reagent strip.
43. How is urinary glucose testing affected by the testing of improperly preserved specimens and the presence of increased amounts of ascorbic acid?
44. State the principle of the Clinitest. What is “pass through” and how can it be avoided?
45. What is the primary difference between reagent strip glucose tests and Clinitest?
46. What urinary glucose test should be performed on newborns?
47. What is the source of urinary ketones?
48. Name the three urinary ketones.
49. State three clinical conditions resulting in the appearance of urine ketones.
50. What is the primary chemical in reagent strip ketone tests? Which ketone does it detect?
51. How will the ketone test on an improperly preserved specimen be affected?
52. Differentiate between hematuria and hemoglobinuria and state the major clinical causes of each.
53. What is the significance of a speckled pattern on the reagent strip test pad for blood?
54. Give the principle of the reagent strip test for blood. How will the presence of increased ascorbic acid or a very low pH affect the test?
55. What is the source of myoglobin?
56. What clinical conditions are associated with myoglobinuria?
57. Differentiate between hemoglobinuria and myoglobinuria using the ammonium sulfate test.
58. State the urine bilirubin and urobilinogen reactions associated with bile duct obstruction, liver disease and hemolytic disease.
59. The oxidation product of bilirubin is ____________________. How will this affect reagent strip test results?
60. What is the name of the reaction used in reagent strip testing for bilirubin?
61. How will the presence of increased ascorbic acid affect reagent strip bilirubin results?
62. What is the confirmatory test for bilirubin and how does it increase the test specificity?
63. What is the chemical name and the common name of the reagent used in testing for the presence of urobilinogen and porphobilinogen?
64. What is the best time of day to collect a specimen for urobilinogen?
65. How does exposure to light affect the results of urinary bilirubin and urobilinogen tests?
66. What is the primary significance of a positive test for urinary nitrite?
67. How will testing of an improperly preserved specimen affect urine nitrite results?
68. What other reagent strip test is most frequently positive when the nitrite is positive?
69. What is the substance measured in the reagent strip test for leukocytes? Do all leukocytes possess this substance? Explain.
70. Is it possible to have a positive reagent strip test for leukocytes and not see any leukocytes in the microscopic? Explain.
71. Give the principle of the reagent strip test for specific gravity.
72. Describe how the light should be controlled when examining unstained urine by brightfield microscopy.
73. Name two sediment constituents that polarized microscopy can help in the identification.
74. How will red blood cells appear in dilute alkaline urine?
75. Describe a glitter cell and the consistency of the urine they appear in.
76. Describe dismorphic red blood cells and their clinical significance.
77. Name two artifacts that are frequently confused with red blood cells
78. Describe the characteristic microscopic findings in cystitis, pyelonephritis and interstitial nephritis.
79. Name, describe and state the source of the three primary epithelial cells found in urine.
80. What is an oval fat body and how is it formed?
81. Describe the process by which casts are formed and state the primary area of the nephron in which they are formed. What clinical defect is conducive to cast formation?
82. What is the material that makes up the matrix of casts?
83. Describe the appearance of red blood cell, white blood cell, epithelial cell, hyaline, granular, fatty, waxy and broad casts and state their clinical significance.
84. How does strenuous exercise affect the results of a routine urinalysis?
85. With what disorder is the appearance of yeast in the urine sediment most frequently associated?
86. Describe the appearance of Trichomonas vaginalis in the urine sediment.
87. Name and describe the crystals found in normal acidic and normal alkaline urine.
88. What is the appearance of a refrigerated specimen containing amorphous phosphates? Amorphous urates?
89. At what pH do abnormal crystals appear?
90. Name and describe three abnormal crystals associated with liver disease.
91. Name and describe three crystals that are amino acids.
92. What is the unique characteristic of cholesterol crystals? Do they polarize?
93. How could you differentiate between similarly appearing uric acid and cystine crystals?
94. What type of crystals may be seen in a specimen with a very high specific gravity?
95. What is the appearance of starch granules under polarized light?
96. For each parameter of the physical and chemical parts of the urinalysis, list the sediment constituents that might be present.
Phlebotomy Psychomotor Objectives

- Upon completion of the phlebotomy internship the student should be able to:
  - Perform venipuncture by the vacuum tube method
  - Perform venipuncture by the syringe method
  - Perform venipuncture by the butterfly method
  - Demonstrate proficiency in the order of draw of vacuum tubes
  - Demonstrate accuracy in patient identification
  - Demonstrate competency in proper labeling of patient samples
  - Demonstrate proficiency in transporting specimens
  - Demonstrate proficiency in collection of blood cultures
  - Observes all isolation precautions when performing venipuncture
  - Washes hands before and after each patient
Phlebotomy Study Guide for Exam

1. Describe the donning and removal of PPE.
2. While performing phlebotomy under what circumstances might you encounter reverse isolation? What PPE and other precautions should be utilized?
3. State the number one safety rule in phlebotomy.
4. What is the primary method for preventing nosocomial infection?
5. Differentiate between contact, airborne and droplet precautions.
6. How does venous blood differ from capillary blood? Name any tests that can be altered if results are compared between the two types of blood.
7. State the principle of the anticoagulants, EDTA, Na citrate and heparin. Relate these anticoagulants to the color of the Vacutainer tubes.
8. What is the purpose of the additives, Na fluoride, thrombin, silica, thixotropic gel?
9. State the common tests associated with the following color tubes, lavender, light blue, green, light green, gray, dark blue, red, red/gray, yellow/black, yellow and brown.
10. What is the principle of an SST?
11. Define expiration date. How does this affect vacutainers?
12. State 4 methods for performing quality control on vacutainer tubes?
   a. When is this performed?
13. State the order of draw when using a vacutainer. Explain the reasoning behind this order.
14. How can failure to follow the order of draw affect a PT? Calcium?
15. What are the unique properties of dark blue tubes?
16. How should the anticoagulant in a light blue tube be adjusted when drawing a patient with polycythemia? Why?
17. What is the purpose of a light blue tube containing soybean trypsin inhibitor?
18. How does a multisample vacutainer needle prevent exposure to blood?
19. Explain the order of tube fill from a syringe and the reasons for this order.
20. State the parts of a syringe.
21. How should blood be transferred from a syringe and the reasons for this order?
22. List 3 possible causes of hemolysis when using a syringe.
23. How does a properly applied tourniquet affect blood flow?
24. State 3 things to analyze when palpating a vein.
25. Define Universal and Standard Precautions and state how they relate to phlebotomy.
26. List three reasons for requiring a requisition form prior to performing a venipuncture.
27. What is the course of action to follow when a patient refuses to have blood drawn?
28. List 5 pieces of information that must be present on a requisition form.
29. List 4 pieces of information that must be present on a patient's ID band.
30. If no ID band is found on the patient's arms, where might it be?
31. The maximum length of time a tourniquet should be applied is ________________________.
32. Name and describe the location of the 3 major veins used for venipuncture.
33. What are the concerns over drawing blood from leg veins?
34. The preferred vein for venipuncture is the ________________________, Why?
35. List 3 reasons for allowing alcohol to dry on a patient's arm prior to performing a venipuncture.
36. How do you prepare for the possibility of encountering a defective vacuum tube?
37. What causes "rolling veins"?
38. The angle of needle insertion is ________________________.
39. List 5 pieces of information that should be present on a specimen label.
Clinical Laboratory Sciences Program

