



Course Syllabus

MLAB 2431- IMMUNOHEMATOLOGY

Revision Date: 8/19/2016

Catalog Description: A study of blood antigens and antibodies. Presents quality control, basic laboratory technique and safety. Includes the principles, procedures and clinical significance of test results in genetics, blood group systems, pre-transfusion testing, adverse effects of transfusions, donor selection and components, and hemolytic disease of the newborn.

Lecture hours = 4, Lab hours = 1

Prerequisites: MLAB 1415, MLAB 1235- Enrollment in this course and the Medical Laboratory Technology Program requires department head approval and successful completion of the admissions process. Students must be accepted into the MLT Program.

Semester Credit Hours: 4

Lecture Hours per Week: 4

Lab Hours per Week: 1

Contact Hours per Semester: 128

State Approval Code: 510040000

Instructional Goals and Purposes: The purpose of this course is to...

Learning Outcomes:

1. Apply principles of safety, quality assurance and quality control in Immunohematology.
2. Evaluate specimen acceptability.
3. Describe blood group genetics, characteristics of the blood group systems, and the principles of immunology as they relate to immunohematology.
4. List the requirements for the donation of blood; and describe the preparation, storage, and use of blood components.
5. Evaluate laboratory test results; select additional procedures to be performed; correlate test results with patient conditions; and describe the principles of and perform routine blood bank tests.

Specific Course Objectives (includes SCANS):

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

1. **Chapter 1 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv)**
 - a. Define the following terms in relation to the red blood cell (RBC) and transfusion: antigens, immunogens, epitopes, and antigenic determinants
 - b. Diagram the basic structure of an immunoglobulin G (IgG) molecule, and label the following components: heavy and light chains, Fab and Fc regions, variable region, hinge region, antigen-binding site, and macrophage-binding site
 - c. Compare and contrast immunoglobulin M (IgM) and IgG antibodies with regard to structure, function, and detection by agglutination reactions.
 - d. Discuss the role of cytokines in immune response.
 - e. Distinguish the primary and secondary immune responses with regard to immunoglobulin class, immune cells involved, level of response, response time, and antibody affinity

- f. List the variables in the agglutination test that affect sensitization and lattice formation
 - g. Accurately grade and interpret observed agglutination reactions using the agglutination grading scale for antigen–antibody reactions performed in test tubes
 - h. Compare the classical and alternative pathways of complement activation
 - i. Recognize hemolysis in an agglutination reaction and explain the significance
 - j. Using the principles of tissue matching, select the best potential graft given the human leukocyte antigen (HLA) typing and antibody specificities
 - k. Explain the role of HLA testing in platelet transfusion support and organ and hematopoietic progenitor cell (HPC) transplants
 - l. Define graft-versus-host (GVH) disease and select methods of prevention in transfusion and transplantation
2. **Chapter 2 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Describe the basic principles of routine testing in the immunohematology laboratory
 - b. Identify sources of antigen and antibody used in testing
 - c. List several routine tests performed in the immunohematology laboratory
 - d. Describe the relationship of potency and specificity to blood banking reagents
 - e. Compare and contrast polyclonal and monoclonal antibodies
 - f. Describe the reagents available for ABO typing
 - g. Describe the reagents available for D typing
 - h. Define the reagent control, and describe its purpose
 - i. Describe the different types and purposes of reagent red blood cells (RBCs)
 - j. Describe the basic principles of antiglobulin testing
 - k. Distinguish between direct and indirect antiglobulin tests (DATs and IATs)
 - l. Identify the indications for implementing DATs and IATs
 - m. Discuss the different sources of possible errors in the performance of antiglobulin testing
 - n. Compare and contrast the composition and appropriate uses of polyspecific and monospecific antiglobulin reagents
 - o. Discuss the role of potentiators in immunohematologic testing
 - p. Describe the functions of the following potentiators in immunohematologic testing: low-ionic-strength solution, bovine serum albumin, polyethylene glycol, and proteolytic enzymes
 - q. Describe the principles of gel technology, microplate techniques, and solid-phase RBC adherence techniques
3. **Chapter 3 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Define the term blood group system with regard to genetic terms
 - b. Differentiate phenotype from genotype
 - c. Explain and solve ABO and Rh blood type inheritance problems.
 - d. Define the following terms: gene, allele, haplotype, mitosis, meiosis and polymorphic.
 - e. Distinguish homozygous from heterozygous, and provide an example using blood group system alleles
 - f. Explain X-linked inheritance (Xg).
 - g. Define codominant, recessive, dominant inheritance.
 - h. Explain phenotype frequency and how it is used to find compatible red blood cell (RBC) units, be able to solve problems.
 - i. Explain the mendelian laws of independent assortment and independent segregation and how they apply to blood group antigen inheritance
 - j. Define the terms linkage and crossing over, and explain how they affect independent assortment
 - k. Define an amorphic gene
4. **Chapter 4 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Define a blood group system with regard to blood group antigens and their inheritance
 - b. Explain Landsteiner's rule
 - c. Define front type, reverse (or back) type.
 - d. Discuss the uses of Anti-A,B reagent.
 - e. Describe the formation of the H antigen from the gene product and its relationship to ABO antigen expression
 - f. Discuss the selection of whole blood, red blood cell, and plasma products for transfusions

