



MLAB 1235 - Immunology/Serology MLAB 1235.401

Course Syllabus

Description

An introduction to the theory and application of basic immunology, including the immune response, principles of antigen-antibody reactions and the principles of serological procedures as well as quality control, quality assurance and safety.

Semester Offered

Spring Only

Credits 2

Lecture Hours 1

Lab Hours 4

Extended Hours 0

Contact Hours 80

State Approval Code 5110040000

Instructor Name Mrs Christina Parrott

Semester/Year Spring 2025

Meeting Time and Location

Online—students are expected to spend at least 3-4 hours per week minimum- reading, reviewing, and participating in assigned activities for successful completion of this course.

Alternate Operations During Campus Closure

In the event of an emergency or announced campus closure due to a natural disaster or pandemic, it may be necessary for Panola College to move to altered operations. During this time, Panola College may opt to continue delivery of instruction through methods that include, but are not limited to: online learning management system (CANVAS), online conferencing, email messaging, and/or an alternate schedule. It is the responsibility of the student to monitor Panola College's website (www.panola.edu) for instructions about continuing courses remotely, CANVAS for each class for course-specific communication, and Panola College email for important general information.

Student Basic Needs

Unexpected circumstances may arise, but Panola College offers various resources to support students. If you need mental health services or are facing challenges with transportation, affording class materials and supplies, or accessing food regularly—issues that may impact your class performance—please visit panola.edu/resources.

Class Attendance

Regular and punctual attendance of classes and laboratories is required of all students. When a student has been ill or absent from class for approved extracurricular activities, he or she should be allowed, as far as possible, to make up for the missed work. If a student has not actively participated by the census date, they will be dropped by the instructor for non-attendance. This policy applies to courses that are in-person, online, hybrid, and hyflex.

Attendance in online courses is determined by submission of an assignment or participation in an activity. According to federal guidelines, simply logging into a distance learning course without participating in an

academic assignment does not constitute attendance. Distance learning is defined as when a majority (more than 50%) of instruction occurs when the instructor and students are in separate physical locations. Students must engage in an academic activity prior to the course census date.

When an instructor feels that a student has been absent to such a degree as to invalidate the learning experience, the instructor may recommend to the Vice President of Instruction that the student be withdrawn from the course. Instructors may seek to withdraw students for non-attendance after they have accumulated the following number of absences:

Fall or spring semesters:

3 or more class meeting times per week - 5 absences

2 class meeting times per week - 3 absences

1 class meeting per week - 2 absences

The student is responsible for seeing that he or she has been officially withdrawn from a class. A student who stops attendance in a class without officially withdrawing from that class will be given a failing grade; consequently, the student must follow official withdrawal procedures in the Admissions/Records Office.

Please note: Health Science and Cosmetology courses may require more stringent attendance policies based on their accreditation agencies. Please see the addendum and/or program handbook for further information concerning attendance.

Pregnant/Parenting Policy

Panola College welcomes pregnant and parenting students as a part of the student body. This institution is committed to providing support and adaptations for a successful educational experience for pregnant and parenting students. Students experiencing a need for accommodations related to pregnancy or parenting will find a Pregnancy and Parenting Accommodations Request form in the Student Handbook or may request the form from the course instructor.

Artificial Intelligence (AI) Course Policy

Broader use of Generative AI permitted within the course.

The use of artificial intelligence (AI) tools, including ChatGPT, is permitted in this course for students who wish to use it. Students must cite AI-generated material that informs their work. Using an AI tool to generate content without proper attribution qualifies as academic dishonesty.

Instructional Goals and Purposes

The purpose of this course is to develop a working knowledge of the principles and procedures of immunology and serology.

Learning Outcomes

1. Apply principles of safety, quality assurance and quality control in Immunology/Serology.
2. Evaluate specimen acceptability.
3. Describe the principles involved in the immune response.
4. Identify the structure, function, and characteristics of immunoglobulins.
5. Explain the principles of and perform serological tests.
6. Evaluate and correlate test results with associated diseases or conditions.