40. State whether the following are acceptable or unacceptable and why.
   a. A patient standing during the venipuncture
   b. Assembling equipment prior to applying the tourniquet
   c. Explaining the procedure to the patient
   d. Requesting the patient to pump the fist during collection
   e. Palpating with the thumb
   f. Cleansing the site in a circular motion from inside to outside
   g. Bending the patient's elbow while applying pressure to the puncture site
   h. Bracing the hand holding the needle against the patient's arm during collection

41. State an error in venipuncture technique that could cause petchiae.

42. State 4 causes of hematomas.

43. What should be done if you encounter a patient without an ID band?

44. What steps should be taken if a patient develops syncope?

45. List 4 methods to make veins appear more prominent.

46. How does a vein that is occlude feel?

47. State whether the following are acceptable or unacceptable venipuncture sites and why.
   a. Antecubital area above an IV drip that has been disconnected for 5 minutes
   b. Wrist below an antecubital hematoma
   c. Antecubital area containing a tattoo
   d. Vein surrounded by a hematoma
   e. Wrist below an IV that has been discontinued for 5 minutes
   f. Arm with a fistula
   g. Right arm of a patient with a right mastectomy
   h. Veins on the back of the hand
   i. Vein that feels hard

48. What precaution must be taken when coagulation tests are drawn from an indwelling line?

49. List 3 reasons why blood may not be obtained even though the needle is in the vein.

50. How can an arterial puncture be detected and what should be done?

51. State 4 causes of hemolysis. List the tests that are most affected by hemolysis.

52. List 5 causes of specimen rejection.

53. How many attempts should you make to collect a blood sample? If unsuccessful what should you do?

54. Discuss potential causes of lipemia.

55. Discuss the effects of diurnal variation on cortisol levels, serum iron and WBC counts.

56. Describe the steps and timing of a GTT.

57. Define peak and trough levels.

58. If requests for a cortisol, FBS and Stat crossmatch in the ER are received at 730, in what order would you collect them.

59. How should a blood culture be collected just prior to the patient receiving antibiotics?

60. Which blood culture bottle is inoculated first? Why?

61. State the special precautions observed when collecting a blood culture.

62. Discuss the major source of contaminated blood cultures.

63. How will a specimen for cold agglutinins drawn in the evening and refrigerated until the morning be affected?

64. Name 4 tests that should be placed in an ice bath immediately after collection. Describe the ice bath.

65. Name 3 tests that should be protected from light.

66. Define chain of custody.

67. What special precautions should be taken when collecting a legal alcohol level?

68. State a major concern when collecting a specimen for potassium and bilirubin by dermal puncture. How can this be avoided?
69. The maximum length of a dermal puncture lancet is ________________. Why?
70. How can blood flow through a dermal puncture area be increased?
71. Describe the Unopette system and discuss possible sources of error related to dermal puncture.
72. Describe the acceptable area for a heel puncture. State 2 possible causes for osteomyelitis.
73. How should a dermal puncture be performed to best obtain a rounded drop
74. Name 2 sources of contamination of the specimen when performing dermal puncture. How can they be avoided?
75. State 4 visible reasons for avoiding a site for dermal puncture.
76. What is the dermal puncture order of draw for a CBC, blood smear and bilirubin?
77. Should a bandage be applied following a heel stick? Why or why not?
78. What is the proper angle of the spreader slide when making a blood smear? How will the smear be affected if the angle is too high?
79. State a cause of the following in a blood smear
   i. Ridges
   ii. Holes in the smear
   iii. Streaks in the feathered edge
   iv. No feathered edge
80. When are thick and thin blood smears performed, and what is their purpose?
81. Discuss the principle of the bleeding time. State the ways in which the template bleeding time standardizes the procedure.
82. What error in patient preparation can prolong a bleeding time?
83. What error in technique can prolong a bleeding time?
84. State the normal template bleeding time. Can an abnormal bleeding time be discontinued? If so, when?
85. What is the primary test in neonatal screening?
86. Describe the procedure for collecting a neonatal filter paper screening test. How will failure to completely fill the circles affect the test?
87. State any additional sources of error in neonatal filter paper collections.
88. What is the value of delta checks related to phlebotomy?
Section 6
Appendix – Printable Evaluation Forms
Instructions to Clinical Staff Evaluator
1. Students should present their evaluation forms packet to you on the Wednesday of the last week of their rotation.
2. Please complete the forms and return to the student Friday of the same week.

Definition of Skill Levels

Entry-level expectations definition: student’s performance equates to that of a new graduate without experience who you think would be a competent employee after completing your department’s normal orientation for new employees.

1. Unsatisfactory: Performance is significantly below entry-level expectations. Performance is unacceptable. Needs continuous monitoring and supervision.
2. Needs Improvement: Performance is marginally below entry-level expectations. Student needs to improve to achieve entry level competencies.
4. Exceeds Expectations: Consistent in meeting entry-level expectations. Student performance demonstrates initiative and independent functioning. Student may excel in some areas.
5. N/A: Not applicable. No opportunity to evaluate criteria. Please mark “NA” across the rating scale if there has been inadequate opportunity to evaluate an attribute.

Instructions to Student (for each rotation)
1. Remove the evaluation forms from this notebook on Wednesday of the last week of your rotation. Make sure your name is on each page. Staple the packet.
2. Complete the first section labeled “Self-Assessment”.
3. Give the entire packet to your supervisor along with a copy of this page.
4. Pick the packet up from your supervisor on Friday.
5. Return the packet along with your evaluation of the rotation and your time sheet.
Student Evaluation of Clinical Rotation

Student Name: ___________________________  Date: ___________________________

Rotation Being Evaluated: □ MICRO  □ HEME  □ CHEM  □ BB  □ SERO  □ U/A  □ Phleb

Affiliate Location: ___________________________  Supervisor: ___________________________

S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U= Unsatisfactory

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<th>Clinical Instruction</th>
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<tr>
<td>Objectives of internship rotation were clearly stated</td>
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<td>Procedures were clearly explained and demonstrated</td>
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<td>Clinical Practicum developed skills needed for profession</td>
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<td>Assigned task kept me occupied for allotted time in area</td>
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<td>Rotation length was appropriate in this department to gain confidence in skills</td>
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<th>Clinical Instructors</th>
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<tr>
<td>Instructors answered questions satisfactorily</td>
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<td>Instructors were available for help</td>
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<td>Instructors were considerate of student needs</td>
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<td>Instructors offered suggestions for improvement</td>
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<td>Instructors were competent in areas of practice</td>
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<td>Instructors brought interesting and unusual events or samples to my attention</td>
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<td>Instructors reviewed my progress throughout the rotation</td>
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<th>Student Expectations</th>
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<td>I felt academically well prepared for this rotation</td>
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<td>I felt confident in applying my academic knowledge to the clinical rotation</td>
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<tr>
<td>The clinical experience developed confidence in my lab skills</td>
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<tr>
<td>My rotation was a valuable learning experience</td>
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Please comment on any strengths or weakness of this rotation or how it can be improved.