- g. Discuss ABO incompatible transfusions and likely outcomes.
 - h. Determine the possible ABO genotypes with an ABO phenotype
 - i. Describe the ABO blood group system antibodies with regard to immunoglobulin class, clinical significance, and in vitro serologic reactions
 - j. Define the terms universal donor and universal recipient as they apply to RBC and plasma products
 - k. List the technical errors that may result in an ABO discrepancy
 - l. Define the acquired B antigen and B(A) phenotypes; discuss the ABO discrepancies that would result from these phenotypes and methods used in resolving these discrepancies
 - m. List reasons for missing or weakly expressed ABO antigens and the test methods used to resolve these discrepancies
 - n. Describe ABO discrepancies caused by extra reactions in serum testing and how they can be resolved
 - o. Discuss the Bombay phenotype with regard to genetic pathway, serologic reactions, and transfusion implications
5. **Chapter 5 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Explain how the D antigen was named Rh
 - b. Discuss the biochemistry of the Rh system, including the gene products and antigen structures
 - c. Predict the Rh genotype given a phenotype
 - d. Define weak D, and list the genetic circumstances that cause this phenotype
 - e. Explain the test for the weak D antigen and the importance of an appropriate control
 - f. Discuss the significance of testing for weak D antigen
 - g. Describe the inheritance and significance of the G antigen
 - h. Explain the significance of Rhnull, Rhmod, and deletion phenotypes
 - i. Describe the characteristics of the Rh system antibodies and their clinical significance with regard to transfusion and hemolytic disease of the fetus and newborn (HDFN)
6. **Chapter 6 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Identify the major antigens classified within the other blood group systems.
 - b. Predict the frequencies of the observed phenotypes and the association of phenotypes with ethnic group diversity.
 - c. Identify the Antibody type (IgG or IgM) associated with antibodies made to blood group antigens. Discuss the characteristics of these two classes of immunoglobulins as they relate to blood group antibodies.
 - d. Discuss heterozygous and homozygous genotypes as it relates to blood group system antigens.
 - e. Discuss the genetic mechanisms for antigen inheritance in each blood group system. Predict the null phenotypes associated with genetic variations.
 - f. Compare and contrast the serologic characteristics and clinical relevance of the antibodies associated with each blood group system.
 - g. Identify unique characteristics of selected blood group systems and their associations with disease- Kell, Kidd, Duffy, I.
 - h. Define dosage in blood group system antigens (homozygous/heterozygous).
 - i. Explain HDN and the blood group antibodies implicated.
 - j. Explain the significance of S,s, and U antigens/antibodies.
7. **Chapter 7 (1a-i, ii, iv, v. 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Define atypical or unexpected antibodies, and explain how they are formed.
 - b. Evaluate antibody screen and direct antiglobulin test (DAT) reactions to predict the most likely category of antibody problem.
 - c. Explain why patient information including transfusion or pregnancy history, age, race, and diagnosis helps in the process of antibody identification.
 - d. Describe the reagent red cell panel and antigram with regard to antigen configuration and ABO type.
 - e. Analyze the phase of reactions to determine the potential clinical significance and class of an antibody.
 - f. Correlate the reaction strength of an antibody to the dosage of an antigen and how it can be a clue to antibody resolution.

