# MLT-2490: IMMUNOLOGY AND SEROLOGY

## Cuyahoga Community College

### Viewing: MLT-2490 : Immunology and Serology

**Board of Trustees:**
1/30/2025

**Academic Term:**
Fall 2025

**Subject Code**
MLT - Medical Laboratory Technology

**Course Number:**
2490

**Title:**
Immunology and Serology

**Catalog Description:**
This course explores the intricate mechanisms underlying the human immune system, from the rapid response of innate immunity to the adaptive capabilities conferring long-term protection. Students will delve into immunity's cellular, molecular, and tissue-level components, examining T and B cell function, antigen recognition pathways, and the delicate balance between protection and dysfunction. Key topics include hypersensitivity reactions, autoimmune diseases, immunodeficiency disorders, and the emerging field of tumor immunology. The course culminates with a focus on the laboratory applications of immunological principles, emphasizing the role of diagnostic techniques and quality assurance measures in the detection and management of infectious diseases.

**Credit Hour(s):**
2

**Lecture Hour(s):**
2

### Requisites

**Prerequisite and Corequisite**
BIO-1500 Principles of Biology I and HTEC-1060 Medical Terminology I; or BIO-2341 Anatomy and Physiology II.

### Outcomes

**Course Outcome(s):**
A. Describe the basic mechanisms of innate and adaptive immunity, including the roles of cells, tissues, and molecules involved.

**Objective(s):**
1. Define innate, adaptive, passive, and active immunity and differentiate between them.
2. List and describe the major components of the innate immune system, along with their functions.
3. Identify the primary and secondary lymphoid organs and summarize their roles in immune responses.
4. Compare and contrast the characteristics of primary and secondary immune responses.
5. List the key features of an antigen that contribute to its immunogenicity.
6. Identify the different classes of antibody molecules and describe their basic structure and function.
7. Define the terms isotype, allotype, and idiotype, and explain their relevance to antibody diversity and immune responses.

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**Course Outcome(s):**
B. Explain the principles and mechanisms of cell-mediated immunity.

**Objective(s):**
1. Identify the primary stages of T cell development and differentiation.
2. Compare and contrast the different T cell subsets and their functions in responding to intracellular and extracellular pathogens.
3. Describe the process of antigen presentation.

4. Explain the mechanisms of T cell activation and the role of co-stimulatory molecules.
5. Describe the effector functions of the different T cell subsets.
6. Identify the characteristics of natural killer cells, including their lack of MHC restriction and mechanisms of target cell recognition.
7. Explain the role of cytokines in immune responses.
8. Compare and contrast the characteristics and functions of major cytokines involved in both innate and adaptive immune responses.
9. Explain the roles of soluble mediators like chemokines and complement proteins in immune cell activation, recruitment, and function.

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**Course Outcome(s):**

C. Describe the mechanisms by which T cells recognize and respond to antigens, that lead to the destruction of infected or abnormal cells.

**Objective(s):**

1. Define isotype switching and list the different antibody isotypes that can be produced.
2. List the different types of memory cells and describe their functions in long-term immunity.
3. Differentiate between antigen-independent and antigen-dependent B cell differentiation.
4. Outline the steps involved in mature B cell activation, including the production of membrane-bound and secreted immunoglobulin.

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**Course Outcome(s):**

D. Review DNA replication, transcription, and translation and their roles in cellular function.

**Objective(s):**

1. Describe the process of DNA replication, including the key enzymes involved and the mechanisms ensuring accuracy.
2. Explain the process of transcription, detailing the steps from initiation to termination and the role of RNA polymerase.
3. Outline the process of translation, highlighting the roles of mRNA, tRNA, ribosomes, and the genetic code in protein synthesis.
4. Discuss the impact of errors in DNA replication, transcription, or translation on cellular function and the development of disease.
5. Analyze the implications of mutations and polymorphisms in DNA sequences on protein structure and function.

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**Course Outcome(s):**

E. Apply genetic principles to interpreting molecular diagnostic test results, including understanding mutations, polymorphisms, and inheritance patterns.

**Objective(s):**

1. Define and differentiate between mutations and polymorphisms and discuss their potential impact on gene function and protein expression.
2. Classify different types of mutations and predict their consequences on protein structure and function.
3. Explain the concept of Mendelian inheritance, including dominant and recessive traits, and how it applies to the interpretation of molecular diagnostic test results.
4. Discuss non-Mendelian inheritance patterns and their relevance to molecular diagnostics.
5. Interpret molecular diagnostic test results in the context of a patient's family history and genetic background.
6. Apply knowledge of genetic principles to the selection and interpretation of appropriate molecular diagnostic tests for various clinical scenarios.