*Make copies of this form to use for each rotation.*
Student Attendance Record

Affiliate Site: ___________________________  Student Name: ___________________________
Lab/Rotation: ____________________________  Manager Name: ___________________________
Rotation Start Date: ______________________

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# Clinical Laboratory Sciences Program

## Week 4

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## Week 6

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<th>Day of Week</th>
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<th>Time Out</th>
<th>Time In</th>
<th>Time Out</th>
<th>Time In</th>
<th>Time Out</th>
<th>Total Hrs</th>
<th>Tech. Initials</th>
<th>Absent Hrs</th>
<th>Absent Reason</th>
<th>Excused Y/N</th>
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</table>
Chemistry Rotation Evaluation Forms
Chemistry Rotation Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Chemistry Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

Directions to Student: Use this form to document your experience during this rotation. Write NA, if the objective was not available. (pg 1/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analyzer Startup/Shutdown</td>
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<td>2. Preventative Maintenance</td>
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<td>4. Analyzer Calibrations</td>
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<td>5. Reagent Inventory and Verification</td>
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<td>6. Sample identification</td>
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<td>7. Routine Operation/Sample processing</td>
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<td>9. Linear Limits/Reportable Range</td>
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<td>10. Delta Flags/Checks</td>
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<td>12. Whole blood analysis</td>
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<td>13. Troubleshooting</td>
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<td>14. Critical Results Procedures</td>
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<td>15. Electrolytes</td>
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<td>16. Enzymes</td>
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<td>17. Non-protein nitrogen</td>
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<td>18. Glucose</td>
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<td>19. Body fluid analysis</td>
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<tr>
<td>20. Cardiac markers</td>
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<tr>
<td>21. Iron studies (Iron/TIBC/Ferritin)</td>
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<td>22. Urine Chemistries</td>
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<td>23. Drugs of Abuse Screen</td>
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<td>24. Therapeutic Drug Monitoring</td>
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<tr>
<td>25. Thyroid Profile</td>
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</tbody>
</table>
### Self-Assessment (to be Completed by the Student) (pg 2/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
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</thead>
<tbody>
<tr>
<td>26. Folate/vitamin B₁₂</td>
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<tr>
<td>27. Cortisol</td>
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<td>28. HCG (quantitative and qualitative)</td>
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<td>29. Tumor markers</td>
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<td>30. Lipid Studies</td>
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<td>31. Blood Gases</td>
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<td>32. Electrophoresis</td>
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<td>33. Ionized calcium/ionized magnesium</td>
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<td>34. Hepatitis testing</td>
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<td>Add additional analytes as needed</td>
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### SummaryComments:

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Student Signature __________________________  Date:  _____________________
# Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

**Student Name:** ___________________________  **Date:** ___________________________

**Type of Evaluation:** Chemistry Rotation Psychomotor Evaluation

**Affiliate Location:** _________________________  **Supervisor:** _________________________

**Directions to clinical faculty:** Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

*S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A (pg 1/2)

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<tr>
<th>Task</th>
<th>Performed or Discussed</th>
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### Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

**S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A (pg 2/2)**

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<td>40.</td>
<td>Ammonia</td>
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</tbody>
</table>

Add additional analytes as needed

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*Each psychomotor attribute is a total of 4 points each.*

\[
\begin{align*}
S+ &= 4 \times ______ = ______ \\
S &= 3 \times ______ = ______ \\
S- &= 2 \times ______ = ______ \\
U &= 1 \times ______ = ______ \\
\text{TOTAL} &= ______
\end{align*}

Please list any additional information in regards to analyzers used and/or tests performed

<table>
<thead>
<tr>
<th>Analyzers</th>
<th>Test</th>
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<tbody>
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</tbody>
</table>

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*All documents of completion must be submitted at the end of the rotation to the SF Internship Coordinator.*

Staff Technologist______________________________ Date: __________________

Clinical Coordinator_____________________________ Date: __________________
Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated: □ MICRO □ HEME □ CHEM □ BB □ SERO □ U/A □ Phleb

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

(U) Unsatisfactory: Student consistently did not display desired skill or behavior
(S-) Needs Improvement: Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist
(S) Meets Expectations: Student demonstrates acceptable skill or behavior for entry-level technologist the majority of the time
(S+) Exceeds Expectations: Student demonstrates above average skill and knowledge. Always displays appropriate professional behaviors.

Knowledge & Skills
S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U= Unsatisfactory, N/A

<table>
<thead>
<tr>
<th>Observed Outcome</th>
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<tbody>
<tr>
<td>Adheres to all safety procedures</td>
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<tr>
<td>Follows laboratory testing procedures and protocols. Is attentive to instruction and able to follow written and verbal instructions</td>
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<tr>
<td>Learns new procedures in a reasonable amount of time</td>
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<tr>
<td>Demonstrates knowledge of assigned readings</td>
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<tr>
<td>Questions asked are appropriate and discerning</td>
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<tr>
<td>Recognizes normal and abnormal results</td>
</tr>
<tr>
<td>Understands the theoretical basis for laboratory tests and is able to recognize significance of tests results</td>
</tr>
<tr>
<td>Plans and organizes work effectively and efficiently</td>
</tr>
<tr>
<td>Demonstrates knowledge of guidelines for reporting data, entering patient results into the computer and can determine acceptability of data generated</td>
</tr>
<tr>
<td>Understands significance and can perform quality control procedures accurately</td>
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<tr>
<td>Possesses technical skills of an entry level technologist</td>
</tr>
</tbody>
</table>
# Affiliate Supervisor Final Evaluation of the Student (Part 3/4)

## Professional Behaviors

<table>
<thead>
<tr>
<th>Attendance and Dependability – Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrives on time, begins work promptly, and completes scheduled days.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>On occasion is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Frequently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Consistently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never arrives on time, always leaves early, takes extended breaks, is absent from work.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

**Initiative - Check 1**

| Assumes responsibility for work and assignments without being reminded. | 20 ( ) |
| Usually assumes responsibility for work and assignments. | 15 ( ) |
| Occasionally assumes responsibility for work and assignments. | 10 ( ) |
| Rarely assumes responsibility for work and assignments. | 5 ( ) |
| Never assumes responsibility for work and assignments. | 0 ( ) |

**Judgment and Decision Making - Check 1**

| Consistently asks appropriate questions recognizing limitations with professional maturity. | 20 ( ) |
| Usually displays good judgment and decision making. | 15 ( ) |
| Occasionally displays good judgment and decision making. | 10 ( ) |
| Shows poor judgment and decision making ability. | 5 ( ) |
| Lacks all professional maturity. | 0 ( ) |

**Integrity - Check 1**

| Always admits mistakes, takes immediate and appropriate action to correct them. | 20 ( ) |
| Usually admits mistakes, takes immediate/appropriate action to correct them. | 15 ( ) |
| Occasionally admits mistakes, takes immediate/appropriate action to correct them. | 10 ( ) |
| Recognizes mistakes, but does not admit them, blames others or rationalizes. | 5 ( ) |
| Ignores and/or covers up mistakes, blames others, rationalizes. | 0 ( ) |