Specific Course Objectives (includes SCANS)

After studying all materials and resources presented in the course, the student will be able to:

(Lab objectives are in *italics*)

1. **Chapter 1 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
 - a. Define the terms:
 - i. Immunology
 - ii. Immunity
 - iii. Antigen
 - iv. Humoral immunity

- v. Serum
 - vi. Plasma
 - vii. Phagocyte/phagocytosis
 - viii. Physical barriers
 - ix. Soluble mediators (cytokines, complement, acute phase reactants)
 - x. Chemotactic factors
- b. Study and understand the diagram of the immune system and its main components:
 - i. Acquired/Adaptive Immunity
 - ii. Passive vs. Active Immunity
 - iii. Humoral vs. Cell-Mediated Immunity
 - iv. Innate/Natural Immunity
 - c. Compare and contrast innate immunity and acquired immunity.
 - d. Describe the organ components of the immune system- primary and secondary.
 - e. Discuss the location and function of Peyer's patches.
 - f. Discuss the functions of T cells, B cells, and macrophages and indicate if they are found in Acquired (Adaptive) or Innate (Natural) Immunity.
 - g. Explain what a CD marker is (CD4+, CD8+)
 - h. Describe how NK cells function (Lack antigen specificity, CD markers, cytokines).
 - i. Discuss the process of T cell development (from thymocyte through mature T cell).
 - j. List the different types of T cells and their functions.
 - k. Discuss the characteristics, role, and functions of natural killer (NK) cells including CD markers have cytokines stimulated, and their role in humoral immunity.
 - l. Discuss the roll of antigen presenting cells (APC) in the generation of antibodies.
 - m. Discuss the role of inflammation in the innate immune system.
 - n. Discuss differentiation and maturation of B cells.
 - o. Define human leukocyte antigen (HLA) and major histocompatibility complex (EMHC).
2. **Chapter 2 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Describe the basic structure of an immunoglobulin.
 - b. Describe the difference between heavy chain and light chain regions.
 - c. *Differentiate the five main immunoglobulin classes found in humans.*
 - d. Define the area the immunoglobulin that determines its specificity.
 - e. Discuss the subclasses of IgG and IgA.
 - f. Explain how an antibody molecule is formed.
 - g. *Know the function of each immunoglobulin molecule.*
 - h. Explain the locations and significance of the Fab and Fc fragments.
 - i. Define isotypic determinants.
 - j. Discuss the concept of isotype switching and how it occurs.
 - k. Compare and contrast primary and secondary immune response.
 - l. Discuss the difference between antigen independent and antigen dependent B cells.
 - m. Understand B cell activation/maturation:
 - i. Stimulatory molecules
 - ii. Types of cells it can become
 - iii. Affinity
 - n. Define idiotype.
 - o. Discuss the difference between "primary response" and "secondary response" of memory B cells regards to:
 - i. Number of cells produced
 - ii. Affinity of antibody
 - p. Define antigen-dependent affinity maturation and list the cells involved in this process.
3. **Chapter 3 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Define and describe the basic requirements for immunogenicity.
 - b. Define antigen, immunogen, allotypes (alloantigens), autoantigens, heteroantigens, epitopes.
 - c. Define and discuss foreignness.
 - d. Discuss how size and complexity and how they influence immunogenicity.
 - e. Define and discuss antigenic determinants/epitopes and how they help the immune system recognize the antigen.
 - f. Discuss the concept of cross-reactivity in antigens.

