MLT-1001: INTRODUCTION TO MEDICAL LABORATORY SCIENCE

Cuyahoga Community College

Viewing: MLT-1001 : Introduction to Medical Laboratory Science

Board of Trustees:
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Academic Term:
Fall 2025

Subject Code
MLT - Medical Laboratory Technology

Course Number:
1001

Title:
Introduction to Medical Laboratory Science

Catalog Description:
This foundational laboratory science course will explore some of the key disciplines, including hematology, urinalysis, immunology, clinical chemistry, and microbiology. Students will gain hands-on experience with essential laboratory skills and low-complexity testing. Through a case study approach, students will follow a patient's journey from initial symptoms to diagnosis, treatment, and monitoring. During this class, students will understand the critical role of the medical laboratory in research, patient care, healthcare systems, and our communities.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
ENG-0995 Applied College Literacies, or appropriate score on English Placement Test, and MATH-0955 Beginning Algebra, or qualified math placement.

Outcomes

Course Outcome(s):
A. Describe the professional standards, regulatory requirements, and key organizations governing medical laboratories.

Objective(s):
1. Explain the differences between licensure, certification, registration, and accreditation in the clinical laboratory field.
2. Identify major governing bodies and agencies involved in regulating medical laboratories.
3. Describe the roles of the organizations involved in governance, certification, and their respective enforcement authority.
4. Identify the following official acronyms associated with the medical laboratory field: ASCLS (American Society for Clinical Laboratory Science), ASCP/BOC American Society for Clinical Pathology/ Board of Certification), MLS (Medical Laboratory Science), MLT (Medical Laboratory Technician), NAACLS (National Accrediting Agency for Clinical Laboratory Science), TJC (The Joint Commission), CAP(College of Americal Pathologists), CLIA (Clinical Laboratory Improvement Amendments), and CLSI(Clinical & Laboratory Standards Institute).
5. Describe the various career paths available in the medical laboratory science profession.

Course Outcome(s):

B. Apply safety regulations in the laboratory and explain best practices within the clinical laboratory setting to ensure the well-being of personnel and patients.

Objective(s):

1. Define standard precautions and identify the two primary bloodborne pathogens they are meant to prevent spreading.
2. Discuss safety regulations governing medical laboratories, including components of Occupational Safety and Health Administration (OSHA) mandated plans for chemical hygiene and bloodborne pathogens, to demonstrate compliance.
3. Define biohazardous waste and describe proper handling and disposal.
4. Design a safety checklist for a laboratory setting, identifying key hazards, including biohazard, chemical, fire, and electrical.
5. Define the terms sterilization and disinfection.

Course Outcome(s):

C. Explain ethical concerns when working in a medical laboratory.

Objective(s):

1. Explain the Health Insurance Portability and Accountability Act (HIPAA), including its definition of protected health information (PHI), applicability, compliance requirements, and the consequences of violations.
2. Explain the concept of informed consent and its importance in medical laboratory procedures.
3. Describe chain of custody and its role in ensuring the integrity of laboratory results in legal matters.
4. Analyze ethical principles in medical laboratory science and apply them to case studies.

Course Outcome(s):

D. Define key educational terms related to medical laboratory science, list the three domains of learning, and explain Bloom's taxonomy along with the modified taxonomy used in medical laboratory science education.

Objective(s):

1. Define the educational terms of competence, objectives, and continuing education unit.
2. List the three domains of learning.
3. Explain Bloom's taxonomy and how each level builds upon the previous level in terms of cognitive complexity.
4. Identify the three modified taxonomy levels for the cognitive domain.
5. Describe the role of continuing education units in the medical laboratory profession.

Course Outcome(s):

E. Explain the scientific method and its application in different areas of medical laboratory science, demonstrating how it drives discovery, innovation, and problem-solving in the field.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Define the scientific method and list its key steps.
2. Describe how the scientific method solves problems and makes informed decisions in medical laboratories.
3. Explain how the principles of the scientific method are embedded in routine laboratory procedures, highlighting the importance of experimental design and controls for ensuring accurate and reliable results.
4. Identify different branches of science that contribute to the interdisciplinary aspect of medical laboratory sciences.
5. List the departments commonly found in a medical laboratory and discuss the testing that takes place in each.

Course Outcome(s):

F. Demonstrate the knowledge and skills required for proper specimen collection, processing, and transport to ensure accurate laboratory results.