- g. Interpret panel reactions using the process of "ruling out."
 - h. Explain the "rule of three" with regard to antibody identification.
 - i. Differentiate warm autoantibody reactions from an antibody to a high-frequency antigen.
 - j. Discuss the purpose of IgG sensitized red cells (Coomb's control cells) added after a negative AHG phase.
 - k. Differentiate alloantibody and autoantibody.
 - l. Define cold antibody and give examples. Explain the process of identifying the specificity of a cold autoantibody and techniques to avoid cold autoantibody reactivity.
 - m. Define and identify low-incidence antigens.
8. **Chapter 8 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv)**
- a. Define compatibility testing and crossmatching.
 - b. List the procedures included in the routine compatibility test, and explain their purpose.
 - c. Discuss the selection of donor blood given in an emergency situation.
 - d. Discuss the selection of crossmatch-compatible whole blood, red blood cells (RBCs), plasma, platelets, and cryoprecipitate for transfusion.
 - e. Discuss strategies for transfusion when compatible blood cannot be located.
 - f. Identify the donor types that are compatible with each blood type, including which are "preferred."
 - g. Describe how crossmatching is handled in the massive transfusion situation.
 - h. List the components (that go in the tubes) to perform: major crossmatch, minor crossmatch, antibody screen, antibody panel, ABO type.
 - i. Explain how immediate-spin (IS) crossmatching and antiglobulin crossmatching are performed and when they would be performed.
 - j. Explain the elements of patient identification and their importance in compatibility testing.
 - k. Explain how compatibility testing is carried out for an infant younger than 4 months.
 - l. Discuss the principles of autologous blood crossmatching
9. **Chapter 9 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv)**
- a. Compare and contrast the forces driving the move to automation in the transfusion service.
 - b. Identify the potential benefits and challenges associated with a change to automation.
 - c. Define the characteristics of positive and negative reactions with the MTS system (pg 220-222) as compared to the traditional tube method.
 - d. Compare and contrast gel technology and solid- phase red cell adherence (SPRCA) assays
10. **Chapter 10 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv)**
- a. List common signs and symptoms of adverse transfusion reactions
 - b. Discuss the mechanisms that can cause immune- and nonimmune-mediated red blood cell (RBC) destruction.
 - c. Compare and contrast the distinguishing features of the following transfusion reactions: febrile, urticarial, and anaphylactic reactions; transfusion-related acute lung injury; and transfusion-associated graft-versus-host (GVH) disease.
 - d. Discuss the causes and clinical features of the bacterial contamination of blood products.
 - e. Describe the clinical features and patients at risk for a transfusion reaction caused by circulatory overload.
 - f. Describe the mechanisms and prevention of transfusion hemosiderosis, citrate toxicity, and posttransfusion purpura.
 - g. Provide direction to medical personnel performing the transfusion in the event of a reported adverse reaction.
 - h. List the initial tests performed in the transfusion service on receipt of a patient's sample after a reaction.
 - i. Identify additional tests that might be required in the investigation of transfusion reactions, and state the rationale for selecting these tests.
 - j. Describe the required documentation and reporting in the investigation of a transfusion reaction.
 - k. Discuss the selection of blood product for patients with a history of febrile nonhemolytic transfusion reactions.
11. **Chapter 11 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv)**
- a. Discuss the cause of hemolytic disease of the fetus and newborn (HDFN).