**Professional Relationships and Cooperation - Check 1**

| Exhibits a tactful, professional manner in interaction with instructors and peers. | 20 ( ) |
| Usually interacts with others in a professional manner. | 15 ( ) |
| Occasionally interacts in a professional manner. | 10 ( ) |
| Is frequently unpleasant in interactions, and/or intolerant of others. | 5 ( ) |
| Behaves in an irritating, disrespectful, argumentative manner towards others. | 0 ( ) |

**TOTAL**

_______
Summary Comments

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

Areas needing improvement:
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
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___________________________________________________________________________________________

Areas of Strength:
___________________________________________________________________________________________
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The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: ________________________________ Date: _____________________

Student (optional) __________________________ Date: _____________________

Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement.
Hematology Rotation Evaluation Forms
Hematology Rotation Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Hematology Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

Directions to Student: Use this form to document your experience during this rotation. Write NA, if the objective was not available. (pg 1/2)

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<th>Explanation Given (notes)</th>
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<tbody>
<tr>
<td>1. Perform start-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Perform and verify QC</td>
<td></td>
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<tr>
<td>3. Automated CBC/DIFF</td>
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<tr>
<td>4. Perform slide scans</td>
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<td>5. Perform WBC estimate</td>
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<tr>
<td>6. Evaluate RBC morphology</td>
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<td>7. Perform platelet estimate</td>
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<td>8. Perform manual differential</td>
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<tr>
<td>9. Review criteria for pathology review</td>
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<tr>
<td>10. Perform reticulocyte count</td>
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<td>11. Observe bone marrow procedure</td>
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<tr>
<td>12. Make PBS slides manually</td>
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<tr>
<td>13. Stain PBS slides</td>
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<tr>
<td>14. Perform bone marrow differential</td>
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<td>15. Perform sickle cell screening test</td>
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<tr>
<td>16. Perform ESR</td>
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<tr>
<td>17. Perform hemacytometer counts</td>
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<tr>
<td>18. Perform CSF cell counts &amp; diff</td>
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<td>19. Perform body fluid cell counts &amp; diff</td>
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<tr>
<td>20. Observe flow cytometry</td>
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<tr>
<td>21. Perform PT/INR</td>
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<td>22. Perform aPTT</td>
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<td>23. Perform fibrinogen</td>
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<td>24. Perform D-dimer</td>
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<tr>
<td>25. Perform PFA 100</td>
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<tr>
<td>Task</td>
<td>Explanation Given (notes)</td>
<td>Observed</td>
<td># Performed w/Assist.</td>
<td># Performed Unassisted</td>
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<tr>
<td>26. Observe mixing study</td>
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<tr>
<td>27. Observe factor assays</td>
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</table>

Add additional procedures as needed

Summary Comments: __________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________

Student Signature __________________________  Date:  _____________________
### Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Student Name: ___________________________ Date: ___________________________

**Type of Evaluation:** Hematology Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

**Directions to clinical faculty:** Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

*S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A (pg 1/2)*

<table>
<thead>
<tr>
<th>Task</th>
<th>Performed or Discussed</th>
<th>Skill level</th>
<th>Date &amp; Initials</th>
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</thead>
<tbody>
<tr>
<td>1. Perform start-up</td>
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<tr>
<td>2. Perform and verify QC</td>
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<td>3. Automated CBC/DIFF</td>
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<td>4. Perform slide scans</td>
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<td>5. Perform WBC estimate</td>
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<td>6. Evaluate RBC morphology</td>
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<td>7. Perform platelet estimate</td>
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<td>8. Perform manual differential</td>
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<td>9. Review criteria for pathology review</td>
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<td>10. Perform reticulocyte count</td>
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<tr>
<td>11. Observe bone marrow procedure</td>
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<tr>
<td>25. Perform PFA 100</td>
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</tbody>
</table>
### Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

S+ = Exceeds expectations, S = Meets expectations, S- = Needs Improvement, U = Unsatisfactory, N/A

<table>
<thead>
<tr>
<th>Task</th>
<th>Performed or Discussed</th>
<th>Skill level</th>
<th>Date &amp; Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Observe mixing study</td>
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<tr>
<td>27. Observe factor assays</td>
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<tr>
<td>Add additional procedures as needed</td>
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</tbody>
</table>

*Each psychomotor attribute is a total of 4 points each.*

S+ = 4 x ______ = _______
S = 3 x ______ = _______
S- = 2 x ______ = _______
U = 1 x ______ = _______

TOTAL _______

Please list any additional information in regards to analyzers used and/or tests performed

<table>
<thead>
<tr>
<th>Analyzers</th>
<th>Test</th>
</tr>
</thead>
</table>

*All documents of completion must be submitted at the end of the rotation to the SF Internship Coordinator.*

Staff Technologist______________________________  Date: __________________

Clinical Coordinator_____________________________  Date: __________________
Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated: □ MICRO □ HEME □ CHEM □ BB □ SERO □ U/A □ Phleb

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

(U) Unsatisfactory: Student consistently did not display desired skill or behavior

(S-) Needs Improvement: Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist

(S) Meets Expectations: Student demonstrates acceptable skill or behavior for entry-level technologist the majority of the time

(S+) Exceeds Expectations: Student demonstrates above average skill and knowledge. Always displays appropriate professional behaviors.

Knowledge & Skills
S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U= Unsatisfactory, N/A

<table>
<thead>
<tr>
<th>Observed Outcome</th>
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<tbody>
<tr>
<td>Adheres to all safety procedures</td>
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<tr>
<td>Follows laboratory testing procedures and protocols. Is attentive to instruction and able to follow written and verbal instructions</td>
</tr>
<tr>
<td>Learns new procedures in a reasonable amount of time</td>
</tr>
<tr>
<td>Demonstrates knowledge of assigned readings</td>
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<tr>
<td>Questions asked are appropriate and discerning</td>
</tr>
<tr>
<td>Recognizes normal and abnormal results</td>
</tr>
<tr>
<td>Understands the theoretical basis for laboratory tests and is able to recognize significance of tests results</td>
</tr>
<tr>
<td>Plans and organizes work effectively and efficiently</td>
</tr>
<tr>
<td>Demonstrates knowledge of guidelines for reporting data, entering patient results into the computer and can determine acceptability of data generated</td>
</tr>
<tr>
<td>Understands significance and can perform quality control procedures accurately</td>
</tr>
<tr>
<td>Possesses technical skills of an entry level technologist</td>
</tr>
</tbody>
</table>
## Professional Behaviors

<table>
<thead>
<tr>
<th>Attendance and Dependability – Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrives on time, begins work promptly, and completes scheduled days.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>On occasion is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Frequently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Consistently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never arrives on time, always leaves early, takes extended breaks, is absent from work.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initiative - Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumes responsibility for work and assignments without being reminded.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually assumes responsibility for work and assignments.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally assumes responsibility for work and assignments.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Rarely assumes responsibility for work and assignments.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never assumes responsibility for work and assignments.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Judgment and Decision Making - Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistently asks appropriate questions recognizing limitations with professional maturity.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually displays good judgment and decision making.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally displays good judgment and decision making.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Shows poor judgment and decision making ability.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Lacks all professional maturity.</td>
<td>0 ( )</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Integrity - Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always admits mistakes, takes immediate and appropriate action to correct them.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Recognizes mistakes, but does not admit them, blames others or rationalizes.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Ignores and/or covers up mistakes, blames others, rationalizes.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Professional Relationships and Cooperation - Check 1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibits a tactful, professional manner in interaction with instructors and peers.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually interacts with others in a professional manner.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally interacts in a professional manner.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Is frequently unpleasant in interactions, and/or intolerant of others.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Behaves in an irritating, disrespectful, argumentative manner towards others.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

