MLS Student Handbook

Michigan Technological University

Updated 6/2022

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I: Program Information

Mission Statement

We equip students with the knowledge, skills, and integrity needed to successfully enter the profession of Medical Laboratory Science and other health-related professional programs.

Program Learning Goals

Goal 1: Apply major concepts of human biology pertinent to MLS.

Goal 2: Perform laboratory skills used by clinical scientists working in a diagnostic laboratory.

Goal 3: Categorize laboratory testing and problem-solving as pre-analytical, analytical, and post-analytical

Goal 4: Process and communicate pertinent clinical information.

Goal 5: Demonstrate professionalism skills in the medical laboratory science field.

Graduate Competencies

- Demonstrate appropriate specimen collection, processing, analysis, and reporting of results in a timely manner with accuracy and precision
- Apply safety and governmental regulations throughout the pre-analytical, analytical, and post-analytical phases of clinical laboratory testing.
- Utilize the principles and practices of professional and ethical conduct while demonstrating appropriate communication skills to sufficiently meet the needs to educate patients and other healthcare professionals
- Demonstrate professional development through continuing education in the field of Medical Laboratory Science
- Put into practice administrative and supervisory skills as are relevant to the healthcare system and Medical Laboratory Science field
- Employ the use of critical thinking and problem-solving skills to identify and evaluate:
    - Calibration, maintenance, quality assurance, and any necessary corrective actions
    - Appropriate confirmatory testing and reporting of abnormal patient results
- Assist with the implementation of test systems including correlational studies, reference ranges, statistical analysis, etc., to allow confident dissemination of accurate testing results

Career Entry Level Description

At the point of career entry, the Medical Laboratory Scientist, also known as Clinical Laboratory Scientist or Medical Technologist, will have proficiency in the medical laboratory testing areas of hematology, chemistry, microbiology, immunology, serology, immunohematology (blood banking), body fluid analysis, urinalysis and molecular testing. This is acquired upon completion of the academic requirements at Michigan Technological University and successful completion of a Clinical Practicum.

MLS Program Accreditation

Michigan Tech's Medical Laboratory Science (MLS) program is accredited by the following institution:
National Accrediting Agency for Clinical Laboratory Sciences
5600 N. River Road, Suite 720
Rosemont, IL 60018
847-929-3597
773-714-8880
773-714-8886 (Fax)
info@naacls.org
www.naacls.org

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Responsibilities of the Program Director

The program director is responsible for the day-to-day operations of the academic program. Duties include, but are not limited to, advising students throughout the MLS program, monitoring curricular requirements in accordance with NAACLS, maintaining outcome data for

the academic and clinical programs, monitoring budgetary matters, and managing continuous improvement of the MLS program.

Responsibilities of the Program and Practicum Coordinator

The program and practicum coordinator will be the primary university contact person for practicum students and will be responsible for organizing student practicums, maintaining NAACLS accreditation, teaching the online practicum course, monitoring student progress, and maintaining ongoing communication with affiliates and practicum students.

Clinical Practicum

Students who wish to be certified Medical Laboratory Scientists must complete a clinical practicum to become eligible to take a national certification examination. The clinical practicum is a 6 month - 1 year long clinical internship in a hospital laboratory after the completion of the MLS program at Michigan Tech (120 credits). Students will have the chance to apply their didactic knowledge while gaining valuable hands-on experience under the guidance and supervision of laboratory employees. This experience includes, but is not limited to, running a variety of tests in each laboratory department, performing quality control, and reviewing results.

Students have a variety of practicum sites to choose from across the Midwest. Please see the Michigan Tech MLS website for an updated map of our hospital affiliates. Students who choose to complete their practicum in a Hospital-based program (see below) may apply to clinical sites outside of Michigan Tech's affiliates.

Some clinical sites may offer practicum students a part-time job working as a laboratory assistant, central specimen processor, phlebotomist, or other laboratory-related job during the course of the clinical practicum. Students are welcome to accept these positions, but are NOT required to in order to complete a practicum at any facility. Additionally, while many hospitals extend job opportunities to students at the completion of their practicum, students are not committed to be employed by that facility when they are placed for the practicum. After the clinical practicum is completed, students are free to apply at any site of their choosing.

MLS Program Degree Concentrations

There are two concentrations available for students to earn a Bachelor of Science degree in Medical Laboratory Science.

Medical Lab Science 3+1

Students who choose the 3+1 major are on the fast track to becoming a Medical Lab Scientist. Students spend three years on campus learning fundamental information in preparation for a fourth-year clinical practicum at a NAACLS-accredited teaching hospital that is affiliated with Michigan Tech. The practicum experience will consist of academic studies combined with hands-on experience in the clinical laboratory.

After successful completion of coursework, hospital training, and the receipt of their BS in MLS, students will be qualified to take an examination for national certification as a Medical Laboratory Scientist.

Medical Lab Science 4+1

Students who choose the 4+1 option are on a similar track as 3+1 students, but with an extra year on campus for study and specialization. Students spend the first three years on campus taking fundamental course work, with an additional year on campus for specialty course work.

Following the completion of your coursework, students have two options for completing a clinical practicum:

1. University-based route

Michigan Tech holds the NAACLS accreditation and students are able to complete their fifth-year practicum at any one of our non-NAACLS accredited affiliate hospitals. Students will complete 120 credit hours in the MLS program at Michigan Tech but will not graduate with their degree until completion of the clinical practicum.