- b. Discuss ABO typing of cord blood and newborns (younger than 6 months).
 - c. Distinguish clinically significant and insignificant antibodies in terms of causing HDFN.
 - d. Outline the procedures used in the diagnosis and management of HDFN.
 - e. List the tests routinely performed on cord blood cells when HDFN is suspected.
 - f. Compare and contrast the clinical and laboratory findings in ABO HDFN versus HDFN caused by anti-D antibody.
 - g. Discuss the composition, eligibility criteria, and principle of Rh immune globulin (RhIG).
 - h. Explain the principle and significance of a positive rosette test for fetomaternal hemorrhage.
 - i. Outline the principle, interpretation, and significance of Kleihauer-Betke test.
 - j. Evaluate laboratory test results for postpartum samples, and determine if RhIG should be administered.
 - k. Calculate the dose of RhIG given the fetomaternal hemorrhage results.
 - l. List the purpose of intrauterine exchange transfusion.
12. **Chapter 12 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Describe the required donor registration information and why it is necessary.
 - b. Explain the importance and discuss the content of the blood donor educational materials.
 - c. Compare the donor medical history criteria intended for protecting the donor with questions that protect the recipient.
 - d. Analyze health history examples that could cause a permanent, indefinite, or temporary deferral.
 - e. List the physical examination criteria for allogeneic blood donation.
 - f. Determine the eligibility status of donors when common medications and recent vaccines are part of the donor history.
 - g. Select eligible donors, and identify donors for deferral.
 - h. Compare and contrast allogeneic and autologous donor criteria.
 - i. List various forms of autologous donations.
 - j. Describe the apheresis procedure, the products that can be collected, and the donor requirements for each.
 - k. Discuss the reason for directed donation and the donor criteria for this procedure.
 - l. Define therapeutic phlebotomy, and state the conditions for which it is used.
13. **Chapter 13 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. List the required tests performed on allogeneic and autologous donor blood.
 - b. Describe the principle of nucleic acid testing for donor blood samples.
 - c. Compare and contrast test sensitivity with test specificity.
 - d. Discuss the theory and evaluate the Western blot test as a confirmatory test.
 - e. Describe when cytomegalovirus (CMV) screening is performed.
 - f. State the frequency of positive tests on blood donated for allogeneic transfusion.
 - g. Define look-back investigation and the Food and Drug Administration (FDA) requirements with regard to hepatitis C virus (HCV) and human immunodeficiency virus (HIV) testing on blood donors.
 - h. State the reason for performing bacterial detection tests on plateletpheresis products.
14. **Chapter 14 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Compare the anticoagulant and preservative solutions with regard to expiration and content.
 - b. Given certain patient clinical conditions, state the blood component most appropriate for their transfusion needs.
 - c. State the storage temperature and storage limits for each blood component.
 - d. Explain the intent and activities of the FDA in regulating blood component preparation, storage, and distribution.
 - e. Discuss the importance of monitored storage equipment for blood components and the alarm requirements.
 - f. Describe essential aspects of safe blood administration
15. **Chapter 15 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2c-i, ii, iii, iv)**
- a. Describe the pathophysiology of acute blood loss and massive transfusion therapy.
 - b. Discuss the causes of bleeding during cardiac surgery.
 - c. Describe the unique hematologic problems and transfusion therapy issues associated with neonates.

- d. Discuss the pathophysiology and transfusion needs of patients with sickle cell disease, thalassemia, and autoimmune disease.
 - e. Explain the transfusion requirements of oncology patients.
 - f. List the acquired and congenital disorders of hemostasis and the appropriate transfusion support for each type of disorder.
 - g. Discuss the transfusion issues unique to chronic renal disease patients and how the use of erythropoietin affects the need for red blood cell (RBC) transfusions.
 - h. List several alternatives for transfusion of blood products and their application in coagulation-deficient, trauma (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2c-i, ii, iii, iv) and oncology patients.
16. **Chapter 16**
- a. Define and list the elements of good manufacturing practices.
 - b. Describe regulatory agencies that govern activities in the blood bank, and apply their regulations.
 - c. Differentiate quality assurance (QA) from quality control.
 - d. Discuss the importance of job descriptions and personnel qualifications.
 - e. Compare and contrast proficiency and competency testing.
 - f. Compare and contrast good record keeping with poor record keeping.
 - g. Describe the elements of a good training program.
 - h. Give examples of methods used to evaluate competency.
 - i. Define calibration, preventive maintenance, quality control, quality assurance, audit trail.
 - j. Define and describe the purpose behind root-cause analysis in error management.
 - k. Describe blood bank (and general lab) safety:
 - i. Waste disposal
 - ii. Standard & Universal precautions
 - iii. Safety Equipment
 - iv. Protective Devices (PPE)
 - v. Accident reports
 - vi. Employee Education
17. **Lab #1 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2b-i, ii, iv, v, vi, 2c-i, ii, iii, iv)**
- a. Interpret blood type tube reactions as positive or negative based on agglutination and grade as negative (0), 1+, 2+, 3+, 4+.
 - b. Explain the purpose of the Rh control and what a positive Rh control means.
 - c. Use tube grading of blood typing tubes to interpret the ABO and Rh blood type (forward and reverse).
 - d. Discuss ABO blood type frequency in the U.S. (most common, least common).
 - e. Explain the logic behind all Anti-A reagents being blue, and all Anti-B reagents being yellow.
 - f. Using models be able to create and interpret all of the blood types -showing correct antigens (or lack of) on the red cells and correct antibodies (or lack of) in the serum.
 - g. Define naturally occurring ABO antibodies. List the naturally occurring ABO antibodies in humans.
 - h. Define front type and reverse type. What is the purpose of doing both?
 - i. Explain the procedure to perform an ABO blood type using the tube method.
18. **Lab #2 (1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi, 1c-i, ii, iv, 2a-i, 2b-i, ii, iv, v, vi, 2c-i, ii, iii, iv)**
- a. Discuss the different ways that an individual can be exposed to a blood group antigen and develop an antibody.
 - b. Discuss the purpose of Coomb's Control Cells (also called check cells). Explain the meaning of negative check cells at the end of an AHG test.
 - c. List the three tests that are done when a "Type & Screen" is ordered.
 - d. List the three phases that are required in the Indirect Antibody Test (IAT)/Antibody Screen.
 - e. List the color that manufacturer's add to the anti-AHG reagent and the reason for coloring the reagent.
 - f. Define antigram.
 - g. Define "autocontrol" in blood bank testing.