**TOTAL**

_______
Summary Comments

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

Areas needing improvement:
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________

Areas of Strength:
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________
_________________________________________________

The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: _______________________________ Date: _____________________

Student (optional) ___________________________ Date: _____________________

Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement
Microbiology Rotation Evaluation Forms
Microbiology Rotation Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Microbiology Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

Directions to Student: Use this form to document your experience during this rotation. Write NA, if the objective was not available. (pg 1/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evaluate specimen acceptability</td>
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<tr>
<td>2. Specimen processing</td>
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<td>3. Colony count streaking</td>
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<td>4. Gram stains</td>
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<td>5. India Ink preps</td>
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<td>6. Acid Fast stains</td>
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<td>7. Germ tubes</td>
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<td>8. KOH preps</td>
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<td>9. Catalase test</td>
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<td>10 Oxidase test</td>
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<td>11. Staph Latex</td>
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<td>12. Group A Strep ID</td>
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<td>13. Group B Strep ID</td>
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<td>14. Group D Strep ID</td>
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<td>15. Spot Indole</td>
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<td>16. CTA sugars</td>
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<td>17. TSI slants</td>
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<td>18. Salmonella/shigella antigen typing</td>
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<td>19. Strep pneumo ID</td>
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<td>20. Hemophilus ID</td>
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<td>21. Novobiocin Disc</td>
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<td>22. Oxacillin/MRSA screen</td>
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<td>23. PYR test</td>
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<td>24. Moraxella catarrhalis test</td>
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<td>25. Automated identification testing</td>
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<tr>
<td>26. Miscellaneous testing</td>
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<td>27. Equipment Quality Procedures</td>
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<td>28. Susceptibility Testing: MIC</td>
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<td>29. Susceptibility Testing: Kirby Bauer</td>
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<td>30. Susceptibility Testing: Etest</td>
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<td>31. Beta-lactamase testing</td>
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<td>32. MRSA testing</td>
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<td>33. Serum Bactericidal levels/MBC</td>
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<td>34. Automated Blood culture</td>
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<td>35. Blind subculture</td>
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<tr>
<td>36. Instrument preventative</td>
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<td>37. AFB digestion</td>
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<td>38. Flurochrome</td>
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<td>39. AFB drug susceptibility</td>
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<td>40. AFB colony type determination</td>
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<tr>
<td>41. AFB identification from worksheets</td>
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<tr>
<td>42. AFB identification from DNA probes</td>
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<td>43. AFB identification from GLC</td>
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<td>44. Rapid yeast identification</td>
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<td>45. Mold identification by morphology</td>
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<tr>
<td>46. Identification of systemic fungus</td>
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<tr>
<td>47. Examination of stained smears</td>
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<tr>
<td>48. Examination of slide culture preps</td>
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<tr>
<td>49. GC/CT by DNA probes</td>
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<tr>
<td>50. Fecal Fat</td>
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<tr>
<td>51. Malarial slides</td>
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<td>52. Stool reducing substances</td>
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<tr>
<td>53. Permanent trichrome slides for</td>
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<tr>
<td>54. Equipment Quality Procedures</td>
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</tbody>
</table>

*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SF.*

Student Signature_____________________________  Date: ___________________
### Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

**Student Name:** ___________________________  **Date:** ___________________________

**Type of Evaluation:** Microbiology Rotation Psychomotor Evaluation

**Affiliate Location:** _________________________  **Supervisor:** _________________________

**Directions to clinical faculty:** Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

*S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory*  

<table>
<thead>
<tr>
<th>Task</th>
<th>Performed or Discussed</th>
<th>Skill level</th>
<th>Date &amp; Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evaluate specimen acceptability</td>
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<tr>
<td>2. Specimen processing</td>
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<tr>
<td>3. Colony count streaking</td>
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<tr>
<td>4. Gram stains</td>
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<tr>
<td>5. India Ink preps</td>
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<tr>
<td>6. Acid Fast stains</td>
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<td>7. Germ tubes</td>
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<td>8. KOH preps</td>
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<td>9. Catalase test</td>
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<td>10. Oxidase test</td>
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<td>13. Group B Strep ID</td>
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<td>14. Group D Strep ID</td>
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<td>15. Spot Indole</td>
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<tr>
<td>16. CTA sugars</td>
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<td>17. TSI slants</td>
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<td>18. Salmonella/shigella antigen typing</td>
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<td>19. Strep pneumo ID</td>
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<td>20. Hemophilus ID</td>
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<td>21. Novobiocin Disc</td>
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<td>22. Oxacillin/MRSA screen</td>
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<td>23. PYR test</td>
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<tr>
<td>24. Moraxella catarrhalis test</td>
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<tr>
<td>25. Automated identification testing</td>
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</table>
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

*S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U= Unsatisfactory*  

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<tbody>
<tr>
<td>26. Miscellaneous testing</td>
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<td>27. Equipment Quality Procedures</td>
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<td>28. Susceptibility Testing: MIC Automated</td>
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<td>29. Susceptibility Testing: Kirby Bauer</td>
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<td>30. Susceptibility Testing: Etest</td>
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<td>31. Beta-lactamase testing</td>
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<td>32. MRSA testing</td>
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<td>33. Serum Bactericidal levels/MBC</td>
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<td>34. Automated Blood culture</td>
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<tr>
<td>35. Blind subculture</td>
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<tr>
<td>36. Instrument preventative maintenance</td>
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<tr>
<td>37. AFB digestion</td>
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<td>38. Flurochrome</td>
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<tr>
<td>39. AFB drug susceptibility</td>
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<td>40. AFB colony type determination</td>
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<td>41. AFB identification from worksheets</td>
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<tr>
<td>42. AFB identification from DNA probes</td>
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<tr>
<td>43. AFB identification from GLC</td>
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<td>44. Rapid yeast identification</td>
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<tr>
<td>45. Mold identification by morphology</td>
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<tr>
<td>46. Identification of systemic fungus</td>
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<td>47. Examination of stained smears</td>
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<td>48. Examination of slide culture preps</td>
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<td>49. GC/CT by DNA probes</td>
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<td>50. Fecal Fat</td>
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<td>51. Malarial slides</td>
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<tr>
<td>54. Equipment Quality Procedures</td>
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</tbody>
</table>
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Microbiology Rotation Psychomotor Evaluation (pg 3/3)

*Each psychomotor attribute is a total of 4 points each.

S+ = 4 x ______ = ______
S- = 2 x ______ = ______
S = 3 x ______ = ______
U = 1 x ______ = ______

TOTAL ______

Please list any additional information in regards to analyzers used and/or tests performed

Analyzers                                      Test

________________________________________________________________________

________________________________________________________________________

*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SFC

Staff Technologist______________________________  Date: __________________
Clinical Coordinator_____________________________  Date: __________________
Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated: □ MICRO  □ HEME  □ CHEM  □ BB  □ SERO  □ U/A  □ Phleb

Affiliate Location: _________________________  Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

(U) Unsatisfactory: Student consistently did not display desired skill or behavior
(S-) Needs Improvement: Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist
(S) Meets Expectations: Student demonstrates acceptable skill or behavior for entry-level technologist the majority of the time
(S+) Exceeds Expectations: Student demonstrates above average skill and knowledge. Always displays appropriate professional behaviors.