Objective(s):

1. Describe the proper procedure for obtaining quality blood specimens for the lab.
2. Cite the appropriate order of draw when additive tubes are used.
3. Distinguish between the various anticoagulants used in blood collection based on their properties and suitability for different laboratory analyses.
4. List and explain frequent causes of phlebotomy complications.
5. Discuss the illegality of arterial puncture by phlebotomists in Ohio and articulate the reason for this restriction.
6. Perform a successful venipuncture on a human subject.
7. Explain the importance of specimen collection and specimen integrity in the delivery of patient care.
8. Describe blood specimen requisitioning, transport, processing, and storage.
9. List the departments commonly found in a clinical lab and discuss the testing performed in them.

Course Outcome(s):

G. Perform essential laboratory techniques, including handling reagents, utilizing lab equipment, and performing precise measurements.

Objective(s):

1. Describe procedures for handling and preparing laboratory reagents, including 2-part reagents, lyophilized products, and quantitative transfer.
2. Determine the appropriate class of glassware for different laboratory applications and its impact on precision.
3. Demonstrate the ability to make a serial dilution by using the proper pipetting technique.
4. Demonstrate proper technique when using an analytic balance.
5. Perform proper centrifugation using various types of centrifuges found in the medical laboratory.

Course Outcome(s):

H. Utilize quality control methodologies, perform laboratory calculations, and interpret the significance of QC outcomes.

Objective(s):

1. Define terms related to laboratory reagents, standards, controls, and analytes.
2. Discuss the importance of quality assurance in a medical laboratory setting.
3. Utilize quality control methods to monitor laboratory processes and ensure the reliability of test results.
4. Utilize standard laboratory units of measurement, perform conversions, and apply mathematical calculations within the context of medical laboratory testing.
5. Discuss handling, preparing, and storing laboratory reagents to maintain quality and ensure accurate results.
6. List the three testing phases, describe errors in each, and correlate thier impact on results.

Course Outcome(s):

I. Explain the principles of spectrophotometry and apply Beer's Law to laboratory analysis.

Objective(s):

1. Define Beer's Law and apply it in the laboratory.
2. Describe how spectrophotometry uses light absorption and reflection to measure the concentration of substances.
3. Create a standard curve and use it to determine the concentration of an unknown.
4. Demonstrate the proper use of a spectrophotometer.

Course Outcome(s):

J. Explain the principles of light microscopy, including the function of microscope components, magnification, and the factors affecting image quality.

Objective(s):

1. Compare and contrast the magnification strengths and applications of low-power, high-power, and oil immersion objectives.
2. Calculate total magnification.

3. Describe the components of a microscope's illumination and magnification systems and explain their functions.
4. Define the term parfocal and explain its significance.
5. Describe the proper cleaning and maintenance of a microscope.
6. Demonstrate the ability to read a peripheral blood smear & wet mount.

Course Outcome(s):

K. Discuss the diabetes disease process and the medical laboratory's contribution to diagnosing and managing it.

Objective(s):

1. Differentiate various aspects of normal glucose metabolism.
2. Identify and describe the common signs and symptoms associated with both type 1 and type 2 diabetes.
3. Compare and contrast the pathophysiology of types 1 & 2 diabetes.
4. Compare point-of-care testing to traditional glucose testing methods.
5. Describe qualitative and semi-quantitative methods for determining glucose.
6. Explain the principle of the A_1C test.
7. Discuss the impact that A_1C testing makes on screening and disease management for diabetes.

Course Outcome(s):

L. Describe the anatomy and physiology of the urinary system, the formation and composition of urine, and the correlation between urinalysis findings and diabetic kidney disease (DKD).

Objective(s):

1. Identify and label the major anatomical structures of the renal system and describe their functions.
2. Illustrate the physiological processes of urine formation, detailing glomerular filtration, tubular secretion, and tubular reabsorption.
3. Summarize the normal chemical composition of urine, including major electrolytes, organic compounds, and waste products.
4. Differentiate between normal and abnormal urinalysis results.
5. Quantify the normal range for daily urine output and identify factors that can influence urine output volume.
6. Illustrate the sequence of events leading from hyperglycemia to the development of glomerular and tubular damage in DKD.
7. Perform a manual urinalysis and explain the results of each test performed.

