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| **Essential Understandings** | * Blood serves as a vehicle for distributing body heat and for transporting nutrients, respiratory gases, and other substances throughout the body
* Blood contains plasma and several formed elements that have various functions in the body.
* Blood has the ability to clot.
* Blood is categorized into ABO and Rh groups to aid the process of transfusions.
* Blood disorders can occur in individuals in every age group.
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| **Essential****Questions** | * What is the composition of blood plasma and how does it function in the body?
* What is the function of red blood cells, white blood cells, and platelets in the blood?
* How does blood clot?
* How are ABO and Rh blood groups determined and how is blood typing used to for the purposes of performing blood transfusions?
* What blood disorders can occur?
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| **Essential Knowledge** | * Blood plasma is 90% water and over 100 different substances are dissolved in it.
* Red blood cells contain hemoglobin that carries oxygen.
* Disorders of the RBCs include anemia, sickle cell anemia, and polycythemia.
* White blood cells are the army of the immune system and they include neutrophils, eosinophils, basophils, lymphocytes, and monocytes.
* WBC disorders include leukemia and leukopenia.
* Hemostasis is regulated by a variety of blood proteins and enzymes in the blood.
* Hemolysis can occur if a recipient gets an incorrect blood transfusion.
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| **Vocabulary** | Plasma proteinsAlbuminAcidosisAlkalosisErythrocytes or red blood cells (RBCs)HematocritHemoglobinAnemiaSickle cell anemia (SCA)Sickle cell trait (SCT)PolycythemiaLeukocytes or white blood cells (WBCs)Buffy coatDiapedesisPositive chemotaxisAmeboid motionLeukocytosisLeucopeniaLeukemiaGranulocytesNeutrophilsEosinophilsBasophilsHistamineAgranulocytesLymphocytesMonocytesPlateletsMegakaryocytesHematopoiesisMyeloid tissueHemocytoblastLymphoid stem cellMyeloid stem cellReticulocyteErythropoietinColony stimulating factors (CSFs)InterleukinsThrombopoietinHemostasisVascular spasmsPlatlet plug formationCoagulation/blood clottingTissue factor (TF)PFProthrombin activatorProthrombinThrombinFibrinogenFibrinSerumThrombusEmbolusThrombocytopeniaPetechiaeHemophiliaAntigenAntibodies/agglutininsAgglutinationABO blood groups Rh blood groupsHemolysisRhoGAMHemolytic disease of the newbornPhysiologic jaundice |
| **Essential** **Skills** | * Describe the physical characteristics of blood plasma
* Describe the characteristics of red blood cells and disorders associated with them.
* Recognize the five types of white blood cells and disorder associated with white blood cells.
* Explain how blood clots.
* Explain who ABO and Rh factors are used to determine blood transfusions.
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| **Related****Maine Learning****Results** | ScienceA. Unifying Themes A1.Systems Students apply an understanding of systems to explain and  analyze man-made and natural phenomena. a. Analyze a system using the principles of boundaries,  subsystems, inputs, outputs, feedback, or thesystem’srelation to other systems and design solutions to a systemproblem. b. Explain and provide examples that illustrate how it may not  always be possible to predict the impact of changing some  part of a man-made or natural system. A3.Constancy and Change Students identify and analyze examples of constancy and change that result from varying types and rates of change in physical,  biological, and technological systems with and without counterbalances.B. The Skills and Traits of Scientific Inquiry and Technological Design B1.Skills and Traits of Scientific InquiryStudents methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis.1. Identify questions, concepts, and testable hypotheses that guide scientific investigations.
2. Design and safely conduct methodical scientific investigations, including experiments with controls.
3. Use statistics to summarize, describe, analyze, and interpret results.
4. Formulate and revise scientific investigations and models using logic and evidence.
5. Use a variety of tools and technologies to improve investigations and communications.
6. Recognize and analyze alternative explanations and models using scientific criteria.
7. Communicate and defend scientific ideas.

 B2.Skills and Traits of Technological DesignStudents use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs.1. Identify new problems or a current design in need of improvement.
2. Generate alternative design solutions.
3. Select the design that best meets established criteria.
4. Use models and simulations as prototypes in the design planning process.
5. Implement the proposed design solution.
6. Evaluate the solution to a design problem and the consequences of that solution.
7. Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations.