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**Course Outcome(s):**

F. Discuss the impact of molecular testing on the diagnosis and management of disease.

**Objective(s):**

1. Compare and contrast traditional diagnostic methods with molecular testing, highlighting the advantages and limitations of each approach in terms of sensitivity, specificity, and turnaround time.
2. Discuss the role of molecular testing in the early detection and diagnosis of diseases, including infectious diseases, genetic disorders, and cancer.
3. Evaluate the impact of molecular testing on disease prognosis and monitoring, including the ability to predict disease progression and response to therapy.

4. Discuss the challenges and limitations of molecular testing.
5. Analyze case studies to illustrate the impact of molecular testing on patient care.
6. Debate the potential for over-reliance on molecular testing and the importance of integrating it with other clinical and diagnostic information.

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**Course Outcome(s):**

G. Explain the principles underlying common immunological techniques used in the clinical laboratory and describe their applications in diagnosing and monitoring diseases.

**Objective(s):**

1. Compare and contrast the principles, components, and applications of various immunoassay formats
2. Differentiate between competitive and non-competitive immunoassays, providing examples of each and their clinical applications.
3. Explain the basic principles and operation of flow cytometry, including the process of cell labeling, data acquisition, and analysis.
4. Identify the criteria for evaluating the suitability of specimens for immunological testing, including factors that may affect specimen quality and integrity.
5. Interpret the results of various immunological tests.
6. Identify potential sources of error and quality control measures in the different types of serological testing.

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**Course Outcome(s):**

H. Define autoimmunity and identify the key concepts associated with its development, including self-tolerance, autoantigens, and autoantibodies.

**Objective(s):**

1. Define immune tolerance and explain its role in preventing autoimmunity.
2. Identify potential mechanisms for the breakdown of immune tolerance and the subsequent development of autoimmunity.
3. Distinguish between organ-specific and systemic autoimmune diseases, listing examples of each.
4. List common clinical symptoms and laboratory findings associated with classic autoimmune diseases.

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**Course Outcome(s):**

I. List the different types of tumor-associated antigens and explain their significance in cancer diagnosis and monitoring.

**Objective(s):**

1. Define immunosurveillance and identify its role in tumor recognition.
2. List different types of tumor-associated antigens (TAAs) and describe their characteristics.

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**Course Outcome(s):**

J. Identify the characteristics, causes, and clinical manifestations of common primary immunodeficiency disorders.

**Objective(s):**

1. Identify and differentiate the major types of primary immunodeficiency disorders.
2. Describe the underlying causes of each major type of primary immunodeficiency disorder.
3. List the clinical manifestations associated with each disorder and explain the immune system component primarily affected by each disorder.
4. Identify the primary immune pathway(s) (classical, lectin, or alternative) affected by each complement deficiency.

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**Course Outcome(s):**

K. Identify the characteristics, causes, and clinical manifestations of common phagocyte deficiencies.

**Objective(s):**

1. List common phagocyte deficiencies (e.g., Chronic Granulomatous Disease, Leukocyte Adhesion Deficiency)
2. Describe the associated clinical symptoms and laboratory findings of common phagocyte deficiencies.

**Course Outcome(s):**

L. Identify the characteristics and causes of acquired immunodeficiency disorders.

**Objective(s):**

1. List commonly acquired immunodeficiencies.
2. Describe the associated clinical and laboratory findings of acquired immunodeficiency disorder.

**Course Outcome(s):**

M. Analyze the immune response to infectious diseases, the principles and methods of laboratory diagnosis, and the quality assurance measures necessary for accurate results.

**Objective(s):**

1. Analyze the relationship between clinical indicators and laboratory findings in common infectious diseases.
2. Explain the preparation and proper handling of materials, reagents, and equipment used in laboratory tests for infectious disease diagnosis, emphasizing quality control measures.
3. Evaluate the performance of various laboratory tests used to diagnose infectious diseases.
4. Interpret test results for infectious diseases, determining acceptability based on established criteria and identifying potential sources of error that may affect results.