Course Outcome(s):

M. Describe hematopoiesis, the function of blood cells, and list the components of blood.

Objective(s):

1. Describe the process of hematopoiesis and the maturation of blood cells.
2. Define hemoglobin and explain its role within red blood cells (RBCs).
3. Explain the composition of blood, along with the structure and function of RBCs, white blood cells (WBCs), and platelets.
4. Illustrate the normal appearance of RBCs and platelets under a microscope.
5. Describe the appearance of the different lines of WBCs and be able to differentiate between them.
6. Describe phagocytosis and identify phagocytic WBCs.
7. Cite the reference ranges of WBCs and discuss the potential causes of abnormal WBC count results.
8. Discuss the principle of Wright staining and prepare a stained peripheral blood smear.

Course Outcome(s):

N. Describe the field of clinical microbiology and laboratory techniques for identifying and characterizing microbes.

Objective(s):

1. Name the distinctive fields of study within microbiology.
2. Explain the relationship between microorganisms, infection, and disease processes.
3. Define the terms pathogen, opportunistic pathogen, healthcare acquired infection (HAI) and community acquired infection (CAI).
4. Explain the importance of proper specimen collection requirements for various microbiological studies.
5. Explain the difference between microbiota (normal flora) and pathogenic organisms.

6. Explain the principle of the gram stain reaction and its significance in differentiating gram-positive and gram-negative bacteria.
7. Perform a Gram stain and correctly interpret the result.

Course Outcome(s):

O. Describe antigen-antibody complexes and their application on serological testing.

Objective(s):

1. Discuss the fundamental principles of the immune response, focusing on innate and adaptive immunity, antigens, antibodies, and their interactions.
2. Describe the main functions of T lymphocytes and B lymphocytes.
3. Explain the principle of ELISA testing.
4. Perform an immunoblot test, explain the underlying principles of the assay, and interpret the results.
5. Perform an ABO Rh type and explain the antigen-antibody interactions occurring in the test.

Course Outcome(s):

P. Describe the mechanisms of hemostasis and how these processes work together to maintain healthy blood flow.

Objective(s):

1. Define hemostasis.
2. List the physiological mechanisms of hemostasis, including vascular response, platelet function, coagulation pathways, and fibrinolysis.
3. Explain the essential functions of platelets in the entire hemostasis process.
4. Explain the process of vasoconstriction and its role in initiating hemostasis. Describe platelet adhesion and its significance in forming a platelet plug.
5. Describe the role of coagulation factors and their interactions in the intrinsic, extrinsic, and common pathways.

Methods of Evaluation:

1. Written assignments
2. Group activities
3. Projects
4. Discussions
5. Case studies
6. Skills assessments
7. Quizzes
8. Exams
9. Lab Practicals

Course Content Outline:

1. Professional standards
   a. Terminology and purpose
      i. Licensure
      ii. Certification
      iii. Registration
      iv. Accreditation
      v. Governance
      vi. Certification
   b. Career Paths
2. Professional Organizations
   a. Identification of key organizations (ASCLS, ASCP/BOC, NAACLS, TJC, CAP, CLIA, CLSI)
   b. Roles and enforcement authority of each organization
3. Laboratory safety
   a. Standard Precautions
      i. Definition
      ii. Primary bloodborne pathogens

1. HIV
2. HBV

b. Safety regulations and compliance
   i. OSHA-mandated plans
      1. Chemical hygiene
      2. Bloodborne pathogens
   ii. Fire hazards
   iii. Electrical safety
   iv. Sharps safety
c. Biohazardous waste
   i. Definition
   ii. Handling
   iii. Disposal
d. Sterilization and disinfection
   i. Definitions
   ii. Differentiation

4. Ethical Practices in the Medical Laboratory
   a. Ethical Principles
      i. Analysis
      ii. Application
   b. Health Insurance Portability and Accountability Act (HIPAA)
      i. Definition of Protected Health Information (PHI)
      ii. Applicability
      iii. Compliance
      iv. Violations
         1. Consequences
   c. Informed Consent
      i. Concept
      ii. Importance
   d. Chain of Custody
      i. Role
      ii. Integrity
5. Education in Laboratory Science
   a. Educational Terminology
      i. Competency
      ii. Objectives
      iii. Continuing education unit (CEU)
   b. Domains of Learning
      i. Cognitive
      ii. Affective
      iii. Psychomotor
   c. Bloom's Taxonomy
      i. Modified levels
         1. Remember
         2. Understand
         3. Apply
      ii. Complexity
   d. Continuing Education Units
      i. Professional development
      ii. Certification maintenance
6. Scientific Method
   a. Definition
   b. Steps
   c. Application
      i. Problem-Solving
      ii. Decision-Making
   d. Procedure integration
      i. Experimental design
      ii. Controls
      iii. Data Collection