- g. Discuss how state and site influence immunogenicity.
 - h. Describe the major steps in antigen processing and presentation by an antigen-presenting cell.
 - i. Describe the major role of MHC components in an immune response and the specific roles that MHC class I and class II molecules play in the response.
4. **Chapter 4 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-ii, iv, v, 2a-iii, 2c-i, ii, iii, iv.)**
- a. Discuss the origin and development of thymocytes into T cells.
 - b. Differentiate the functions of the subsets of T cells: helper T Cells (CD4+), cytotoxic T Cells (CD8+), regulatory T cells.
 - c. Discuss the difference between the Th1 and Th2 T helper subsets.
 - d. Define the function of T17.
 - e. Explain the concept of antigen presentation for T-cells and their subsets
 - i. Role of activation and antigen-presenting cells
 - ii. MHC molecules involved
 - iii. Cytokines stimulated
 - iv. Co-stimulatory signal molecules
 - v. Cells stimulated
 - f. List and describe the general features of cytokines involved in INNATE immunity including the cells that produce them and what cells are affected by them (e.g. IL-1, IL-6, TNF- α)
 - g. List and describe the general features of cytokines involved in ADAPTIVE immunity including the cells that produce them and what cells are affected by them. (e.g. IL-5, IL-10, IFN- γ).
 - h. Define immunological tolerance.
 - i. Know which T cell subset has the function of:
 - i. Lysis
 - ii. Apoptosis
 - iii. Inflammation
 - iv. B cell activation
5. **Chapter 5 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-ii, iv, v, 2a-iii, 2c-i, ii, iii, iv.)**
- a. Define apoptosis as it relates to as it relates to T cells.
 - b. Discuss the synthesis and composition of complement.
 - c. List the functions of complement.
 - d. Define chemotaxis.
 - e. List the three different pathways of complement activation lead to cell lysis.
 - f. Describe the three different functions—recognition, activation, and membrane attack—of each of the three pathways.
 - g. Describe regulators of the complement system, both fluid phase and membrane bound. Name and describe the functions of the subunits that are anaphylatoxins and chemotaxins as well as those that are involved in immune adherence and in opsonization.
 - h. Name and describe the functions of the subunits that are involved in (1) the production of inflammatory mediators, (2) B-cell activation, and (3) memory.
6. **Chapter 6 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-ii, iv, v, 2a-iii, 2c-i, ii, iii, iv.)**
- a. *Define characteristics and methodologies of "visible" techniques:*
 - i. *Precipitation*
 - ii. *Agglutination*
 - iii. *Radial immunodiffusion*
 - b. *Explain how prozone, postzone, and equivalence affect the amount of lattice cross-linked precipitates.*
 - c. *Interpret Ouchterlony immunodiffusion patterns.*
 - d. *Define Sandwich Assay.*
7. **Chapter 7 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-ii, iv, v, 2a-iii, 2c-i, ii, iii, iv.)**
- a. *Compare and contrast direct and indirect immunoassays.*
 - b. *Define competitive assay.*
 - c. *Define characteristics of the following methodologies:*
 - i. *Radioimmunoassay*
 - ii. *Fluorescent Immunoassays*
 - iii. *Chemiluminescent assays*
 - d. *Discuss the basic concepts of flow cytometry.*
 - e. *Understand how a flow cytometry instrument works.*

8. **Chapter 8 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- Define the terms:*
 - Titer*
 - Dilution*
 - Serial Dilution*
 - Diluent/Solute*
 - Specificity*
 - Sensitivity*
 - Efficiency*
 - Positive and Negative Predictive Values*
 - Be able to calculate:*
 - the amount of solute and diluent needed in the preparation of various simple and compound dilutions.*
 - calculate final dilution of a sample after being given the initial dilution and subsequent dilution(s) performed.*
 - calculate the amount of buffer that must be added to achieve a dilution ratio.*
 - calculate the amount of serum needed to make a defined volume of a defined dilution.*
 - calculate sensitivity.*
 - calculate specificity.*
 - Be able to convert from one prefix to another: kilo-, deca-, deci-, centi-, micro- have nano-, pico-, atto-, zepto*
9. **Chapter 9 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- List and describe the four types of hypersensitivity reactions.
 - Compare and contrast the role of antibody (and their different immunoglobulin classes), T cells have macrophages, neutrophils, and complement in each of the hypersensitivity reactions described. (Be sure to know the numerical number associated with each hypersensitivity type).
 - Give an example of a clinical condition that is characteristic of each form of hypersensitivity.
 - Define the terms hypersensitivity, allergy, and allergen.
 - Describe the roles of IgE, cross-linking, and mast cells in type I hypersensitivity.
 - Describe the roles of antibody and complement in type II hypersensitivity.
 - Describe the roles of immune complexes, complement, and phagocytes in type III hypersensitivity.
 - Diagnose each form of hypersensitivity from clinical manifestations.
10. **Chapter 10 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- Describe mechanisms for autoimmunity.
 - Define systemic autoimmunity.
 - Discuss the role of genetics, gender, and environmental factors in the etiology of autoimmunity.
 - Describe the clinical symptoms and laboratory findings of Systemic Lupus Erythematosus (SLE).
 - Describe the clinical symptoms and laboratory findings of Rheumatoid Arthritis (RA).
 - Name and describe different diagnostic tests for the diagnosis of rheumatoid arthritis.*
 - List and describe different tests for the diagnosis of systemic lupus erythematosus.*
 - Name and describe laboratory tests that are common to different systemic autoimmune diseases.*
 - Describe possible biological mechanisms that may lead to systemic lupus erythematosus.
11. **Chapter 11 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- Define organ-specific autoimmunity.
 - Describe the clinical symptoms and laboratory findings of Grave's disease.
 - Describe the clinical symptoms and laboratory findings of Hashimoto's thyroiditis.
 - Describe the clinical symptoms and laboratory findings of Addison's Disease (Primary Adrenal Insufficiency).
 - Describe the clinical symptoms and laboratory findings of Type I Diabetes.
 - Describe the clinical symptoms and laboratory findings of Celiac Disease.
 - Discuss the diagnosis and management of type 1 diabetes.*
 - Discuss the causes and effects of antiphospholipid syndrome.
12. **Chapter 12 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- Define and explain benign, malignant, invasive, metastasis, cancer, carcinoma have adenocarcinoma, sarcoma, leukemia, lymphoma, myeloma, grade, and stage.
 - Define tumor immunosurveillance.
 - Discuss these antigens that are associated with human tumors:*