University-based route practicum students will enroll in BL4612 (SML University Practicum) for coursework while receiving hands-on experience in the clinical lab. This is a 12-credit, online course that begins the semester the student starts their clinical practicum.

After successful completion of the clinical practicum, students will officially graduate with 132 credits and earn their diploma. At this time students will be qualified to take an examination for national certification as a Medical Laboratory Scientist, following approval from the Michigan Tech Program Director.

2. Hospital-based route

Students complete their fifth-year practicum at any NAACLS-accredited hospital. Students will complete 120 credit hours in the MLS program at Michigan Tech and graduate with their Bachelor of Science degree in Medical Laboratory Science before starting their clinical practicum.

Students may choose to apply to the Michigan Match program, Wisconsin affiliates, Minnesota affiliates, Ohio affiliates, or seek out their own opportunities elsewhere. All coursework, examinations, and clinical experience are at the discretion of the clinical practicum site under this route.

After successful completion of the clinical practicum, students will be qualified to take an examination for national certification as a Medical Laboratory Scientist, following approval from the hospital Program Director.

Students may also choose to forego a clinical practicum and pursue other opportunities. This could include professional schools (medical school, PA school, etc.) or graduate school (MS, PhD). Students who opt out of doing a practicum will graduate with a BS in Medical Laboratory Science upon completion of 120 credit hours and meeting all other requirements.

Granting the Degree

Upon completion of all degree requirements for each concentration, students will graduate and receive their Bachelor of Science degree in Medical Laboratory Science from Michigan Tech. The awarding of the degree is NOT contingent on the student passing a national certification examination.

Academic Advising

The Program Director is your academic advisor in the MLS program. You are required to meet with your academic advisor at least once per semester to review your academic progress and choose an academic schedule that fits your needs. It is your responsibility to ensure that you complete all courses required to obtain your degree.

Michigan Technological University and the Medical Laboratory Science Program have the responsibility to maintain precise records of academic advancement in the program while maintaining confidentiality, impartiality, and privacy of all academic records as defined by the 1974 Family Education Rights and Privacy Act.

Transfer Students

Students wishing to transfer into the Medical Laboratory Science program from another degree program at Michigan Tech must contact the Program Director to set up an advising meeting. Admission into the program is at the discretion of the Program Director. Transfer students must have a GPA of at least 2.75 or higher in order to be eligible for a University-route clinical practicum.

Program Major Requirements

The following is an overview of the major requirements and specific concentration requirements for the 3+1 and 4+1 degree options. **Please see the MLS 3+1 or 4+1 Degree Audit for the full course and credit requirements.**

MLS 3+1/4+1 Major Requirements

Course Number	Title	Credits	Semester Offered
BL 0600	Practicum and Career Prep	1*	Spring
BL 1200	General Biology II	3	Spring, Summer
BL 1210	General Biology II Lab	1	Spring, Summer
BL 1600	Intro to Medical Lab Science	1	Fall
BL 1710	Medical Terminology	1	Fall
BL 2010	Anatomy & Physiology I	3	Fall, Summer
BL 2011	Anatomy & Physiology I Lab	1	Fall, Summer
BL 2020	Anatomy & Physiology II	3	Spring
BL 2021	Anatomy & Physiology II Lab	1	Spring
BL 2200	Genetics	3	Spring
BL 2410	Basic Medical Lab Techniques	3	Fall
BL 3020	Biochemistry I	3	Fall, Summer
BL 3210	General Microbiology	4	Fall
BL 3230	Medical Bacteriology	4	Spring
BL 3640	General Immunology	3	Fall, Summer
BL 3780	Medical Parasitology Lab	1	Spring
BL 4550	Clinical Chemistry	3	Spring
BL 4640	Clinical Immunology & Serology	2	Fall
BL 4720	Hematology and Hemostasis	3	Fall
BL 4725	Immunohematology Techniques	2	Fall
BL 4980	SML Core Concept Integration	2	Spring
CH 1150	University Chemistry I	3	Fall, Spring, Summer
CH 1151	University Chemistry I Lab	1	Fall, Spring, Summer
CH 1160	University Chemistry II	3	Fall, Spring, Summer
CH 1161	University Chemistry II Lab	1	Fall, Spring, Summer
CH 2410	Organic Chemistry I	3	Fall, Spring, Summer
MA 2720	Statistical Methods	4	Fall, Spring, Summer

MLS 3+1 Concentration Requirements

Course Number	Title	Credits	Semester Offered
BL 3611	Phlebotomy	1	Spring
BL 4030	Molecular Biology	3	Fall, Summer
PH 1200	Physics by Inquiry II	1	Fall, Spring
PH 1210	College Physics II	3	Spring, Summer
BL 4610	SML Medical Practicum I	15	Fall, Spring, Summer
BL 4611	SML Medical Practicum II	15	Fall, Spring, Summer

MLS 4+1 Concentration Requirements

Course Number	Title	Credits	Semester Offered
BL 3220	Medical Mycology and Virology	3	Spring
BL 3611	Phlebotomy	1	Spring
BL 4800	Molecular Diagnostics	5	Spring
PH 1110	College Physics I	3	Fall, Summer
PH 1111	College Physics I Lab	1	Fall, Summer
PH 1200	Physics by Inquiry II	1	Fall, Spring
PH 1210	College Physics II	3	Spring, Summer

II: Student Involvement and Resources

While in the MLS program, students are encouraged to get involved in opportunities outside of program coursework. Not only do these look great on a resumé, but they also provide students with valuable experiences, networking, and learning opportunities. Additionally, the MLS program and Michigan Tech offer students a variety of on-campus resources to support their classroom learning. The following headers provide more information on some of these opportunities for students.