- iv. Analysis
- v. Interpretation
- vi. Improvement process

e. Field integration
- i. Biology
  1. Cellular biology
  2. Microbiology
  3. Molecular biology
  4. Genetics
  5. Hematology
  6. Immunology
- ii. Chemistry
  1. Clinical chemistry
  2. Biochemistry

7. Specimen Collection, Processing, and Transport
   a. Phlebotomy
      - i. Quality specimen collection
        1. Venous
        2. Arterial
        3. Capillary
      - ii. Order of draw
        1. Anticoagulants
           a. Properties
           b. Testing compatibility
        2. Phlebotomy complications
           a. Hematomas
           b. Nerve injury
           c. Infection
           d. Thrombophlebitis
           e. Hemolysis
           f. Petechiae
      - iii. Legality of Arterial Puncture in Ohio
   b. Requestions
   c. Preanalytical errors
   d. Patient education
8. Essential Laboratory Techniques
   a. Handling Laboratory Reagents
      - i. Procedures for 2-part reagents
      - ii. Lyophilized products
      - iii. Quantitative transfer
   b. Glassware Selection
      - i. Volumetric
      - ii. Non-volumetric
      - iii. Specialty
   c. Serial Dilutions
      - i. Proper pipetting technique
      - ii. Dilution calculations
   d. Analytic Balance
      - i. Proper technique
      - ii. Solution calculation
   e. Centrifugation
      - i. RPM
      - ii. Balancing
      - iii. Ultracentrifugation
   f. Spectrophotometer
      - i. Key components
      - ii. Working principle
9. Quality control methodologies and laboratory calculations

a. Terminology
    i. Reagents
    ii. Standards
    iii. Controls
    iv. Analytes
b. Quality Assurance
c. QC Methods
    i. Monitoring processes
    ii. Reliability
d. Laboratory units of measurement and conversions
    i. Standard units
    ii. Conversions
    iii. Mathematical calculations

10. Beer's Law
    a. Definition
    b. Laboratory application
    c. Absorbance and Reflectance
    d. Principles and differentiation
    e. Standard Curves
        i. Creation
        ii. Utilization
11. Light Microscopy
    a. Component identification and function
        i. Ocular
        ii. Objectives
            1. Low-power
            2. High-power
            3. Oil immersion
        iii. Condenser
        iv. Diaphragm
        v. Aperture
        vi. Diopter Adjustment
    b. Principle
        i. Illumination
        ii. Magnification
        iii. Resolution
        iv. Focusing
        v. Contrast
        vi. Parfocal
    c. Total Magnification Calculations
    d. Microscope Cleaning and Maintenance
        i. Consumables
        ii. Proper use of immersion oil
        iii. Proper Handling
        iv. Storage
        v. Moving
        vi. Common improper use and handling to avoid
    e. Specimen analysis
        i. Magnification
        ii. Diaphragm placement
        iii. Identification
        iv. Dry mounts
        v. Wet mounts
12. Diabetes
    a. Glucose Metabolism
        i. Glycogenesis
        ii. Gluconeogenesis
        iii. Lipogenesis
        iv. Glycolysis

- b. Type 1 diabetes
  - i. Signs and symptoms
  - ii. Pathophysiology
  - iii. Patient Care
- c. Type 2 diabetes
  - i. Signs and symptoms
  - ii. Pathophysiology
  - iii. Patient care
- d. Point-of-Care glucose testing
  - i. Principle
  - ii. Usage
- e. Traditional glucose testing
  - i. Principle
  - ii. Usage
- f. Manual Urinalysis
  - i. Principles
  - ii. Tests

13. Anatomy and Physiology of the urinary system
    - a. Renal Anatomy and Function
      - i. Major structures
      - ii. Role in urine formation
    - b. Urine Formation
      - i. Glomerular filtration
      - ii. Tubular secretion
      - iii. Reabsorption
    - c. Normal Urine Composition
      - i. Electrolytes
      - ii. Organic compounds
      - iii. Waste products
    - d. Urinalysis Results
      - i. Normal findings
      - ii. Abnormal findings
        1. Clinical significance
        2. Impact on patient health
    - e. Diabetic Kidney Disease
      - i. Clinical significance in patients
        1. Glomerular damage
        2. Tubular damage
    - f. Development
14. Hematology
    - a. Hematopoiesis
      - i. Process
    - b. Hemoglobin
      - i. Definition
      - ii. Function
    - c. Blood Composition
      - i. RBCs
      - ii. WBCs
      - iii. Platelets
      - iv. Plasma
        1. Protein and trace elements
    - d. Appearance in microscopy
      - i. RBCs
      - ii. WBCs
      - iii. Platelets
    - e. WBC Types
      - i. Neutrophils
      - ii. Lymphocytes
      - iii. Monocytes