Knowledge & Skills

<table>
<thead>
<tr>
<th>Observed Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adheres to all safety procedures</td>
</tr>
<tr>
<td>Follows laboratory testing procedures and protocols. Is attentive to instruction and able to follow written and verbal instructions</td>
</tr>
<tr>
<td>Learns new procedures in a reasonable amount of time</td>
</tr>
<tr>
<td>Demonstrates knowledge of assigned readings</td>
</tr>
<tr>
<td>Questions asked are appropriate and discerning</td>
</tr>
<tr>
<td>Recognizes normal and abnormal results</td>
</tr>
<tr>
<td>Understands the theoretical basis for laboratory tests and is able to recognize significance of tests results</td>
</tr>
<tr>
<td>Plans and organizes work effectively and efficiently</td>
</tr>
<tr>
<td>Demonstrates knowledge of guidelines for reporting data, entering patient results into the computer and can determine acceptability of data generated</td>
</tr>
<tr>
<td>Understands significance and can perform quality control procedures accurately</td>
</tr>
<tr>
<td>Possesses technical skills of an entry level technologist</td>
</tr>
</tbody>
</table>
### Professional Behaviors

#### Attendance and Dependability – Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrives on time, begins work promptly, and completes scheduled days.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>On occasion is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Frequently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Consistently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never arrives on time, always leaves early, takes extended breaks, is absent from work.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

#### Initiative - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumes responsibility for work and assignments without being reminded.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually assumes responsibility for work and assignments.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally assumes responsibility for work and assignments.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Rarely assumes responsibility for work and assignments.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never assumes responsibility for work and assignments.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

#### Judgment and Decision Making - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistently asks appropriate questions recognizing limitations with professional maturity.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually displays good judgment and decision making.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally displays good judgment and decision making.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Shows poor judgment and decision making ability.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Lacks all professional maturity.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

#### Integrity - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always admits mistakes, takes immediate and appropriate action to correct them.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Recognizes mistakes, but does not admit them, blames others or rationalizes.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Ignores and/or covers up mistakes, blames others, rationalizes.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

#### Professional Relationships and Cooperation - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibits a tactful, professional manner in interaction with instructors and peers.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually interacts with others in a professional manner.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally interacts in a professional manner.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Is frequently unpleasant in interactions, and/or intolerant of others.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Behaves in an irritating, disrespectful, argumentative manner towards others.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

**TOTAL**

_______
Summary Comments

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

Areas needing improvement:

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Areas of Strength:

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: ________________________________ Date: _____________________

Student (optional) __________________________ Date: _____________________

Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement
Immunohematology Rotation Evaluation Forms
Clinical Laboratory Sciences Program

Immunohematology Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Immunohematology Rotation Psychomotor Evaluation

Affiliate Location: _________________________ Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

Directions to Student: Use this form to document your experience during this rotation. Write NA, if the objective was not available. (pg 1/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
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<tbody>
<tr>
<td>1. ABO typing</td>
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<tr>
<td>2. ABO discrepancies</td>
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<tr>
<td>3. Rh typing</td>
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<tr>
<td>4. Antibody Screen</td>
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<td>5. Antibody Identification</td>
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<tr>
<td>6. Antigen Typing</td>
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<tr>
<td>7. Immediate spin crossmatches</td>
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<td>8. Extended crossmatches</td>
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<td>9. DAT</td>
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<td>10 Transfusion reaction work-up</td>
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<td>11. Adsorptions</td>
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<td>12. Acid Elutions</td>
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<td>13. Lui Freeze Elution</td>
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<tr>
<td>14. Panel study using eluate</td>
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<tr>
<td>15. Blood component selection criteria</td>
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<tr>
<td>16. Saline replacement technique</td>
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<td>17. Mini cold panel</td>
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<tr>
<td>18. Fetal screen/Rosette test</td>
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<td>19. Thaw FFP/Cryo</td>
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<td>20. Grade agglutinations: tube &amp; gel</td>
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<tr>
<td>21. Pool platelets</td>
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<td>22. Irradiate blood products</td>
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<td>23. Issue blood products</td>
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<td>24. Cord blood studies</td>
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<td>25. Quality control</td>
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<td>26. Donor blood collection</td>
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<td>27. Component preparation</td>
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</table>
Self-Assessment (to be Completed by the Student) (pg 2/2)

Summary Comments: __________________________________________________________
________________________________________________________________________
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Student Signature __________________________  Date: _____________________
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Immunohematology Rotation Psychomotor Evaluation

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Saline replacement technique</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Mini cold panel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Fetal screen/Rosette test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Thaw FFP/Cryo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Grade agglutinations: tube &amp; gel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Pool platelets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Irradiate blood products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Issue blood products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Cord blood studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. Quality control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Donor blood collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Component preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

S+ = Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A (pg 2/2)

*Each psychomotor attribute is a total of 4 points each.

S+ = 4 x ______ = _______
S = 3 x ______ = _______
S- = 2 x ______ = _______
U = 1 x ______ = _______

TOTAL _______

Please list any additional information in regards to analyzers used and/or tests performed

Analyzers        Test

_________________________________________________________________________

_________________________________________________________________________

*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SFC

Staff Technologist______________________________  Date: __________________

Clinical Coordinator_____________________________  Date: __________________
Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated:  □ MICRO  □ HEME  □ CHEM  □ BB  □ SERO  □ U/A  □ Phleb

Affiliate Location: _________________________  Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

(U) Unsatisfactory: Student consistently did not display desired skill or behavior

(S-) Needs Improvement: Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist

(S) Meets Expectations: Student demonstrates acceptable skill or behavior for entry-level technologist the majority of the time

(S+) Exceeds Expectations: Student demonstrates above average skill and knowledge. Always displays appropriate professional behaviors.