**Course Outcome(s):**

N. Identify the four types of hypersensitivity reactions and their key characteristics.

**Objective(s):**

1. List the four types of hypersensitivity reactions.
2. Match each hypersensitivity type with its corresponding immune mechanism.

**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. Introduction
    a. History
    b. Principle
    c. Vaccines
    d. Components
        i. Cells
        ii. Organs
    e. Active immunity
    f. Passive immunity
2. Innate immunity
    a. Principle
        i. First line defense
        ii. Non-specific
        iii. Components

1. Physical barriers
    a. Skin
    b. Mucous membranes
2. Phagocytic cells
    a. Neutrophils
    b. Macrophages
    c. Dendritic
    d. Monocytes
3. Chemical barriers
    a. pH
    b. Lysosomes
4. Inflammatory response
5. Soluble mediators
    a. Cytokines
    b. Complement
    c. Acute phase reactants

3. Adaptive immunity
    a. Principle
        i. Specificity
        ii. Memory
    b. Cell-mediated immunity
        i. Components
            1. T-cell
                a. Development
                b. Differentiation
                c. Subsets
                    i. CD markers
                        1. CD 8+
                        2. CD 4+
                    ii. Effector T-cells
                        1. Th
                        2. Tc
                        3. TREG
                d. Effector functions
                    i. Lysis
                    ii. Apoptosis
                    iii. Inflammation
                    iv. B-cell activation
            2. Antigen recognition and presentation
                a. Cells
                    i. Antigen presentation cells (APC)
                    ii. Stimulated cells
                b. Activation
                c. MHC molecules
                d. Co-receptors
                e. Signaling
                f. Cytokines
            3. Natural Killer cells
                a. Role
                b. Characteristics
                    i. MHC restriction
                    ii. CD markers
                c. Functions
    c. Humoral Immunity
        i. Cell interactions
            1. APC
            2. CD4+
        ii. Isotype switching
        iii. Memory cells

1. B-cell
2. T-cells
3. Innate lymphoid cells
4. Natural killer cells
5. Resident

iv. B-cells
1. Development
2. Differentiation
   a. Antigen-independent
   b. Antigen-dependent B

v. B-cell activation
1. Stimulatory molecules
   a. Membrane-bound
   b. Secreted
2. Plasma cells

vi. Isotype switching
vii. Long-term immunity

4. Antigens
   a. Definition
   b. Antigen vs. Immunogen
   c. Structure
      i. Classes
      ii. Chain regions
         1. Light
         2. Heavy chain
      iii. Fragments
         1. Fab
         2. Fc
   d. Immunogenicity
      i. Molecular size
      ii. Complexity
      iii. Foreignness
      iv. Epitopes
      v. Dosage
      vi. Cross-reactivity
   e. Affinity
   f. Titer
   g. Isotype
   h. Allotype
   i. Idiotype
5. Cytokines
   a. Functions
   b. Production
   c. Effects
   d. Innate immunity
      i. IL-1
      ii. IL-6
      iii. TNF-a
   e. Adaptive immunity
      i. IL-2
      ii. IL-4
      iii. IL-5
      iv. IL-10
      v. IFN-y
   f. Polymorphonuclear Leukocytes and Macrophages
      i. Chemotaxis factor
      ii. Migration inhibitory factor
      iii. GM-CSF
6. Molecular Biology and Genetics

a. DNA
    i. Replication
    ii. Transcription
    iii. Translation
b. Mutations
c. Polymorphisms
d. Mendelian genetics
e. Non-Mendelian genetics
f. Enzymes
    i. Endonucleases
    ii. Exonucleases
    iii. Ligases
    iv. Polymerases
    v. Reverse transcriptase
    vi. Phosphatases
    vii. Kinases

7. Molecular Diagnostics
    a. Test principles
        i. Electrophoresis
        ii. Blotting
        iii. Amplification
        iv. Fluorescence in situ hybridization (FISH)
    b. Application in patient care
        i. Diagnosis
        ii. Prognosis
        iii. Management
        iv. Monitoring
    c. Limitations
    d. Sources of error
8. Immunological Techniques
    a. Specimens
        i. Types
        ii. Suitability
    b. Principles
        i. Visible
            1. Precipitation
            2. Agglutination
            3. Diffusion
            4. Flocculation
        ii. Competitive binding
            1. Radioimmunoassay
            2. Enzyme immunoassay
            3. Chemiluminescent assay
        iii. Noncompetative binding
            1. Sandwich assays
            2. Enzyme immunoassays
            3. Chemiluminescent assays
    c. Flow cytometry
        i. Applications
        ii. Instrumentation
    d. Quality control
        i. Preanalytical
        ii. Analytical
        iii. Postanalytical
        iv. Sources of errors
9. Autoimmunity
    a. Immune tolerance
    b. Mechanism
    c. Clinical symptoms and laboratory findings

