



Western Technical College

10513120 Basic Hematology

Course Outcome Summary

Course Information

Description	This course covers the theory and principles of blood cell production and function, and introduces you to basic practices and procedures in the hematology laboratory.
Career Cluster	Health Science
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	108

Pre/Corequisites

Prerequisite 10513114 Urinalysis

Textbooks

Clinical Laboratory Hematology. 4th Edition. Copyright 2020. McKenzie, Shirlyn B., Landis-Piwowar, Kristin, and Williams, Lynne. Publisher: Pearson. **ISBN-13**: 978-0-13-470936-9. Required.

Heme Notes: Pocket Atlas of Cell Morphology. Copyright 2014. Harmening, Denise M. Publisher: F. A. Davis Co. **ISBN-13**: 978-0-8036-1902-9. Required.

Learner Supplies

Lab Coat - \$20. **Vendor**: Campus Shop. Required.

Safety Glasses. **Vendor**: Campus Shop. Required.

Sharpie Permanent Marker - Black. **Vendor:** Campus Shop. Required.

Three-ring binder. **Vendor:** Campus Shop. Required.

Western Red Program Patch. **Vendor:** Campus Shop. Required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Expand a Growth-Mindset
3. Cultivate Passion: Increase Self-Awareness
4. Live Responsibly: Develop Resilience
5. Refine Professionalism: Improve Critical Thinking

High Impact Practices

1. Work-Based Learning: this course applies your learning to your desired profession by working in industry placements such as internships, practicums, clinicals, or co-ops.

Program Outcomes

1. Practice laboratory safety and regulatory compliance
2. Collect and process biological specimens
3. Monitor and evaluate quality control in the laboratory
4. Apply modern clinical methodologies including problem solving and troubleshooting according to predetermined criteria
5. Correlate laboratory results to diagnosis of clinical conditions and/or diseases
6. Perform information processing in the clinical laboratory
7. Model professional behaviors, ethics, and appearance

Course Competencies

1. Diagram the structure of a cell.

Assessment Strategies

- 1.1. by developing a diagram of a hypothetical cell

Criteria

You will know you are successful when:

- 1.1. you identify all of the parts of a cell.
- 1.2. you describe the function of each cellular component.

Learning Objectives

- 1.a. Describe the chemical composition and general function of cellular membranes
- 1.b. Explain the general membrane activities of passive and facilitated diffusion, active transport, osmosis and endocytosis
- 1.c. Describe the structure and function of each of the cytoplasmic organelles found in a typical mammalian cell

- 1.d. Describe the features of the nucleus
- 1.e. Relate the nuclear structures to the cellular activities that are associated with the nucleus
- 1.f. Describe the processes of mitosis and meiosis

2. Summarize basic principles of platelet production and function.

Assessment Strategies

- 2.1. by developing a diagram of the platelet production process

Criteria

You will know you are successful when:

- 2.1. you describe platelet maturation cycles.
- 2.2. you identify stages of maturation.
- 2.3. you describe general platelet functions.

Learning Objectives

- 2.a. Explain the origin of blood cells
- 2.b. Trace the sequential sites of cellular proliferation and development
- 2.c. Name the bones that participate in active hematopoiesis in adults
- 2.d. Identify the function of the hematopoietic growth factors
- 2.e. Describe where in the body platelets are produced
- 2.f. List and explain functions of thrombopoietin or thrombopoietin like cytokines
- 2.g. Describe the process of formation of platelets from a megakaryoblast to a mature thrombocyte
- 2.h. Describe the length of time for each step of maturation
- 2.i. Describe 2 overall features that are important in platelet identification

3. Summarize production and function of each white blood cell type.

Assessment Strategies

- 3.1. Project

Criteria

You will know you are successful when:

- 3.1. you describe white blood cell maturation cycles.
- 3.2. you identify stages of maturation.
- 3.3. you describe general white blood cell functions.