Society of Medical Laboratory Scientists (SMLS)

The Society of Medical Laboratory Scientists is a student organization on Michigan Tech's campus. SMLS was established to encourage professionalism, high standards of scholarship, and understanding of the responsibilities and demands of the medical technology profession, to act as a service organization to the community and campus, and to acquaint the general public with the profession.

SMLS fosters mentorship between upper- and lowerclassmen by providing a space to network, host exam reviews, and socialize. SMLS is also responsible for hosting campus events, such as blood drives and fundraisers. Meetings are open to any student interested in medical lab science!

ASCLS-WI Annual Meeting

MLS students have the opportunity to attend the annual American Society for Clinical Laboratory Science (ASCLS) – Wisconsin state convention. This conference takes place during the Spring semester. Students get to listen to keynote speakers on current topics in the clinical lab, participate in Q+As, and network with other students and MLS professionals.

HOSA Visits

MLS students have the opportunity to volunteer for HOSA - Future Health Professionals high school visits. Local high school students visit Michigan Tech's campus to learn about the profession and perform basic laboratory tests under the supervision of instructors and current MLS students.

Undergraduate Teaching Assistant (UTA)

Students have the opportunity to be UTAs for various lab courses in the MLS program, including BL2410 (Basic Medical Lab Techniques), BL3230 (Medical Bacteriology), and BL3611 (Phlebotomy). Students interested in being a UTA need to have completed the course they wish to assist with. Only students with phlebotomy certification or work experience as a phlebotomist are qualified to be a UTA for BL3611.

Professional Organizations for Students

Students are encouraged to join professional organizations while enrolled in the MLS program at Michigan Tech. A student membership for these societies is often significantly discounted or even free! There are many benefits to joining, including educational resources and some scholarship opportunities. Some of these professional organizations are listed below:

Association for the Advancement of Blood & Biotherapies - formerly American Association of Blood Banks (AABB)	www.aabb.org
American Association for Clinical Chemistry (AACC)	www.aacc.org
American Society for Clinical Laboratory Science (ASCLS)	www.ascls.org
American Society for Clinical Pathology (ASCP)* **	www.ascp.org
American Society for Microbiology (ASM)	www.asm.org
American Society of Cytopathology (ASC)	www.cytopathology.org
American Society of Hematology (ASH)	www.hematology.org
Association for Molecular Pathology (AMP)	www.ampweb.org
Association of Genetic Technologists (AGT)	www.agt-info.org

****FREE student membership!**

Course Help and Resources

There are various campus resources to aid students with course work.

- Campus learning centers
    - Biology Learning Center
    - Chemistry Learning Center
    - Math Learning Center
    - Physics Learning Center
    - MTU Writing Center
- MTU Waino Wahtera Center for Student Success
- Instructor's office hours – found on each course syllabus
- SMLS exam reviews

III: General Policies

Program Admission

Admission to the Medical Lab Science Program is made on a rolling basis. Students may enter the program at the start of the Fall or Spring semester, or may transfer in laterally from other programs. GPA and ACT criteria for program admission comply with Michigan Tech standards. Students should have a GPA >3.0 and ACT score greater than or equal to 22. Students who do not meet the criteria will be evaluated on a case-by-case basis.

Transfer Credit

Students who transfer into the MLS program at Michigan Tech from other institutions may have completed previous credit hours. Depending on the course and institution, these credits may or may not transfer to be used toward your degree at Michigan Tech. Please refer to the Transfer Equivalency System to see which courses from other institutions may transfer before contacting the Program Director.

Tuition, Fees, & Refund Policy

Please see Student Finance Policies.

Student Grievance & Appeals

Please see the Dean of Students website.

Academic Integrity

Please review the full Michigan Tech Academic Integrity Policy.

Students in violation of the University Academic Integrity Policy could be subject to disciplinary probation, grading sanctions, suspension, or expulsion as outlined in the policy. Instances of academic dishonesty are handled on a case-by-case basis.

Discipline

The Medical Laboratory Science program at Michigan Tech follows all guidelines set by the Michigan Tech Student Code of Community Conduct. Situations that require disciplinary intervention are handled on a case-by-case basis.

Professionalism

By becoming a medical laboratory scientist, you are entering the healthcare field. You will be working daily with technologists, nurses, physicians, administrators, patients and/or the general public. Thus, it is essential that you act professionally and dress in an appropriate manner in

order to provide excellent patient care. You are not only representing yourself, but also your laboratory and the profession as a whole. This begins while you are in the MLS program at Michigan Tech – each core MLS course dedicates a part of your overall class grade to professionalism. Some examples of professional and unprofessional behaviors are listed below, but note that this is not a comprehensive list.