i. Organ-specific autoimmune diseases
1. Grave's disease
2. Hashimoto's thyroiditis
3. Addison's disease
4. Celiac disease
5. Diabetes – Type 1

ii. Systemic autoimmune diseases
1. Systemic Lupus Erythematosus
2. Rheumatoid arthritis
3. Scleroderma
4. Sjögren's Syndrome

10. Tumor Immunology
    a. Tumor-associated antigens
        i. Carcinoembryonic antigen (CEA)
        ii. Alpha-fetoprotein (AFP)
        iii. Prostate-specific antigen (PSA)
        iv. Beta-2-microglobulin
        v. Human Chorionic Gonadotropin (HCG)
        vi. Cancer Antigen (CA) 125
        vii. CA 19-9
    b. Tumor recognition
    c. Immunosurveillance
11. Immunodeficiency Disorders
    a. Characteristics
    b. Laboratory findings
    c. B cell immunodeficiencies
        i. Bruton's tyrosine kinase (Btk) deficiency
    d. T cell immunodeficiencies
        i. DiGeorge's syndrome
    e. Combined T and B cell immunodeficiencies
        i. Severe combined immunodeficiency (SCID)
        ii. Wiskott-Aldrich syndrome
12. Acquired immunodeficiency disorders
    a. Characteristics
    b. Causes
    c. Acquired B cell deficiency
    d. HIV
13. Phagocyte Deficiencies
    a. Characteristics
    b. Mechanism
    c. Common laboratory testing
    d. Chronic granulomatous disease (CGD)
        i. Disease process
        ii. Clinical symptoms
        iii. Laboratory findings
    e. Chediak-Higashi syndrome
        i. Condition process
        ii. Clinical symptoms
        iii. Laboratory findings
    f. Job's syndrome
        i. Condition process
        ii. Clinical symptoms
        iii. Laboratory findings
14. Infectious Diseases
    a. Epstein-Barr infection
        i. Infection process
        ii. Immune response
        iii. Clinical symptoms
        iv. Laboratory findings

b. Hepatitis A, B, & C
    i. Infection process
    ii. Immune response
    iii. Clinical symptoms
    iv. Laboratory findings
c. Rubella
    i. Infection process
    ii. Immune response
    iii. Clinical symptoms
    iv. Laboratory findings
d. Syphilis
    i. Infection process
    ii. Immune response
    iii. Clinical symptoms
    iv. Laboratory findings
e. Group A Streptococcal infections
    i. Infection process
    ii. Immune response
    iii. Clinical symptoms
    iv. Laboratory findings
f. Cytomegalovirus
    i. Infection process
    ii. Immune response
    iii. Clinical symptoms
    iv. Laboratory findings

15. Hypersensitivity Reactions
    a. Hypersensitivity I
        i. Mechanism
        ii. Clinical symptoms
    b. Hypersensitivity II
        i. Mechanism
        ii. Clinical symptoms
    c. Hypersensitivity III
        i. Mechanism
        ii. Clinical symptoms
    d. Hypersensitivity IV
        i. Mechanism
        ii. Clinical symptoms

## Resources

Miller, C. D., & Stevens, L. E. *Clinical Immunology and Serology: A Laboratory Perspective* . 5th ed. Philadelphia:F.A. Davis Company, 2023.

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

Turgeon, M. L. *Clinical Laboratory Science: Concepts, Procedures, and Clinical Applications*. St. Louis, MO: Elsevier, 2022.

Turgeon, M. L. *Immunology & Serology in Laboratory Medicine*. 7th ed. St. Louis, MO: Elsevier, 2022.

Rich, Robert, et al. *Clinical Immunology Principles and Practice* . 6th ed. St. Louis, MO:Elsevier, 2023.

**Resources Other**

ASCP. July 2023. Medical Laboratory Technician, MLT(ASCP) Examination Content Guideline. 9 Sept. 2024. https://www.ascp.org/content/board-of-certification#

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