Learning Objectives

- 3.a. Describe the process of hematopoiesis as it relates to WBC production
- 3.b. Identify the five different WBC types
- 3.c. Describe the cellular characteristics of the five common leukocyte types in normal peripheral blood.
- 3.d. List where WBC production occurs in the body for each type of WBC.
- 3.e. List the name of each cell type in the maturation process for granulocytes, monocytes, and lymphocytes.
- 3.f. Describe factors that influence WBC maturation.
- 3.g. Identify the length of time for each step of WBC maturation for granulocytes, monocytes, and lymphocytes.
- 3.h. Identify the average percentage of each of the five common leukocyte types.
- 3.i. List each type of immature neutrophil found in the proliferative and storage compartment of the bone marrow along with the length of time and percentage of each.
- 3.j. Identify the contents of granules in granulocytes and how they influence function.
- 3.k. Describe the step by step process of phagocytosis.
- 3.l. Name the two primary and three secondary lymphoid tissues.
- 3.m. Identify the anatomical sites populated by T lymphocytes and B lymphocytes.
- 3.n. State the percentage of T and B lymphocytes found in the peripheral blood of adults.
- 3.o. Describe the pathway and characteristics of plasma cell development.
- 3.p. Describe the role of neutrophils, monocytes, eosinophils, basophils, lymphocytes, and plasma cells play in fighting disease in the human body.
- 3.q. Describe the major function of T, B, and NK lymphocytes.
- 3.r. State the major type and percentage of leukocytes found in 6 month old infants.

4. Summarize the production and function of red blood cells.

Assessment Strategies

4.1. Project

Criteria

You will know you are successful when:

- 4.1. you describe red blood cell maturation cycles.
- 4.2. you identify stages of maturation.
- 4.3. you describe general red blood cell functions.

Learning Objectives

- 4.a. State the normal lifespan of an erythropoiesis.
- 4.b. Name the sites of erythropoiesis from the early embryonic stage of development until fully established in adults.
- 4.c. List the substances needed for proper erythropoiesis.
- 4.d. Identify the site of erythropoietin production.
- 4.e. Describe the normal condition that stimulates the production of erythropoietin.
- 4.f. Identify the stages of RBC maturation.
- 4.g. Describe the normal percentage of reticulocytes in circulation.
- 4.h. State the function of hemoglobin.
- 4.i. List the structural components of normal hemoglobin.
- 4.j. Describe the synthesis of hemoglobin.
- 4.k. List the embryonic hemoglobins.
- 4.l. List the globin chains found in HbA, HbA₂, and HbF, along with their respective concentration (%) found in vivo.
- 4.m. Describe the formation of glycosylated hemoglobin in normal and hyperglycemic individuals.
- 4.n. Explain the role of 2,3 DPG oxygenation of the hemoglobin molecule.
- 4.o. Define "shift to the left" and "shift to the right" in relation to the hemoglobin oxygen dissociation curve.
- 4.p. Explain the importance of enzymes in cellular reactions.
- 4.q. Describe the function of the three pathways involved in energy generation of a RBC.
- 4.r. Explain how RBCs are removed from circulation at the end of their lifespan.

5. Perform normal blood smear review and cell identification.

Assessment Strategies

- 5.1. by completing a blood smear evaluation report

Criteria

You will know you are successful when:

- 5.1. you estimate platelets that agree with assayed value.
- 5.2. you estimate WBC that agrees with assayed value.
- 5.3. you describe RBC morphology that agrees with assayed value.
- 5.4. you include WBC differential results that are within 95% confidence limits.
- 5.5. you describe information relevant to a complete and concise report.
- 5.6. you report on proper sample identification.
- 5.7. you report results with proper units.

Learning Objectives

- 5.a. Familiarize self with microscope and proper usage
- 5.b. Describe normal RBC morphology on a wright stained peripheral blood smear
- 5.c. Identify variations in RBC size, shape and color that can be seen in an erythrocyte on a wright stained peripheral blood smear
- 5.d. Describe the grading system used to describe RBC abnormalities on a peripheral blood smear
- 5.e. Classify the 5 different types of WBCs on a wright stained peripheral blood smear
- 5.f. Identify platelets on a wright stained peripheral blood smear
- 5.g. Perform a platelet estimate on a wright stained peripheral blood smear

6. Perform hematology calculations.

Assessment Strategies

- 6.1. Product

Criteria

You will know you are successful when:

- 6.1. you calculate RBC indices.
- 6.2. you calculate absolute WBC counts.
- 6.3. you complete reticulocyte calculations.
- 6.4. you calculate nucleated RBC corrections.
- 6.5. you calculate dilutions.
- 6.6. you complete hemacytometer calculations.
- 6.7. you identify the problem statement for each calculation type.
- 6.8. you perform calculations systematically.
- 6.9. you employ mathematical reasoning.
- 6.10. you provide answers with clearly labeled units of measurement.
- 6.11. you write solutions using appropriate significant digits.
- 6.12. you represent the solution (diagram, model, picture, drawing, ect.) where appropriate.