Knowledge & Skills
S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U= Unsatisfactory , N/A

<table>
<thead>
<tr>
<th>Observed Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adheres to all safety procedures</td>
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<td>Questions asked are appropriate and discerning</td>
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<td>Plans and organizes work effectively and efficiently</td>
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<td>Demonstrates knowledge of guidelines for reporting data, entering patient results into the computer and can determine acceptability of data generated</td>
</tr>
<tr>
<td>Understands significance and can perform quality control procedures accurately</td>
</tr>
<tr>
<td>Possesses technical skills of an entry level technologist</td>
</tr>
</tbody>
</table>
Affiliate Supervisor Final Evaluation of the Student (Part 3/4)

Professional Behaviors

<table>
<thead>
<tr>
<th>Professional Behaviors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attendance and Dependability – Check 1</strong></td>
<td></td>
</tr>
<tr>
<td>Arrives on time, begins work promptly, and completes scheduled days.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>On occasion is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Frequently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Consistently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never arrives on time, always leaves early, takes extended breaks, is absent from work.</td>
<td>0 ( )</td>
</tr>
<tr>
<td><strong>Initiative - Check 1</strong></td>
<td></td>
</tr>
<tr>
<td>Assumes responsibility for work and assignments without being reminded.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually assumes responsibility for work and assignments.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally assumes responsibility for work and assignments.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Rarely assumes responsibility for work and assignments.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Never assumes responsibility for work and assignments.</td>
<td>0 ( )</td>
</tr>
<tr>
<td><strong>Judgment and Decision Making - Check 1</strong></td>
<td></td>
</tr>
<tr>
<td>Consistently asks appropriate questions recognizing limitations with professional maturity.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually displays good judgment and decision making.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally displays good judgment and decision making.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Shows poor judgment and decision making ability.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Lacks all professional maturity.</td>
<td>0 ( )</td>
</tr>
<tr>
<td><strong>Integrity - Check 1</strong></td>
<td></td>
</tr>
<tr>
<td>Always admits mistakes, takes immediate and appropriate action to correct them.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally admits mistakes, takes immediate/appropriate action to correct them.</td>
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</tr>
<tr>
<td>Recognizes mistakes, but does not admit them, blames others or rationalizes.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Ignores and/or covers up mistakes, blames others, rationalizes.</td>
<td>0 ( )</td>
</tr>
<tr>
<td><strong>Professional Relationships and Cooperation - Check 1</strong></td>
<td></td>
</tr>
<tr>
<td>Exhibits a tactful, professional manner in interaction with instructors and peers.</td>
<td>20 ( )</td>
</tr>
<tr>
<td>Usually interacts with others in a professional manner.</td>
<td>15 ( )</td>
</tr>
<tr>
<td>Occasionally interacts in a professional manner.</td>
<td>10 ( )</td>
</tr>
<tr>
<td>Is frequently unpleasant in interactions, and/or intolerant of others.</td>
<td>5 ( )</td>
</tr>
<tr>
<td>Behaves in an irritating, disrespectful, argumentative manner towards others.</td>
<td>0 ( )</td>
</tr>
</tbody>
</table>

**TOTAL**  

_______
Summary Comments

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

Areas needing improvement:

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Areas of Strength:

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: ________________________________ Date: _____________________

Student (optional) __________________________ Date: _____________________

*Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement*
Specials Rotation Evaluation Forms
Seroology, Urinalysis, Phlebotomy
Serology Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Serology Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

**Directions to Student:** Use this form to document your experience during this rotation. Write NA, if the objective was not available. (pg 1/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analyzer Startup/Shutdown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Preventative Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Analyzer QC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Syphilis serology (EIA, RPR, VDRL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Hepatitis testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. H. pylori Ab (IgM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. HSV Ab (IgM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Lyme disease Ab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Mumps Ab (IgM, IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mycoplasma Ab (IgM, IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Parvovirus Ab (IgM, IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Rubella Ab (IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1. VZV Ab (IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. WNV Ab (IgM, IgG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary Comments:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Student Signature __________________________  Date: _____________________
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Serology Rotation Psychomotor Evaluation

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

S+ = Exceeds expectations, S = Meets expectations, S- = Needs Improvement, U = Unsatisfactory, N/A

<table>
<thead>
<tr>
<th>Task</th>
<th>Performed or Discussed</th>
<th>Skill level</th>
<th>Date &amp; Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Analyzer Startup/Shutdown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Preventative Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Analyzer QC</td>
<td></td>
<td></td>
</tr>
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<td>Syphilis serology (EIA, RPR, VDRL)</td>
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<td>5.</td>
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<td></td>
</tr>
<tr>
<td>6.</td>
<td>H. pylori Ab (IgM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>HSV Ab (IgM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Lyme disease Ab</td>
<td></td>
<td></td>
</tr>
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<td>9.</td>
<td>Mumps Ab (IgM, IgG)</td>
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<td>10.</td>
<td>Mycoplasma Ab (IgM, IgG)</td>
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<td></td>
</tr>
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<td>11.</td>
<td>Parvovirus Ab (IgM, IgG)</td>
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</tr>
<tr>
<td>12.</td>
<td>Rubella Ab (IgG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>VZV Ab (IgG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>WNV Ab (IgM, IgG)</td>
<td></td>
<td></td>
</tr>
</tbody>
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*Each psychomotor attribute is a total of 4 points each.

S+ = 4 x _______ = _______
S  = 3 x _______ = _______
S- = 2 x _______ = _______
U   = 1 x _______ = _______

TOTAL  _______

Please list any additional information in regards to analyzers used and/or tests performed

Analyzers

________________________________________________________________________

________________________________________________________________________

*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SFC

Staff Technologist______________________________ Date: __________________

Clinical Coordinator_____________________________ Date: __________________
**Affiliate Supervisor Final Evaluation of the Student (Part 2/4)**

**Student Name:** ___________________________  **Date:** ___________________________

**Rotation Being Evaluated:**
- [ ] MICRO  
- [ ] HEME  
- [ ] CHEM  
- [ ] BB  
- [ ] SERO  
- [ ] U/A  
- [ ] Phleb

**Affiliate Location:** ___________________________  **Supervisor:** ___________________________

**Directions to clinical faculty:** Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

- **(U) Unsatisfactory:** Student consistently did not display desired skill or behavior
- **(S-) Needs Improvement:** Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist
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**Knowledge & Skills**

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### Professional Behaviors

#### Attendance and Dependability – Check 1

<table>
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<tr>
<th>Description</th>
<th>Points</th>
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<td>Arrives on time, begins work promptly, and completes scheduled days.</td>
<td>20 (   )</td>
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<td>10 (   )</td>
</tr>
<tr>
<td>Consistently is tardy to work, leaves early, takes extended breaks, is absent from work.</td>
<td>5 (   )</td>
</tr>
<tr>
<td>Never arrives on time, always leaves early, takes extended breaks, is absent from work.</td>
<td>0 (   )</td>
</tr>
</tbody>
</table>

#### Initiative - Check 1

<table>
<thead>
<tr>
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<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumes responsibility for work and assignments without being reminded.</td>
<td>20 (   )</td>
</tr>
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<td>Usually assumes responsibility for work and assignments.</td>
<td>15 (   )</td>
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<tr>
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</tr>
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</tr>
<tr>
<td>Never assumes responsibility for work and assignments.</td>
<td>0 (   )</td>
</tr>
</tbody>
</table>

#### Judgment and Decision Making - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistently asks appropriate questions recognizing limitations with professional maturity.</td>
<td>20 (   )</td>
</tr>
<tr>
<td>Usually displays good judgment and decision making.</td>
<td>15 (   )</td>
</tr>
<tr>
<td>Occasionally displays good judgment and decision making.</td>
<td>10 (   )</td>
</tr>
<tr>
<td>Shows poor judgment and decision making ability.</td>
<td>5 (   )</td>
</tr>
<tr>
<td>Lacks all professional maturity.</td>
<td>0 (   )</td>
</tr>
</tbody>
</table>

