

Virginia Western Community College
MDL 101
Introduction to Medical Laboratory Techniques

Prerequisites

None

Course Description

Introduces the basic techniques of the medical laboratory including terminology, calculations, quality control, microscopy, phlebotomy, and an overview of hematology, clinical chemistry, blood bank, immunology, microbiology, virology and urinalysis.

Semester Credits: 3 Lecture Hours: 2 Lab/Clinical/Internship Hours: 1

Required Materials**Textbook:**

Clinical Laboratory Science 7th Edition by M.L. Turgeon ISBN: 978-0-323-22545-8

Other Required Materials:

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Course Outcomes

At the completion of this course, the student should be able to:

- Explain the concepts of lab safety, universal precautions and infection control
- Perform the preparation of solutions used in the clinical lab
- Perform pipetting using micropipettes and volumetric pipettes
- Perform serial and regular dilutions of different types of lab reagents and patient samples
- Describe how to prepare molar solutions and simple dilutions
- Explain how to convert between metric units such as milliliters and microliters
- Describe the difference between quality control and quality assurance
- Analyze and interpret quality control data
- Judge whether quality control data is within acceptable limits
- Identify blood cells, bacteria, and urine samples using a light microscope
- List the common diseases of red blood cells and white blood cells
- Explain the purpose of common clinical chemistry tests
- Recall reference ranges for blood cell counts and common clinical chemistry tests
- Identify common disease causing bacteria and viruses
- Differentiate between various blood components
- Identify issues involving blood compatibility
- Identify some newer molecular based laboratory testing procedures

Topical Description

I. Fundamentals of the Clinical Laboratory

- A. Clinical Laboratory Science
- B. History of Clinical Laboratory Science
- C. Clinical Laboratory Overview
- D. CLIA '88
- E. Laboratory Departments
- F. Health Care Organization
- G. Primary Accrediting Organizations
- H. External Government Laboratory Accreditation and Regulation
- I. Alternate Sites of Testing
- J. Medical-Legal Issues
- K. Medical Ethics

II. Systems of Measurement, Laboratory Equipment and Reagents

- A. Systems of Measurement
- B. SI (International) System; Volumetric Glassware; Pipettes
- C. Laboratory Balances
- D. Laboratory Reagent Water

III. Laboratory Mathematics and Solution Preparation

- A. Significant Figures
- B. Exponents
- C. Density and Specific Gravity
- D. Expressions of Solution Concentration
- E. Proportions and Ratios
- F. Concentrations
- G. Dilutions

IV. Quality Assessment and Quality Control in the Clinical Laboratory

- A. Patient Specimens
- B. Clinical Laboratory Improvement Amendments
- C. Voluntary Accrediting Organizations
- D. ISO 15189 Standards in Clinical Laboratories
- E. Lean and Six Sigma
- F. Quality Assessment
- G. Quality Assessment-Error Analysis
- H. Quality Assessment-Phases of Testing
- I. Proficiency Testing
- J. Accuracy in Reporting Results and Documentation
- K. Quality Control
- L. Control Specimens
- M. Quality Assessment Descriptors
- N. Quality Control Statistics
- O. Monitoring Quality Control
- P. Testing Outcomes

V. Phlebotomy

- A. Quality Assessment
- B. Infection Control
- C. Specimen Collection
- D. Venous Blood Collection
- E. Capillary or Peripheral Blood Collection by Skin Puncture
- F. Capillary Blood Collection
- G. Specimens: General Preparation

VI. The Microscope

- A. Parts of the Microscope
- B. Care and Cleaning of the Microscope
- C. Use of the Microscope
- D. Other Types of Microscopes
- E. Digital Microscopy

VII. Basic and Contemporary Techniques in the Clinical Laboratory

- A. Photometry
- B. Absorbance Spectrophotometry
- C. Reflective Spectroscopy
- D. Nephelometry
- E. Flow Cytometry
- F. Immunofluorescent Labeling Techniques
- G. Molecular Diagnostic Techniques
- H. Electrochemical Methods
- I. Chromatography

VIII. Introduction to Clinical Chemistry

- A. Glucose and Glucose Metabolism
- B. Diabetes
- C. Electrolytes
- D. Acid-base Balance and Blood Gases
- E. Renal Function
- F. Uric Acid
- G. Cardiac Disease
- H. Liver and Pancreatic Testing
- I. hormone Assays
- J. Tumor Markers
- K. Therapeutic Drug Monitoring
- L. Drugs of Abuse

IX. Principles and Practice of Clinical Hematology

- A. Hematopoiesis: Blood Cell Maturation and Function
- B. Erythrocytes
- C. Leukocytes
- D. Thrombocytes
- E. Clinical Hematology Procedures
- F. Additional Hematology Procedures
- G. Red Blood Cell Indices
- H. Microscopic Examination of the Peripheral Blood Film

X. Hemostasis and Coagulation

- A. Hemostatic Mechanism
- B. Qualitative Platelet Disorders
- C. Coagulation
- D. Pathways for Coagulation Cascade
- E. Fibrinolysis
- F. Protective Mechanisms against Thrombosis
- G. Tests for Hemostasis and Coagulation