Professional Behaviors

- Respects other students, faculty, and staff, and their identities, opinions, and beliefs
- Arrives to class and/or lab on time and prepared
- Takes responsibility for their own learning
- Communicates with the instructor (absences, asking for help, etc.)
- Completes all work with honesty and integrity (doing the right thing when no one is looking)
- Displays a genuine interest and willingness to learn and improve
- Demonstrates reliability by showing up to class/meetings/outside activities on time
- Maintains a calm and collected behavior and positive attitude when things do not go as planned
- Taking initiative during class and in lab
- Uses technology appropriately (note: cell phones are **NOT** permitted in the lab)

Unprofessional Behaviors

- Displays rude behavior or is disrespectful to other students, faculty, and staff (this includes body language, eye rolling, etc.)
- Absence from class/lab without notifying the instructor ahead of time
- Repeated tardiness to class/lab, failure to turn assignments in on time, and/or showing up unprepared
- Performs the bare minimum to accomplish a task or assignment
- Swearing, discriminatory, or intimidating/threatening language
- Disrespectful language towards instructors or students in class/lab
- Demonstrates a lack of interest in subject matter
- Falling asleep in class/lab

- Makes appointments with faculty/staff or other students and fails to show up
- Demonstrates a disruptive behavior in the classroom (arriving late, speaking during a quiz/exam, cell phone use while instructor/other students are speaking)
- Inappropriate use of technology (use of cell phones in the lab)

Attendance

Attendance policies will be outlined clearly in each course syllabus. Students are expected to arrive on time and attend all classes and labs regularly. In the event that the student is unable to attend class or lab, they **must** email the instructor prior to the start of class/lab. Missing class and failing to notify your instructor may cause a decrease in your professionalism score for the course.

Missed Work

The ability to make up missed assignments, exams, labs, or other coursework is up to the discretion of each instructor. **Please note that not all labs can be made up due to time constraints.**

Program Progression

Students in the Medical Laboratory Science program must comply with all academic and curricular policies set by the Dean of Students Office, including probation, suspension, and possible dismissal. Please familiarize yourself with these policies at the Dean of Students website. Students who wish to complete a practicum at an accredited teaching hospital will be evaluated based on that program's requirements. Students who wish to complete a practicum through the University-based route are required to have a departmental GPA of greater than or equal to 2.75, and an overall cumulative GPA of greater than or equal to 2.75.

Equal Opportunity Policy

In keeping with its responsibilities as an educational institution, Michigan Technological University is committed to a policy of affording equal opportunity to all of its employees, students, applicants for employment and applicants for admission without regard to race, religion, color, national origin, age, sex, sexual orientation, gender identity, height, weight, genetic information, or marital status. The University is also committed to a policy of educating and employing disabled individuals and veterans without discrimination. These policies are to be implemented with due regard for the relative qualifications of all involved.

Student Disability Policy

Michigan Tech is committed to ensuring that all qualified individuals with disabilities have the opportunity to take part in educational programs and services on an equal basis. The aim is to

provide this opportunity in an integrated setting that fosters independence and meets the guidelines of the Americans with Disabilities Act (ADA) and the Rehabilitation Act of 1973.

Please see the Student Disability Services website for more information about available accommodations and other eligibility requirements.

Student Rights and Expectations

As a Medical Laboratory Science student at Michigan Tech, you are a valued member of our program. You have the right to:

- Be treated professionally and with respect
- Be addressed by your preferred name and pronouns
- Learn in a safe environment
- Know where and how to access all safety procedures
- Know where and how to contact your instructors
- Know your instructor's course expectations, including the grading scale
- Be provided a course syllabus
- Have access to all classroom policies

As a student, you have responsibilities to uphold in the classroom. Michigan Tech's MLS program aims to teach and enforce professionalism throughout your time at the university. You are responsible for:

- Attending class
- Arriving on time to class or other scheduled events
- Coming prepared to class
- Taking responsibility for your own learning
- Treating others with respect
- Observing Michigan Tech's academic honesty policies
- Practicing professionalism in your classes, labs, and meetings

Essential Functions/Technical Performance Standards

Essential Functions/Technical Performance Standards represent the non-academic requirements of the program. Students must be able to meet and master program essential functions, or request reasonable accommodations to successfully complete these essential functions, in order to participate in the medical laboratory science/clinical practicum programs. All applicants are expected to:

1. **Manual Dexterity:**
   Possess the gross/fine motor skills and hand/eye coordination to safely perform diagnostic procedures which includes performing phlebotomy, using chemicals, specimens, microbiology cultures, laboratory instruments and equipment, and computers

2. **Visual Acuity:**
   - Differentiate different colors and shades, characterize clarity and viscosity of medical specimens, reagents, and chemical reaction end products
   - Examine microscopic specimens and be able to differentiate color, shading, and structural differences
   - Read text, numbers, and graphs in print, on computer monitors, and hand-writing
   - Judge distance, depth, and 2 or 3 dimensional structures

3. **Physical, Mental and Emotional Health:**
   - Function for an 8-hour work day under stressful conditions
   - Be able to recognize emergency situations and react in an appropriate manner
   - Move around the hospital and laboratory freely and safely
   - Follow verbal directions with normal or corrected hearing
   - Be able to bend, stoop and stand; lift 20 pounds; maintain prolonged sitting or standing positions; perform repetitive tasks
   - Maintain concentration with distractions