#### Integrity - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always admits mistakes, takes immediate and appropriate action to correct them.</td>
<td>20 (   )</td>
</tr>
<tr>
<td>Usually admits mistakes, takes immediate/appropriate action to correct them.</td>
<td>15 (   )</td>
</tr>
<tr>
<td>Occasionally admits mistakes, takes immediate/appropriate action to correct them.</td>
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</tr>
<tr>
<td>Recognizes mistakes, but does not admit them, blames others or rationalizes.</td>
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</tr>
<tr>
<td>Ignores and/or covers up mistakes, blames others, rationalizes.</td>
<td>0 (   )</td>
</tr>
</tbody>
</table>

#### Professional Relationships and Cooperation - Check 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibits a tactful, professional manner in interaction with instructors and peers.</td>
<td>20 (   )</td>
</tr>
<tr>
<td>Usually interacts with others in a professional manner.</td>
<td>15 (   )</td>
</tr>
<tr>
<td>Occasionally interacts in a professional manner.</td>
<td>10 (   )</td>
</tr>
<tr>
<td>Is frequently unpleasant in interactions, and/or intolerant of others.</td>
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</tr>
<tr>
<td>Behaves in an irritating, disrespectful, argumentative manner towards others.</td>
<td>0 (   )</td>
</tr>
</tbody>
</table>

**TOTAL** _______
Affiliate Supervisor Final Evaluation of the Student (Part 4/4)

Summary Comments

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

Areas needing improvement:
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Areas of Strength:
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: ________________________________ Date: _____________________

Student (optional) __________________________ Date: _____________________

Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement
# Urinalysis Evaluation Forms

**Student Name:** ___________________________  **Date:** ___________________________

**Type of Evaluation:** Urinalysis Rotation Psychomotor Evaluation

**Affiliate Location:** _________________________  **Supervisor:** _________________________

## Self-Assessment (to be Completed by the Student)

### Directions to Student:
Use this form to document your experience during this rotation. Write NA, if the objective was not available.  (pg 1/2)

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinalysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Daily Startup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Routine Urinalysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Clinitest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Ictotest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Protein Confirmation (SSA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 24 hour Urine Collection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Pregnancy Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Crystals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Porphobilinogen in urine (if applicable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Myoglobin Screening (if applicable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Summary Comments:**

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________

Student Signature __________________________  Date: _____________________
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Urinalysis Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Directions to clinical faculty: Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A

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<td>Urinalysis</td>
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</tr>
<tr>
<td>1. Analyzer Startup/Shutdown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Preventative Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Analyzer QC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Routine Urinalysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Clinitest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Ictotest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sulfosalicylic acid (SSA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. CSF fluid counts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Synovial fluid counts</td>
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<td>10. Synovial fluid crystal identification</td>
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*Each psychomotor attribute is a total of 4 points each.

S+= 4 x ______ = _______
S= 3 x ______ = _______
S- = 2 x ______ = _______
U = 1 x ______ = _______
TOTAL _______

Please list any additional information in regards to analyzers used and/or tests performed

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<tr>
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*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SFC

Staff Technologist______________________________  Date: __________________

Clinical Coordinator_____________________________  Date: __________________
Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated: □ MICRO □ HEME □ CHEM □ BB □ SERO □ U/A □ Phleb

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

(U) Unsatisfactory: Student consistently did not display desired skill or behavior
(S-) Needs Improvement: Student requires constant, detailed supervision in order to perform in the laboratory. Skills or behaviors at times are below that expected of an entry-level technologist
(S) Meets Expectations: Student demonstrates acceptable skill or behavior for entry-level technologist the majority of the time
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Knowledge & Skills
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Affiliate Supervisor Final Evaluation of the Student (Part 3/4)

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<tr>
<th>Professional Behaviors</th>
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</tr>
<tr>
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<td></td>
</tr>
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<tr>
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**TOTAL** _______
**Affiliate Supervisor Final Evaluation of the Student (Part 4/4)**

**Summary Comments**

Please comment on any weaknesses of the student or areas needing improvement. These comments will help the student identify areas that they are good in and the areas in which more work is needed. These comments are to be viewed as helpful so that the student has a general idea as to which skills are acceptable and which skills they will need to improve. Also, please comment on any areas of strength, which the student exhibits.

**Areas needing improvement:**

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

**Areas of Strength:**

___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

**Evaluator:** ________________________________  **Date:** _____________________

**Student (optional)** __________________________  **Date:** _____________________

*Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement*
Phlebotomy Evaluation Forms

Student Name: ___________________________ Date: ___________________________

Type of Evaluation: Phlebotomy Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Self-Assessment (to be Completed by the Student)

Directions to Student: Use this form to document your experience during this rotation. Write NA, if the objective was not available.

<table>
<thead>
<tr>
<th>Task</th>
<th>Explanation Given (notes)</th>
<th>Observed</th>
<th># Performed w/Assist.</th>
<th># Performed Unassisted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urinalysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Performs venipuncture by vacutainer method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Performs venipuncture by the syringe method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Performs venipuncture by butterfly method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Demonstrates proficiency in the order of draw</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Demonstrates accuracy in patient identification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Demonstrates competency in properly labeling patient samples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Demonstrates proficiency is transporting specimens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Demonstrates proficiency in collection of blood cultures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Observes all isolation precautions when performing venipuncture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Washes hands before and after each patient</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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Summary Comments: ____________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Student Signature __________________________  Date: ___________________________
Affiliate Supervisor Final Evaluation of the Student (Part 1/4)

Student Name: ___________________________  Date: ___________________________

Type of Evaluation: Phlebotomy Rotation Psychomotor Evaluation

Affiliate Location: _________________________  Supervisor: _________________________

Directions to clinical faculty: Select the level that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student needs improvement or is unsatisfactory and are always encouraged.

S+=Exceeds expectations, S=Meets expectations, S-=Needs Improvement, U=Unsatisfactory, N/A

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</tr>
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*Each psychomotor attribute is a total of 4 points each.

\[ S^+ = 4 \times \text{______} = \text{______} \]
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**TOTAL** \[ \text{______} \]

Please list any additional information in regards to analyzers used and/or tests performed

**Analyzers**

**Test**

__________________________________________________________________________

__________________________________________________________________________

*All documents of completion must be submitted at the end of the rotation to the Internship Coordinator at SFC*

Staff Technologist______________________________  Date: __________________

Clinical Coordinator_____________________________  Date: __________________
Clinical Laboratory Sciences Program

Affiliate Supervisor Final Evaluation of the Student (Part 2/4)

Student Name: ___________________________ Date: ___________________________

Rotation Being Evaluated: □ MICRO □ HEME □ CHEM □ BB □ SERO □ U/A □ Phleb

Affiliate Location: _________________________ Supervisor: _________________________

Directions to clinical faculty: Select the number that best describes the student’s performance during this rotation. Write NA, if you are unable to rate the student in a particular category. Summary comments are required if the student need improvement or is unsatisfactory and are always encouraged.

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Areas needing improvement:
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___________________________________________________________________________________________
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Areas of Strength:
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The clinical instructor is encouraged to review the evaluation with the student. If there are concerns with the evaluation, please contact the Santa Fe College Clinical Internship Coordinator to help you resolve issues dealing with the student evaluation.

Evaluator: ________________________________ Date: _____________________

Student (optional) __________________________ Date: _____________________

Student: This document becomes a part of your permanent file. Your signature verifies that you have read this document and does not indicate that you are in agreement.