XI. Renal Physiology and Urinalysis

- A. Overview of Urinalysis
- B. Renal Anatomy and Physiology
- C. Collection and Preservation of Urine Specimens
- D. Physical Properties of Urine
- E. Chemical Tests in Routine Urinalysis
- F. Microscopic Analysis of Urine Sediment
- G. Constituents of Urine Sediment

XII. Introduction to Microbiology

- A. Introduction to Microorganisms
- B. Classification of Microorganisms: Taxonomy
- C. Protection of Laboratory Personnel, Decontamination, Disinfection, and Sterilization
- D. Specimens for Microbiological Examination
- E. Basic Equipment and Techniques Used in Microbiology
- F. Identification of Bacteria
- G. Urine Cultures
- H. Throat Cultures
- I. Genitourinary Cultures
- J. Blood Cultures
- K. Wound or Soft Tissue Cultures
- L. Antimicrobial Sensitivity Tests
- M. Quality Control in the Microbiology Lab
- N. Tests for Viruses (Virology)

XIII. Immunology and Serology

- A. Overview of Immunology and Serology
- B. Antigens and Antibodies
- C. Complement
- D. Body Defenses against Microbial Disease
- E. Hypersensitivity
- F. Types of Antigens and Reactions
- G. Cells and Cellular Activities of the Immune System
- H. Immunologic Disorders
- I. Principles of Immunology and Serologic Methods
- J. Specimens for Serology and Immunology
- K. Immunologic and Serologic Testing for Bacterial and Viral Diseases
- L. Autoimmune Disorders

XIV. Immunohematology and Transfusion Medicine

- A. Overview of Blood Banking
- B. Benefits and Reasons for Transfusion
- C. Whole Blood, Blood Components, and Derivatives for Transfusion
- D. Blood Donation: Donors, Collection, Storage, and Processing
- E. Other Types of Blood Donations
- F. Antigens and Antibodies in Immunohematology
- G. ABO Red Blood Cell Group System
- H. Rh Red Blood Cell Group System
- I. Other Blood Group Systems
- J. Antihuman Globulin Reaction (Coombs Test)
- K. Compatibility Testing and Crossmatching
- L. Hemolytic Disease of the Newborn

MDL 101 Introduction to Medical Laboratory Techniques

Lab Syllabus

Lab 1. General Introduction to the Medical Laboratory

- Laboratory Safety
- Laboratory Workflow from Collecting the Specimen to Reporting of Results
- Quality Control in the Medical Laboratory
- Pre-analytical, Analytical and Post Analytical Errors in the Laboratory

Lab 2. Lab Mathematics and Solution Preparation

- Scientific Units and Metric System Conversions
- Significant Figures
- Preparation of Molar Solutions
- Dilutions and Serial Dilutions
- Generation and Interpretation of Standard Curves

Lab 3. Microscopy

- Care and Use of the Microscope
- Examination of Blood Cells
- Examination of Bacteria
- Examination of Urine Sediments

Lab 4. Phlebotomy

- Equipment, Collection Tubes, and Order of Draw
- Preparation of Patient and Tourniquet Application
- Use of Proper Techniques to Obtain "Blood" from a Simulator Arm
- Obtaining Correct Blood Samples from Volunteer Donors
- Avoiding Pre-analytical Errors When Collecting Blood Samples

Lab 5. Introduction to Laboratory Instrumentation

- Basic Laboratory Equipment Use, Preventative Maintenance and Validation/ Calibration
- Basic of Centrifugation: balancing and sample separation
- Use of Pipettes
- Documentation for Instrument Use and Maintenance

Lab 6. Basic Clinical Chemistry Laboratory Techniques

- Standards, Control Samples, and Standard Curves
- Performing Total Protein and Albumin Assays

Lab 7. Basic Hematology Laboratory Techniques

- Counting of Blood Cells
- Performing a WBC Differential Count
- Performing a hematocrit using a Microcapillary Tube

Lab 8. Urinalysis

- Macroscopic Urinalysis by Urine Dipsticks
- Microscopic Urinalysis: Identification of Common Urine Sediment Components
- Use and Care of Refractometers

Lab 9. Introduction to Microbiology I

- Understanding Aseptic Technique
- Introduction to Media Used for Microbiologic Sample Culture
- Performing Isolation Streaking for Media Plates
- Overview of Equipment and QC

Lab 10. Introduction to Microbiology II

Performing and Reading Gram Stains

Lab 11. Introduction to Blood Bank/Transfusions I

- Overview of Blood Group and Red Blood Cell Antigen Inheritance: Genetics Worksheet(s)
- Capillary Puncture Procedure
- Slide typing: ABO / Rh, other antigens

Lab 12. Introduction to Blood Bank/Transfusions II

- Overview of Red Blood Cell Antibodies
- Titration of Antibodies
- Grading of Reactions and Antibody Detection Techniques
- Tube Test for ABO Antibodies

Notes to Instructors

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