4. **Behavior:**
   - Be able to work independently, with flexibility and be adaptable to change
   - Be willing to work with sharp objects, hazardous chemicals and infectious/biohazardous material
   - Recognize situations that may be potentially hazardous
   - Conduct work with honesty, compassion, ethical behavior and responsible actions
   - Work as a team in regards to learning, tasks, problem solving and patient care

5. **Intellectual and Creative Thinking:**
   - Perform complex interpretive testing, possess troubleshooting skills, and exercise sound judgement
     - Recognize and correct deviations in testing
   - Prioritize work, be productive, and accurate within realistic time allowances

6. Communication:

The primary language for all verbal and written communication is English.

- Understand and follow verbal, non-verbal, and written instructions
- Effectively communicate verbally and in writing
- Clearly present oral presentations to diverse audiences
- Comprehend technical materials: text, numbers, math, graphs, textbooks, journals, instructions, internet, manuals, etc.
- Prepare papers, reports and posters both independently and in group projects
- Take written, oral, computer and laboratory practical exams at the post-secondary level within established time frames
- Interact and communicate effectively and confidentially with laboratory peers, hospital staff, administration, and patients (it should be noted that patients will be of varying ages, and physical and mental states)
- Use computer software, instructional technology, and the Internet for purposes of communication and education

References:

1. Technical Performance Standards/Essential Functions for MTIMPM Hospital-Based Clinical Practicum Programs 8/12/13
2. ASCLS Essential Functions 2012-2016

Hepatitis B/Immunization Policy

Students in the lab and clinical sites will come into direct contact with human blood and body fluids. In order to participate in some laboratory activities, students must provide proof of Hepatitis B vaccination or antibody titer. Receiving the vaccine protects you, other students, and your future patients. Students who refuse vaccination will have to sign a declination form, indicating that you have been made aware of the vaccine, all risks associated with not receiving the vaccination, and that you may change your mind and become vaccinated at any time. Scheduling to get the vaccine and payment are the responsibility of the student.

Many clinical affiliates require the Hepatitis B vaccine as part of the student's immunization record. Declination of the vaccine may delay the practicum placement for students.

Health Information Portability and Accountability Act (HIPAA)

Students in the MLS program will have the opportunity to tour several labs/healthcare facilities in their courses. Anything that is seen or heard during these tours **stays in the lab per HIPAA regulations.** It is a great experience to be able to tour these labs and we want to maintain a professional relationship with these hospitals and ensure that touring can continue. The Health Information Portability and Accountability Act (HIPAA) of 1996 provides the national standard for protecting individuals' medical records and other personal health information. Students are provided with information on the Privacy Rule while in the MLS program and at pre-practicum orientation. Disclosure of patient information to any unauthorized person could result in fines or imprisonment, and is ground for dismissal from the program. Never discuss patient results outside of the laboratory and do not release any patient information to unauthorized individuals.

Teach Out Plan

NAACLS requires the program to have a "teach out" plan in case the program unexpectedly closes due to natural or unnatural disasters or permanent closure. Intentional closure of the program will be communicated to all students immediately. In case of disaster the university will inform students of a plan for continuation of their education as soon as that information is available. NAACLS will be notified and a teach out plan will be provided to them within 30 days of the official announcement of program closure.

Prospective students:

- In the case of permanent closure students will be informed that the program will not take a new cohort due to program closure.
- In the case of a natural or unnatural disaster the program will work with other laboratory science programs to continue education and training until training can resume at the college.
- Students will be counseled in applying to other local programs.
- Program closure information will be communicated to incoming students through our program listserv.

Current students:

- Students will be informed of program closure.
- In the case of a natural or unnatural disaster the program will work with other laboratory science programs to continue education and training until training can resume at the college.
- In the event of a mandated permanent closure currently enrolled students will be allowed to complete the program.
- The Program Director will be designated to clear students applying for the certification exam.

IV: Competencies

MTU MLS Program Entry Level Competencies

Specimen Collection:

1. Demonstrate knowledge and proficiency of the following blood collection procedures:
    a. Patient identification and preparation
    b. Collection device selection and usage
    c. Order of draw
    d. Aseptic technique
    e. Specimen labeling and handling
    f. Capillary and venous collection
    g. Proper use of PPE and adherence to hospital safety regulations

Hematology:

1. Identify and describe the cellular components of blood, bone marrow, and body fluids.
2. Identify and describe the function of the cellular components of blood, bone marrow, and body fluids.
3. Prepare and evaluate blood smears in a timely and accurate manner for the following:
    a. WBC differentials – normal and abnormal
    b. WBC estimate
    c. Platelet estimate
    d. RBC morphology – normal and abnormal
4. Correlate cell morphology and patient values with the correct pathological states.
5. Properly employ the use of various cytochemical stains.
6. Demonstrate the following manual procedures and/or calculations accurately:
    a. Erythrocyte sedimentation rate (ESR)
    b. Reticulocyte counts
    c. RBC indices
    d. WBC correction for nucleated RBC's
    e. Fluid cell counts
7. Employ the use of additional routine or confirmatory testing to the level of accuracy established by the laboratory.
8. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
9. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Coagulation:

1. List the steps and factors in the coagulation scheme.
2. Perform automated, semi-automated, and manual testing with the level of accuracy established by the laboratory for the following tests:
    a. Prothrombin time (INR); with significance of ISI

b. Activated partial thromboplastin time
c. Fibrinogen
d. D-dimer
e. Factor assays
f. Mixing studies
g. Anticoagulant therapy

3. Correlate patient values with pathological or therapeutic states.
4. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
5. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Urinalysis:

1. Explain the structure and function of the urinary tract.
2. Perform automated, semi-automated, and manual testing with the level of accuracy established by the laboratory for the following tests:
    a. Urinalysis
    b. Urine pregnancy tests
    c. Other miscellaneous urinalysis tests
3. Identify, analyze, and report the physical and chemical properties and urine constituents.
4. Identify and explain the presence of normal and abnormal elements found in the microscopic examination of urine sediment.
5. Recognize and explain the presence of contaminants and artifacts in the microscopic examination of urine sediment.
6. Explain the chemical reaction of tests and accurately correlate their results to pathological states.
7. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
8. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Chemistry:

1. Describe specified clinical chemistry assays with reference to the principles of the procedure and chemical reactions involved.
2. Accurately perform procedures including:
    a. Spectrophotometry
    b. Electrophoresis and densitometry
    c. Enzyme immunoassay
    d. Blood gas analysis
    e. Osmometry
    f. Automated instrumentation analysis
3. Apply the appropriate mathematical calculations to practical laboratory situations.

4. Recognize normal and abnormal patient values and correlate results with pathological or therapeutic states.
5. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
6. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Microbiology:

1. Perform a variety of bacteriological procedures to demonstrate proficiency in identifying 90% of usually occurring bacteria
2. Perform and accurately interpret the laboratory-established procedures for each of the following:
    a. Inoculation and streaking of aerobic and anaerobic organisms
    b. Gram stain and microscopic examination of clinical materials and culture isolates
    c. Identification of aerobic and anaerobic bacteria by serological, biochemical, and antimicrobial testing
    d. Sensitivity testing
    e. Acid fast staining
    f. Ova and parasites
    g. Fungus identification
    h. Blood cultures
    i. Wet preps
3. Differentiate normal and pathogenic flora.
4. Correlate abnormal patient results with the appropriate pathogenic states.
5. Describe the principles and procedures of molecular testing.
6. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
7. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Immunohematology:

1. Explain the basic methods and principles of immunohematology testing.
2. Explain the significance of special requirements with regard to:
    a. Patient identification
    b. Specimen labeling
    c. Transcription of results
    d. Record keeping
    e. Release of units for transfusion
    f. Emergency uncrossmatched release
3. Perform the following procedures on patient specimens with 100% accuracy and correct interpretation:
    a. ABO and Rh

b. Antibody screen
c. Weak D testing
d. Antibody identification
e. Direct and Indirect Antiglobulin tests
f. Pre-transfusion crossmatch and compatibility testing
g. Elutions, adsorptions, neutralizations
h. Titers
i. Donor unit processing of components
j. Rh Immune Globulin
k. Transfusion reaction

4. Describe, perform, evaluate, and interpret immunohematology testing required for blood and blood component therapy
5. Correlate results with patient condition.
6. Describe blood components currently available for therapeutic use with regard to:
    a. Storage
    b. Preparation
    c. Infusion
    d. Indications for use
    e. Leukocyte reduction methods
    f. Irradiation
    g. Autologous/directed donation
7. List the general health requirements, disease markers, and reasons for exclusion of potential blood donors
8. Select the appropriate components for patient transfusion given their blood type, antibody screen, and patient history.
9. Appropriately prioritize patient work with regard to urgency of the situation.
10. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
11. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Immunology/Serology:

1. Identify the cells and organs of the immune system and explain their functions.
2. Describe immunologic principles for the method of testing performed, including the limitations of the test system and diagnostic significance of the results.
3. Accurately perform or discuss the following procedures:
    a. Serologic screening, serial dilutions and titers
    b. Flocculation, latex and RBC agglutination
    c. Precipitation methods
        i. RID
        ii. Ouchterlony
    d. Immunoelectrophoresis/Immunofixation

    e. ELISA
    f. Direct and indirect immunofluorescence
    g. Flow cytometry
4. Maintain efficient work area by keeping area clean and replenishing supplies and reagents.
5. For instrumentation and equipment:
    a. Describe the principle of operation and key components
    b. Perform necessary calibrations and quality controls
    c. Identify instrumental causes of unexpected patient results
    d. Troubleshoot all analyzer malfunctions
    e. Perform regular preventative maintenance and repairs

Management/Education:

1. Distinguish between cognitive, affective, and psychomotor domains.
2. Prepare a resume and cover letter.
3. Explain routine maintenance and calibration of laboratory equipment and identify necessary corrective action to maintain quality controls.
4. Identify and explain pre-analytical, analytical, and post-analytical sources of error in laboratory testing.
5. Explain the principles of laboratory management, supervision, and continuing education.
6. Demonstrate communication skills with all levels of hospital personnel while maintaining professional and ethical conduct.
7. Describe the integration of laboratory information systems (LIS) with electronic health records.
8. Discuss the process of certification, accreditation, proficiency and competency testing, and laboratory inspection.