- i. *Carcinoembryonic antigen (CEA)*
 - ii. *Alpha-fetoprotein (AFP)*
 - iii. *Prostate-specific Antigen*
 - iv. *Beta-2-microglobulin*
 - v. *HCG*
 - vi. *CA125*
 - vii. *CA 19-9*
- d. *State the use for and limitations of Bence-Jones protein.*
- e. Define staging.
13. **Chapter 15(1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Differentiate primary and secondary immunity.
 - b. List another name for immunodeficiencies involving antibody production (B cells).
 - c. Discuss the characteristics of congenital/genetic B cell immunodeficiencies:
 - i. X-linked agammaglobulinemia (Bruton's disease)
 - ii. Selective immunoglobulin deficiencies (IgA)
 - d. Discuss the characteristics of congenital/genetic T cell immunodeficiencies:
 - i. Thymic aplasia (DiGeorge's syndrome)
 - e. Discuss the characteristics of combined B cell and T cell immunities:
 - i. Severe combined immunodeficiency disease (SCID)
 - ii. Wiskott-Aldrich syndrome
 - f. Discuss the characteristics of common complement component deficiencies:
 - g. Discuss the characteristics of Phagocyte Deficiencies:
 - i. Chronic granulomatous disease (CGD)
 - ii. Chediak-Higashi syndrome
 - iii. Job's Syndrome
 - h. List and describe therapeutic approaches to different forms of immunodeficiency.
14. **Chapter 16 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Describe the different methods of transmission of HIV.
 - b. Identify the human cells targeted by HIV.
 - c. Describe the effect of HIV infection on the immune system and the development of AIDS.
 - d. Describe the confirmatory test for HIV detection.
 - e. Give examples of opportunistic infections commonly found in AIDS patients.
 - f. Describe current treatments for HIV and AIDS.
 - g. *Describe the clinical and laboratory findings in a patient with HIV.*
 - h. *Describe the clinical and laboratory findings in a patient with AIDS.*
15. **Chapter 17 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Describe the symptoms of hepatitis.
 - b. *Describe the clinical and laboratory findings in patients with:*
 - i. *Hepatitis A*
 - ii. *Hepatitis B*
 - iii. *Hepatitis C*
 - c. Describe the hepatitis A and B vaccines.
 - d. Understand the infection risks associated with patients who have the various hepatitis viruses for laboratory and personal safety.
 - e. Describe the relationship between HBV and HBD (delta).
 - f. Describe common forms of HCV transmission
16. **Chapter 18 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
- a. Describe the similarities of the viruses of the Herpesviridae family.
 - b. *Describe the clinical and laboratory findings in patients with Rubella.*
 - c. *Describe the clinical and laboratory findings in patients with Cytomegalovirus (CMV).*
 - d. Discuss Epstein-Barr virus (EBV) in terms of virus type, infection course, immunity, and population affected.
 - e. Describe how an infectious mononucleosis diagnosis is made.
 - f. Discuss the effects of a congenital CMV infection.
 - g. *Describe the etiology and epidemiology of rubella and rubeola infection.*
 - h. Explain the signs and symptoms of acquired and congenital rubella infection.
 - i. *Describe laboratory diagnosis of varicella.*