Learning Objectives

- 6.a. State the normal range of RBC indices
- 6.b. Describe the relationship of RBC indices to the appearance of RBCs
- 6.c. Describe situations when calculations to correct for the presence of nucleated RBCs are necessary
- 6.d. List normal ranges for WBC counts
- 6.e. Describe situations when a manual WBC count may be performed
- 6.f. List normal ranges for platelet counts
- 6.g. Describe situations when a manual platelet count may be performed
- 6.h. List normal ranges for reticulocyte counts

7. Perform blood smear preparation and staining.

Assessment Strategies

- 7.1. by preparing a stained blood smear
- 7.2. by evaluating the quality of a stained blood smear
- 7.3. by writing a summary of the staining procedure

Criteria

You will know you are successful when:

- 7.1. you perform all critical steps in the right order.
- 7.2. you organize work area.
- 7.3. you wear personal protective equipment.
- 7.4. you follow infection prevention and safety procedures.
- 7.5. you provide an explanation of the process as you perform it.
- 7.6. you present sound reasoning as you describe the decisions you make throughout the process.
- 7.7. you prepare blood smear according to NCCLS criteria.
- 7.8. you label the blood smear properly.
- 7.9. you stain the blood smear properly.
- 7.10. you perform blood smear that shows no artifacts.
- 7.11. you troubleshoot slide and stain quality and take appropriate action.
- 7.12. you summarize staining principles.
- 7.13. you summarize limitations of procedure.

Learning Objectives

- 7.a. List characteristics of a properly prepared peripheral blood smear
- 7.b. List characteristics of an improperly prepared peripheral blood smear
- 7.c. List different available staining methods for a peripheral blood smear
- 7.d. Correlate correct staining procedure with color of cells
- 7.e. Describe problems that can occur in blood staining
- 7.f. List ways to correct problems
- 7.g. Describe the appearance of artifacts on a peripheral blood smear

8. Perform hemacytometer cell counts.

Assessment Strategies

- 8.1. by analyzing a specimen
- 8.2. by completing a WBC and platelet count lab report

- 8.3. by preparing a summary of each laboratory procedure

Criteria

You will know you are successful when:

- 8.1. you perform all critical steps in the right order.
- 8.2. you organize work area.
- 8.3. you wear personal protective equipment.
- 8.4. you follow infection prevention and safety procedures.
- 8.5. you describe cell count that agrees with determined value.
- 8.6. you report proper sample identification.
- 8.7. you report results with proper units.
- 8.8. you summarize principle of procedures.
- 8.9. you summarize clinical applications.
- 8.10. you summarize specimen requirements.
- 8.11. you include reference intervals in summary.
- 8.12. you summarize limitations of procedures.

Learning Objectives

- 8.a. Characterize the appearance of WBC using phase contrast microscopy.
- 8.b. Describe reagents used in a manual WBC count.
- 8.c. List dilutions used in a manual WBC count.
- 8.d. Characterize the appearance of a platelet using phase contrast microscopy.
- 8.e. Describe reagents used in a manual platelet count.
- 8.f. List dilutions used in a manual platelet count.
- 8.g. Characterize errors that can occur in manual counts.

9. Perform basic hematology procedures, including hematocrit, hemoglobin, ESR, and reticulocyte count.

Assessment Strategies

- 9.1. by analyzing a specimen for each of the laboratory procedures
- 9.2. by completing lab reports for each of the laboratory procedures
- 9.3. by preparing a summary of each of the laboratory procedures

Criteria

You will know you are successful when:

- 9.1. you perform all critical steps in the right order.
- 9.2. you organize work area.
- 9.3. you wear personal protective equipment.
- 9.4. you follow infection prevention and safety procedures
- 9.5. you provide an explanation of the process as you perform it.
- 9.6. you present sound reasoning as you describe the decisions you make throughout the process.
- 9.7. you report results that agree with assayed values.
- 9.8. you identify the sample.
- 9.9. you report results with proper units.
- 9.10. you summarize principle of procedures.
- 9.11. you summarize clinical application.
- 9.12. you summarize specimen requirements.
- 9.13. you include reference intervals in your summary.
- 9.14. you describe limitations of procedures.