- h. Name the CLASS of Immunoglobulin (Ig)/Antibodies that are "clinically significant" in blood banking (meaning the class that will cause hemolytic transfusion reactions and/or hemolytic disease of the newborn).
19. **Lab #3(1a-i, ii, iv, v, 1b-ii, iii, iv, v, vi. 1c-i, ii, iv. 2a-i. 2b-i, ii, iv, v, vi. 2c-i, ii, iii, iv)**
- a.

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.

Students in all sections of this course will be required to do the following:

1. Lecture Assignments
2. Lecture Quizzes
3. Lecture Exams
4. Lecture Final Exam
5. Laboratory Pre-lab Quizzes
6. In-Lab Activities
7. Post-lab Assignments
8. Laboratory Practicals

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 and quizzes 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 will be assigned and assessed during the semester and used to calculate the student's final grade.

Assignments

1. Assignments Chapters 1-16
2. Assignments Quizzes 1-16
3. Pre-lab Quizzes 1-3
4. In-lab assignments – 4 assignments
5. Post-lab assignments- 4 assignments

Assessment(s):

1. Lecture Exams 1-3
2. Final Exam
3. Lab Practicals 1-3

Course Grade:

The grading scale for this course is as follows:

- **Lecture- 2/3 of Final Grade**
 - Major Exams 50%
 - Quizzes 15%
 - Homework Assignments 20%
 - Final Exam 15%

- **Laboratory- 1/3 of Final Grade**
 - Pre-Lab Quizzes 10%
 - Case Assignments 20%
 - In-Lab Assignments 20%
 - Practicals 50%

Texts, Materials, and Supplies:

- Blaney, Kathy D. and Howard, Paula R. (2013). *Basic & Applied Concepts of Blood Banking and Transfusion Practices, 3rd ed.* St. Louis: Elsevier.
- White lab coat

Required Readings:

- Course textbook
- All information given in Canvas

Recommended Readings:

- Medical Dictionary (reference).

Other:

- For current texts and materials, use the following link to access bookstore listings: <http://www.panolacollegestore.com>
- For testing services, use the following link: <http://www.panola.edu/elearning/testing.html>
- 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 Administration Building or go to <http://www.panola.edu/student-success/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, *The Pathfinder*: <http://www.panola.edu/student-success/documents/pathfinder.pdf>

More Information:

Laboratory Dress Code

The student will be expected to attend class clean and neatly dressed in long pants or scrubs and wear closed-toe shoes. A laboratory coat will must be worn snapped or buttoned up during all laboratory sessions. Hair that is shoulder length or longer must be worn up or securely tied back. Gloves must be worn when handling biological materials.

Behavioral Conduct

While a student is representing Panola College as a Medical Laboratory Technology student, they will be expected to conduct themselves in such a manner as to reflect favorably on themselves and on the Program. If a student acts in such a manner as to reflect immature judgment or disrespect for others, the student will be called before the MLT Department Chair for determination of their status in the Program. Inappropriate conduct is grounds discipline and may be cause for immediate probation or dismissal from the Program.

Academic Dishonesty

Under no circumstances shall a student submit work that is not their own. Copying answers for study questions, cheating on exams and/or submitting laboratory results which are not your own are expressly prohibited.

Time Commitment

According to "Hints on How to Succeed in College Classes"

<http://tinyurl.com/3dqegz> you should budget your time per week for this four hour credit course as follows:

1. Reading assigned text 2 to 3 hours
2. Homework assignments 3 to 6 hours
3. Time for review and test preparation 3 hours
4. Total study time per week 8 to 12 hours PER WEEK

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 time line 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 data bases 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.