- j. Describe the difference between a primary infection with varicella zoster and a reactivation.
17. **Chapter 19 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
 - a. *Describe the clinical and laboratory findings in syphilis.*
 - b. *List and describe the different clinical stages of syphilis.*
 - c. *Discuss the host immune response to Treponema pallidum.*
 - d. *List and describe diagnostic tests for syphilis.*
 - e. *Describe the different diseases caused by Group A Strep.*
 - f. *List and describe different laboratory approaches for the detection of streptococci.*
 - g. *Discuss different approaches by which bacteria evade or downregulate the host immune responses against them.*
 18. **Chapter 23 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2c-i, ii, iii, iv.)**
 - a. *Compare and contrast transcription and translation.*
 - b. *Name the 4 DNA bases.*
 - c. *List the analytes each are used to detect: dot blot, Southern blot, and Northern blot.*
 - d. *Discuss the basic principles of*
 - i. *Nucleic Acid probes*
 - ii. *Hybridization*
 - iii. *Microarrays*
 - iv. *Polymer Chain Reaction (PCR)*
 19. **Lab #1 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2b-i, ii, iv, v, vi. 2c-i, ii, iii, iv.)**
 - a. *Define multivalent antigen.*
 - b. *Understand and identify the different reactions of identity on an ouchterlony plate.*
 - c. *Define "identity", "partial identity", and "non-identity" as they relate to ouchterlony reactions.*
 - d. *Define antibody excess zone.*
 - e. *Define antigen excess zone.*
 - f. *Describe the purpose of the humidity incubation chamber in the ouchterlony experiment.*
 - g. *Identify the media used in ouchterlony experiments.*
 - h. *Define precipitation as it relates to ouchterlony.*
 20. **Lab #2 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2b-i, ii, iv, v, vi. 2c-i, ii, iii, iv.)**
 - a. *Name the hormones related to pregnancy.*
 - b. *Name the female reproductive hormones and their role in the fertility cycle.*
 - c. *Understand and demonstrate use of an automatic pipettor- including what each "stop" does and the correct way to draw up and dispense liquid.*
 - d. *Describe the concept of ELISA.*
 - e. *Know what the acronym ELISA stands for.*
 - f. *Describe the purpose of using controls in any test.*
 - g. *Understand the procedure to follow when one or more of the test controls "fail."*
 - h. *List at least three analytes that are commonly tested for using ELISA.*
 - i. *Describe the antigen-antibody reaction.*
 - j. *Describe the role of the second antibody (conjugate) and the substrate in ELISA.*
 21. **Lab #3 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-ii, iv, v. 2a-iii. 2b-i, ii, iv, v, vi. 2c-i, ii, iii, iv.)**
 - a. *Describe hemagglutination.*
 - b. *Define endpoint or titer.*
 - c. *Evaluate serial dilutions, grading reactions and determine endpoint.*
 - d. *Name 3 tests in which finding the "titer" of an antibody is useful.*
 - e. *Describe proper "shaking for hemagglutination" technique and why it is important.*
 - f. *Define serial dilution.*
 - g. *Differentiate between antibody and antigen, including the location of each in blood.*
 - h. *Understand and complete serial dilution sequences mathematically.*

Course Content

A general description of lecture/discussion topics included in this course are listed in the Learning Objectives / Specific Course Objectives sections of this syllabus.

Methods of Instruction/Course Format/Delivery

This is a mainly online course so it will require a lot of outside proactive work by the student. The instructor will provide guidance as needed. The student will be evaluated by assignments, quizzes, cases, and exams as assigned by the instructor outside of the classroom. The student will be required to come to a Panola

College Testing Center to take all major examinations. Laboratories will take place on three pre-determined Saturdays during the semester and will be mandatory. During the laboratories the students will be evaluated by case studies, in-lab assignments, and lab practicals as assigned by the instructor.

Major Assignments/Assessments

The following items are assigned and assessed during the semester and used to calculate the student's final grade.

Course Grade

The grading scale for this course is as follows:

- Lecture Grade = 2/3 of grade
- Lab Grade = 1/3 of grade

Lecture

- Major Exams 40%
- Quizzes 20%
- Homework Assignments 20%
- Final Exam 20%

Laboratory

- Pre-Lab Quizzes 10%
- Post-Lab Quizzes 10%
- Case Assignments/Projects 10%
- In-Lab Assignments 40%
- Practicals 30%

Texts Materials, and Supplies

Clinical Immunology/Serology 5th Ed	Required	9780803694408	Miller, L.,Stevens, C.	F.A. Davis
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Other

- Courses conducted via video conferencing may be recorded and shared for instructional purposes by the instructor.
- For current texts and materials, use the following link to access bookstore listings: <https://www.panolacollegestore.com>.
- For testing services, use the following link: <https://www.panola.edu/student-services/student-support/academic-testing-center>.
- If any student in this class has special classroom or testing needs because of a physical learning or emotional condition, please contact the ADA Student Coordinator in Support Services located in the Charles C. Matthews Student Center or go to <https://www.panola.edu/student-services/student-support/disability-support-services> for more information.
- Withdrawing from a course is the student's responsibility. Students who do not attend class and who do not withdraw will receive the grade earned for the course.
- Student Handbook: <https://www.panola.edu/> (located on at the bottom under student)

SCANS Criteria

1. Foundation skills are defined in three areas: basic skills, thinking skills, and personal qualities.
 - a. Basic Skills: A worker must read, write, perform arithmetic and mathematical operations, listen, and speak effectively. These skills include:
 - i. Reading: locate, understand, and interpret written information in prose and in documents such as manuals, graphs, and schedules.
 - ii. Writing: communicate thoughts, ideas, information, and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.