    iv. Eosinophils
    v. Basophils
  f. Phagocytosis
    i. Definition
    ii. Identification
  g. Wright Staining
    i. Principle
    ii. Use
  h.
15. Microbiology fundamentals
  a. Fields of study
    i. Bacteriology
    ii. Virology
    iii. Mycology
    iv. Parasitology
  b. Organisms
    i. Microbiota
    ii. Pathogenic organisms
    iii. Opportunistic pathogens
  c. Infections
    i. Community-acquired infections
    ii. Hospital-acquired infections
  d. Specimen Collection
    i. Proper collection
    ii. Collection for antigen testing
16. Immune system
  a. Fundamentals
    i. Define
      1. Innate immunity
      2. Adaptive immunity
      3. Antigens
      4. Antibodies
    ii. Self vs Non-self recognition
  b. Function and role of main cells
    i. T Lymphocytes
    ii. B Lymphocytes
17. Serological Testing
  a. Principle
    i. Antigen-antibody interactions
  b. Tests
    i. ELISA tests
    ii. Agglutination based tests
  c. Blood group testing
    i. Application
    ii. Compatibility testing
18. Hemostasis
  a. Definition
  b. Physiological Mechanisms
    i. Vascular response
      1. Vasoconstriction
    ii. Platelet function
    iii. Coagulation pathways
    iv. Fibrinolysis
  c. Platelet
    i. Platelet adhesion
    ii. Plug formation
  d. Coagulation Pathways
    i. Intrinsic
    ii. Extrinsic
    iii. Common

Skills

1. Identify hazards in the lab and take proper action.
2. Demonstrate the use of personal protective equipment.
3. Utilize standard laboratory units of measurement and perform conversions.
4. Perform a successful venipuncture.
5. Prepare a peripheral blood smear and stain for cell identification.
6. Prepare a wet mount slide.
7. Perform and interpret a POCT test on an unknown specimen.
8. Demonstrate the use of a spectrophotometer and prepare a standard curve.
9. Perform a blood group typing test and interpret results.
10. Calculate basic statistics for use in quality control.
11. Calculate concentrations created in performing a serial dilution.
12. Demonstrate the proper use of an analytical balance.
13. Use and properly balance different types of centrifuges.
14. Use a pipette to create tube dilutions, serial dilutions, and for quantitative transfer.
15. Demonstrate proper use, care, and maintenance of a microscope.
16. Perform and utilize a Gram stain to determine whether an organism as gram-positive or negative.
17. Perform the biochemical testing of a urine specimen.

Issues

1. The medical laboratory's impact on patient care.
2. Ethics in the medical laboratory sciences.
3. Quality control in the medical laboratory
4. Governance of the medical laboratory.

Resources

Beck, S.J., & LeGrys, V.A. (2019) (2019) *Clinical Laboratory Education*, McLean: The American Society for Clinical Laboratory Sciences.

McCall, Ruth. (2023) *Phlebotomy Essentials, Enhanced Edition*, Burlington, MA: Jones & Bartlett Learning.

Polancic, J & Riding, K. (2016) *Entry Level Curriculum for Medical Laboratory Technician (MLT)*, McLean: American Society for Clinical Laboratory Science.

Turgeon, Mary L. *Clinical Laboratory Science: Concepts, Procedures, and Clinical Applications*. 9th ed. St. Louis, MO: Elsevier, 2022.

Young, S. (2014) *Medical Laboratory Science Body of Knowledge*, McLean: American Society for Clinical Laboratory Science.

Resources Other

ASCLS. 2024. American Society for Clinical Laboratory Sciences. 5 Sept 2024. https://ascls.org/about-ascls/

ASCP. July 2023. Medical Laboratory Technician, MLT(ASCP) Examination Content Guideline. 6 Sept. 2024. https://www.ascp.org/content/board-of-certification#

Instructional Services

OAN Number:

Transfer Assurance Guide OHL008

CTAN Number:

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