C. The Scientific and Technological Enterprise C1.Understandings of InquiryStudents describe key aspects of scientific investigations: that they are guided by scientific principles and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly.1. Describe how hypotheses and past and present knowledge guide and influence scientific investigations.
2. Describe how scientists defend their evidence and explanations using logical argument and verifiable results.

C2.Understanings About Science and TechnologyStudents explain how the relationship between scientific inquiry and technological design influences the advancement of ideas, products, and systems.1. Provide an example that shows how science advances with the introduction of new technologies and how solving technological problems often impacts new scientific knowledge.
2. Provide examples of how creativity, imagination, and a good knowledge base are required to advance scientific ideas and technological design.

C3.Science, Technology, and SocietyStudents describe the role of science and technology in creating and solving contemporary issues and challenges.b. Explain how ethical, societal, political, economic, and cultural factors influence personal health, safety, and the quality of the environment. 1. Explain how ethical, societal, political, economic, religious,

and cultural factors influence the development and use of science and technology.C4.History and Nature of ScienceStudents describe the human dimensions and traditions of science, the nature of scientific knowledge, and historical episodes in science that impacted science and society.1. Describe the ethical traditions in science including peer review, truthful reporting, and making results public.
2. Select and describe one of the major episodes in the history of science including how the scientific knowledge changed over time and any important effects on science and society.
3. Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists.
4. Provide examples of criteria that distinguish scientific explanations from pseudoscientific ones.

D. The Physical Setting D2.EarthStudents describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems.c. Describe and analyze the effects of biological and  geophysical influences on the origin and changing nature of  Earth Systems.d. Describe and analyze the effects of human influences on Earth Systems.D3.Matter and EnergyStudents describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. h. Describe radioactive decay and half-life.E. The Living Environment E1.BiodiversityStudents describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity.1. Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment.
2. Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species.
3. Analyze the relatedness among organisms using structural and molecular evidence.
4. Analyze the effects of changes in biodiversity and predict possible consequences.

E2.EcosystemsStudents describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change.1. Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate.
2. Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations.

E3.CellsStudents describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals.a. Describe the similarities and differences in the basic  functions of cell membranes and of the specialized parts  within cells that allow them to transport materials, capture  and release energy, build proteins, dispose of waste,  communicate, and move. b. Describe the relationship among DNA, protein molecules,  and amino acids in carrying out the work of cells and how this  is similar among all organisms. c. Describe the interactions that lead to cell growth and division  (mitosis) and allow new cells to carry the same information as  the original cell (meiosis). d. Describe ways in which cells can malfunction and put an  organism at risk.e. Describe the role of regulation and the processes that  maintain an internal environment amidst changes in the  external environment.f. Describe the process of metabolism that allows a few key  biomolecules to provide cells with necessary materials to  perform their functions.g. Describe how cells differentiate to form specialized systems for carrying out life functions. E4.Heredity and ReproductionStudents examine the role of DNA in transferring traits from generation to generation, in differentiating cells, and in evolving new species.c. Explain how the instructions in DNA that lead to cell  differentiation result in varied cell functions in the organism  and DNA. d. Describe the possible causes and effects of gene mutations. E5.EvolutionStudents describe the interactions between and among species, populations, and environments that lead to natural selection and evolution.1. Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms.
2. Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation.
3. Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage.

 d. Relate structural and behavioral adaptations of an organism to its survival in the environment. |
| **Sample****Lessons****and****Activities** | * Microscope labs looking at human blood samples including diseased blood.
* Using models to explain ABO and Rh blood types.
* Do ABO and Rh blood typing lab.
* View blood vessels during rat and fetal pig dissections.
* Read articles related to disorders caused by homeostatic imbalance of the blood.
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| **Sample****Classroom****Assessment****Methods** | * Quiz
* Chapter Test
* Worksheets

Labs |
| **Sample****Resources** | * Publications:
	+ Essentials of Human Anatomy and Physiology, 9th edition by Elaine N. Marieb
	+ Anatomy and Physiology Coloring Workbook: A Complete Study Guide by Elaine N. Marieb
	+ Essentials of Human Anatomy and Physiology Laboratory Manual by Elaine N. Marieb
* Videos:
	+ National Geographic: Inside the Living Body
	+ National Geographic: The Incredible Human Machine
* Other Resources

Lab Supplies |