- iii. Arithmetic and Mathematical Operations: perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
 - iv. Listening: receive, attend to, interpret, and respond to verbal messages and other cues.
 - v. Speaking: Organize ideas and communicate orally.
 - b. Thinking Skills: A worker must think creatively, make decisions, solve problems, visualize, know how to learn, and reason effectively. These skills include:
 - i. Creative Thinking: generate new ideas.
 - ii. Decision Making: specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternative.
 - iii. Problem Solving: recognize problems and devise and implement plan of action.
 - iv. Visualize ("Seeing Things in the Mind's Eye"): organize and process symbols, pictures, graphs, objects, and other information.
 - v. Knowing How to Learn: use efficient learning techniques to acquire and apply new knowledge and skills.
 - vi. Reasoning: discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.
 - c. Personal Qualities: A worker must display responsibility, self-esteem, sociability, self management, integrity, and honesty.
 - i. Responsibility: exert a high level of effort and persevere toward goal attainment.
 - ii. Self-Esteem: believe in one's own self-worth and maintain a positive view of oneself.
 - iii. Sociability: demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
 - iv. Self-Management: assess oneself accurately, set personal goals, monitor progress, and exhibit self-control.
 - v. Integrity and Honesty: choose ethical courses of action.
2. Workplace competencies are defined in five areas: resources, interpersonal skills, information, systems, and technology.
- a. Resources: A worker must identify, organize, plan, and allocate resources effectively.
 - i. Time: select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
 - ii. Money: Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
 - iii. Material and Facilities: Acquire, store, allocate, and use materials or space efficiently. Examples: construct a decision timeline chart; use computer software to plan a project; prepare a budget; conduct a cost/benefits analysis; design an RFP process; write a job description; develop a staffing plan.
 - b. Interpersonal Skills: A worker must work with others effectively.
 - i. Participate as a Member of a Team: contribute to group effort.
 - ii. Teach Others New Skills.
 - iii. Serve Clients/Customers: work to satisfy customer's expectations.
 - iv. Exercise Leadership: communicate ideas to justify position, persuade and convince others, responsibly challenge existing procedures and policies.
 - v. Negotiate: work toward agreements involving exchange of resources, resolve divergent interests.
 - vi. Work with Diversity: work well with men and women from diverse backgrounds. Examples: collaborate with a group member to solve a problem; work through a group conflict situation, train a colleague; deal with a dissatisfied customer in person; select and use appropriate leadership styles; use effective delegation techniques; conduct an individual or team negotiation; demonstrate an understanding of how people from different cultural backgrounds might behave in various situations.
 - c. Information: A worker must be able to acquire and use information.
 - i. Acquire and Evaluate Information.
 - ii. Organize and Maintain Information.
 - iii. Interpret and Communicate Information.

- iv. Use Computers to Process Information. Examples: research and collect data from various sources; develop a form to collect data; develop an inventory record-keeping system; produce a report using graphics; make an oral presentation using various media; use on-line computer databases to research a report; use a computer spreadsheet to develop a budget.
- d. Systems: A worker must understand complex interrelationships.
 - i. Understand Systems: know how social, organizational, and technological systems work and operate effectively with them.
 - ii. Monitor and Correct Performance: distinguish trends, predict impacts on system operations, diagnose deviations in systems' performance and correct malfunctions.
 - iii. Improve or Design Systems: suggest modifications to existing systems and develop new or alternative systems to improve performance. Examples: draw and interpret an organizational chart; develop a monitoring process; choose a situation needing improvement, break it down, examine it, propose an improvement, and implement it.
- e. Technology: A worker must be able to work with a variety of technologies.
 - i. Select Technology: choose procedures, tools or equipment including computers and related technologies.
 - ii. Apply Technologies to Task: understand overall intent and proper procedures for setup and operation of equipment.
 - iii. Maintain and Troubleshoot Equipment: Prevent, identify, or solve problems with equipment, including computers and other technologies. Examples: read equipment descriptions and technical specifications to select equipment to meet needs; set up and assemble appropriate equipment from instructions; read and follow directions for troubleshooting and repairing equipment.