V: Laboratory Safety

Students are required to abide by all safety rules found in the MLS Safety Practices for the Clinical Lab Standard Operating Procedure (SOP):

- Keep all personal items such as coats, notes, books, book bags, handbags, etc. away from potentially contaminated laboratory areas. Items such as these must remain outside of the laboratory or in designated clean areas within the laboratory.
- Proper handwashing is a very important factor in arresting the transmission of disease. Directions for proper handwashing are located at each sink. Wash your hands:
    - Before and after performing any procedure involving use of gloves for patient or personal contact such as venipuncture, capillary puncture, urine collection, throat culture, etc. Remember that **fresh non-latex gloves** must be used for direct contact with each patient.
    - If your hands become contaminated with human blood or other human body fluids.
    - If your gloves become contaminated with human blood or other body fluids. (Note: Remove the contaminated gloves and wash your hands.)
    - Immediately prior to leaving the laboratory.
- Keep fingernails clean and short.
- Keep long hair tied back.
- Notify your lab partner and the instructor if you feel ill, weak, or faint; report any injury to the instructor immediately.
- Dress for safety:
    - Keep in mind that cloth shoes, shoes that do not cover the entire foot, loose fitting clothing, scarves, neckties, and jewelry may be hazardous and are not to be worn in the laboratory.
    - Wear a fluid resistant laboratory coat (available at the Michigan Tech Bookstore and ChemStores), and button it completely to assure maximum personal protection. **You will not be allowed to participate in laboratory exercises without an acceptable protective coat.** This coat must not be worn outside of the laboratory, and must be stored on the designated coat rack.
    - Wear appropriate masks when dealing with organisms causing tuberculosis. (Note: You will not deal with TB organisms in Michigan Tech campus-based student laboratories.)
- **Read the entire assigned laboratory exercise before beginning** and note any special precautions you may need to take. If you are unsure how to safely perform any portion of the procedure, be sure to ask before you proceed.

- Do not eat, drink, smoke, apply cosmetics or lip balm, bite fingernails, or insert contact lenses while in the laboratory, and remember not to moisten labels with your tongue, chew pencils, or lick fingers before turning pages.
- Disinfect your work area with a 1:10 dilution of household bleach (prepared daily) at the beginning and end of each laboratory period.
- Be sure to clean up spills containing human blood or other potentially infectious materials (OPIM) immediately. First, remove any broken glass with forceps and dispose of it in the sharps containers to be autoclaved. Next, absorb as much of the spill as possible with wet paper towels, or spill kit powder if appropriate, being sure to wear non-latex gloves; and wash the area with mild soap to remove protein residue. Finally, flood the spill area with 1:10 dilution of household bleach, allow to stand for 15 minutes, and then complete the clean up by using absorbent paper towels. Dispose of contaminated material in the biohazard bag.
- NEVER pipette by mouth. Appropriate pipetting devices are available for use in each laboratory procedure. Ask if you cannot find them.
- Do not leave pipettes sticking out of reagent bottles, flasks, test tubes, or laying on the bench. Place them in the pipette washer tip up.
- When dealing with human blood and body fluids it is necessary to utilize Universal/Standard Precautions. This means that you must treat ALL human samples and reagents containing human materials as potential carriers of disease.
- Wear protective non-latex gloves when performing procedures involving any human body fluid, including clean up. This includes any contaminated laboratory equipment or supplies such as instruments, test tube racks, or glassware.
- Use laboratory safety goggles (available at the MTU Bookstore) or other appropriate face protection such as plastic/plexiglass shield (available in 20-1103), during any procedure likely to generate droplets containing blood, body fluid, or harsh chemicals. Examples of such procedures include:
    - Opening snap top specimen containers
    - Uncapping any vacutainer type blood or urine collection tube
    - Processing specimens by centrifugation
    - Pouring specimens
    - Use of analyzers with tubing
    - Dilution, pouring, or use of disinfectants
    - Disposing of specimens
- Disinfect goggles and face shield prior to each laboratory session by wiping them with 10% bleach and allow them to air dry; goggles must be worn when handling or transferring chemicals for clinical analyses or chemicals used in specimen preparation for analysis.
- Minimize the production of droplets and aerosols by:

    - Covering all test tubes prior to centrifugation
    - Operating the centrifuge only with its cover closed
    - Leaving the centrifuge cover closed for 15 minutes if a tube breaks during centrifugation. This allows settling of airborne material. Remember to disinfect the centrifuge in accordance with broken glass/spill procedures.
    - Performing activities such as blending, sonicating, and vigorous mixing only in covered containers or in a class I or II biological safety cabinet
    - Removing stoppers from blood tubes only after covering the tube and stopper with a laboratory tissue. Open it "away" from yourself and others.