Learning Objectives

- 9.a. Describe the proper type of specimen collection and handling for the stated procedure
- 9.b. Describe sources of error in the stated procedure
- 9.c. Describe the clinical application of the stated procedure
- 9.d. Describe the manual hematocrit procedure including application and sources of error
- 9.e. List normal hematocrit ranges for males and females
- 9.f. List normal hematocrit ranges for males and females
- 9.g. List normal hemoglobin ranges for males and females
- 9.h. Describe different erythrocyte sedimentation (ESR) procedures
- 9.i. List RBC and physical factors that influence ESR results

9.j. Describe different procedures for measuring reticulocytes including stains and normal ranges

10. Operate hematology analyzer.

Assessment Strategies

10.1. Oral, Written and/or Skill Assessment

Criteria

You will know you are successful when:

- 10.1. you perform all critical steps in the right order.
- 10.2. you organize work area.
- 10.3. you wear personal protective equipment.
- 10.4. you follow safety and infection prevention procedures.
- 10.5. you evaluate specimen integrity.
- 10.6. you troubleshoot instrument problems and take appropriate action.
- 10.7. you maintain appropriate records relating to instrument operation.
- 10.8. you identify the sample.
- 10.9. you describe different methodologies of hematology analyzers.

Learning Objectives

- 10.a. Identify universal precautions
- 10.b. Describe proper specimen and integrity used for analysis by an automated hematology analyzer
- 10.c. List the parameters measured by basic benchtop hematology analyzers
- 10.d. Describe the methods used to measure the basic parameters
- 10.e. Name the parameters measured by total cell counting systems
- 10.f. Describe reagents used by a basic benchtop hematology analyzer
- 10.g. Describe the basic theory of electrical impedance principle of cell counting and sizing.
- 10.h. Describe the basic theory of the optical detection principle of cell counting and sizing.
- 10.i. Explain the fundamental concepts of laser technology.
- 10.j. Describe the principles of flow cytometry.

11. Interpret hematology analyzer data.

Assessment Strategies

11.1. by preparing a written graphic analysis of hematology analyzer data

Criteria

You will know you are successful when:

- 11.1. you provide comparison to normal values.
- 11.2. you perform histogram evaluation.
- 11.3. you identify and explain possible causes for inappropriate and erroneous values.
- 11.4. you describe possible actions for correcting inappropriate and erroneous values.

Learning Objectives

- 11.a. Describe the process and output of automated hematology cell counters
- 11.b. Describe characteristics of histograms
- 11.c. Describe the appearance of microcytic and macrocytic erythrocytes on a histogram
- 11.d. Explain how the RDW is calculated and give the normal range
- 11.e. Describe the relationship of the RDW to the MCV
- 11.f. Describe the appearance of a leukocyte histogram generated by different automated hematology instrumentation
- 11.g. Describe the appearance of a platelet histogram
- 11.h. Explain how the MPV is calculated
- 11.i. Compare the relationship between MPV and the platelet count
- 11.j. Describe the interpretation of scattergrams generated by different automated hematology instrumentation

12. Perform quality control procedures.

Assessment Strategies

12.1. by preparing a quality control report

Criteria

You will know you are successful when:

- 12.1. you discuss QC results.
- 12.2. you interpret QC data.
- 12.3. you suggest possible corrective actions for QC problems.

Learning Objectives

- 12.a. Identify vocabulary related to quality control and quality assurance
- 12.b. Describe the contents of the laboratory procedures manual
- 12.c. List and explain essential nonanalytical factors in quality assurance
- 12.d. Name the functions of a quantitative quality control program
- 12.e. Describe the use of a Levy-Jennings quality control chart
- 12.f. Describe types of changes that can be observed in a quality control chart
- 12.g. Describe proficiency testing