- When handling chemical reagents be sure to read all labels carefully. Consult Material Safety Data Sheets (MSDS) when appropriate. (Note: Know the locations of MSDS for the chemical reagents you use. There is a hard copy set of all department MSDS in the main Biology office, Dow 740.) MSDS include:
    - Identity of the material and manufacturer
    - Hazardous ingredients/identity information
    - Physical/chemical characteristics
    - Fire and explosion hazard data
    - Reactivity data
    - Health hazard data
    - Precautions for safe handling and use
    - Control measures

- Clearly label all specimens and reagents. If possible, include:
    - Contents
    - Concentration
    - Date of opening and/or preparation
    - Storage requirements
    - Expiration date
    - Hazard information
    - ID of individual who collected the specimen or prepared the reagent

- If you must leave the laboratory, ask someone to assume the responsibility for instruments and reagents actively in use. Do not leave an "active" area unattended.

- Clean, disinfect, and organize your work area before leaving the laboratory. Be sure to dispose of all potentially harmful substances and apparatus properly.
    - With the exception of sharp objects, disposable items contaminated with human blood and other human body fluids much be placed in the biohazard bags provided. These bags will be autoclaved by the laboratory.
    - Needles, lancets, or other "sharps" (including capillary tubes and glass microscope slides) contaminated with biological materials must be placed in the small, rigid plastic safety containers provided. These items go directly into the containers without being broken, cut, or bent. Use only needles that have OSHA approved safety guards. Lock the guard in place before needle disposal and put

them, along with their disposable adapter, into the safety container. These containers will be autoclaved by the laboratory staff prior to disposal.
    - Broken glass not presenting a biological hazard must be placed in the designated puncture-resistant cardboard containers or contaminated sharps containers, depending on the size of the broken piece.
    - Human blood, blood products, excretions and secretions must be carefully poured into liquid impervious biohazard bags
    - Materials labeled infective will be autoclaved by the laboratory staff and disposed of in a sanitary landfill
    - Laboratory glassware and plastic ware that is not contaminated with biological materials must be washed according to the instructions provided. Remember to use gloves.

- Do not handle gas cylinders under direct supervision of the instructor. If treated improperly, they can become missiles capable of penetrating walls
- When handling electrical equipment, keep your hands dry and be sure your feet and body are away from any water. Be aware that an electrical shock victim has the potential to conduct current to a rescuer. Campus Facilities handles all utility problems. During normal working hours (8:00 AM – 5:00 PM Monday-Friday) call 487-2303; after normal working hours and on weekends and holidays call Public Safety at 487-2216 and they will call appropriate Campus Facilities personnel.
- Be sure that you know the fire evacuation plan for the laboratory. NEVER use the elevators during a fire. The stairways are designed to be used as inside fire escapes.
- Be sure that you know the location of the following items, and how to use them:
    - Fire extinguisher
    - Fire blanket
    - Fire alarm
    - First aid kit
    - Eye wash fountain
- In the unlikely event of a severe fire, explosion, chemical spill, or other unusual laboratory disaster:
    - Help any injured party, removing them from the site, if appropriate
    - Shut off all flames and sources of gas
    - Evacuate the laboratory immediately, closing windows and doors as you leave, if possible
    - Summon help. If no faculty or staff member is readily available, sound the fire alarm, leave the area, go directly to a phone, dial one the emergency numbers listed below, and report the emergency.
        - The nearest phones are in:
            - Anatomy lab (20-1101)
            - Stockroom (20-1102)
            - MLS prep room (20-1104)

        - General Biology Lab (20-1106)
        - General Biology Lab (20-1108)
    - The **Emergency Red Phone** closest to MEEM 1103 is on the 9th floor adjacent to the elevators. Other phones are located adjacent to elevators on floors 1, 5, 6, 7, and 8.
- **FOR ALL EMERGENCIES DIAL 911**
    - Other important numbers you may use to get help (dial 8 to get off-campus numbers):
        - Michigan Tech Public Safety 487-2216
        - Biology Main Office (DOW Building) 487-2025
        - Dean of Students Office 487-2212
        - Poison Control Center 8-1-800-562-9781
- Remain calm and make every effort to think clearly if an unexpected situation should occur.
- Medical Waste Disposal
    - All non-breakable items that have the potential to be contaminated with biohazard material are placed in the autoclave biohazard bags. These bags are autoclaved before disposal.
    - Any disposable glass items are to be placed in designated broke glass containers. Any disposable glass items potentially contaminated with biohazard materials are soaked in a 10% bleach solution for 30 minutes, rinsed, then disposed.
    - All non-breakable, non-biohazard materials are placed in the regular trash.
    - All "sharps" are placed in labeled biohazard red sharps containers. When they are 2/3 full they will be sealed and autoclaved prior to disposal.

References:

Center for Disease Control and Prevention, www.cdc.gov (reviewed 11/5/10 – afs)

Department of Biological Science Laboratory Safety Manual, 2008.

Grill, P. personal communication/presentation, Keweenaw Memorial Medical Center Laboratory Safety Training, 2002.

Henry, J.B., Clinical Diagnosis and Management by Laboratory Methods, 20th ed., W. B. Saunders Co., 2001, p. 34-36.

Occupational Safety and Health Administration, U.S. Department of Labor, www.osha.gov (reviewed 11/5/10 – afs)

State of Michigan Department of Energy, Labor, and Economic Growth, http://www.michigan.gov/dleg/0,1607,7-154-11407---,00.html [MIOSHA] (reviewed 11/5/10 – afs)

I have read and do understand the previously listed laboratory safety rules.

Name (print clearly):

_____

last first middle initial

Signature: _____

Date: _____

Course number: _____