uBEATS Teacher's Guide:

Blood Components and Cells

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Blood Components and Cells" module for grades (11-12).

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Identify the four main components of blood.
- Compare the functions of each of those blood components.
- Discuss medical conditions involving abnormalities with blood components.

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Introduction

When a person experiences a cut through the skin, how does the body stop the bleeding? Platelets already present in the blood stream stick together at the damaged site and start forming a plug. Our blood is made up of many fascinating cells and features that help us function. In this module, you will learn about the structure and function of each component of blood: red blood cells, white blood cells, platelets, and plasma. Each type is highly specialized and helps to keep us healthy. Lastly, we will discuss what happens when there are abnormalities in the blood and how these can affect our health.

Prior Knowledge

Before beginning this module, the student should understand the Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning.

Core Idea LS1.A: From Molecules to Organisms: Structures and Processes A Framework for K-12 Education

- Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at a too high or too low external temperature, with too little food or water available), the organism cannot survive. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Science and Engineering Practices NGSS

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing solutions

Crosscutting Concepts NGSS

- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

Key Terms/Vocabulary

Blood components, red blood cells (erythrocytes), hemoglobin, bone marrow, oxygen transport, white blood cells (leucocytes), neutrophils, eosinophils, basophils, lymphocytes, monocytes, granulocytes, agranulocytes, nucleus, bacteria, virus, parasites, platelets, blood clot, megakaryocyte, plasma, electrolytes, proteins, nutrients, respiratory gases, hormones, blood vessels, urine, transfusion, blood type, rhesus factor, antigen, universal donor, anemia, hemolytic anemia, pernicious anemia, thrombus, anticoagulants, embolus.

Science Standards

This module is related to the content of **UNMC High School Alliance: Introduction to Pathology and Microbiology**

Pathology is the study of disease processes. The field lays the foundation for all clinical medicine and medical research. All diseases begin at the cellular level and changes in the structure and function of tissues ultimately lead to symptoms that health care providers see on a daily basis. This course will introduce students to medical terminology, normal histology and gross/microscopic pathology, allowing students to correlate the findings they see into basic clinical concepts.

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

Structure and Function: SC.HSP.6.1.F.

- Construct an explanation based on evidence that animals have structures that function to support survival, growth, behavior, and reproduction.

Structure and Function: Anatomy & Physiology: SC.HSP.6.6.A

- Communicate scientific information that explains the patterns of organization in the cardiovascular/respiratory system.

Structure and Function: Anatomy & Physiology: SC.HSP.6.6.B

- Develop and use a model to identify and describe the relationship between the structures and physiological processes of the cardiovascular/respiratory system.

Structure and Function: Anatomy & Physiology: SC.HSP.6.6.D

- Construct and present arguments using evidence to support claims about the causes of dysfunction in the cardiovascular/respiratory system.

Extensions of the lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- To help the students see personal relevance, suggest that they have a private conversation within their families regarding blood types.
- The teacher may need to address student misconceptions about these important concepts:
    - Human blood is red, never blue. In the presence of an abundance of oxygen, the iron-rich hemoglobin is bright red. When the oxygen is depleted, the blood is a dark red.
    - Bone marrow can be red or yellow. Red bone marrow produces billions of new red blood cells every day.
    - White blood cells can be identified in a variety of ways. Under a microscope a nucleus is visible, and this distinguishes the white blood cell from the red blood cell, which has no nucleus. Next, all the white blood cells can be divided into two structural categories: those that have granules (granulocytes) and those that do not (agranulocytes). According to their functions, white blood cells are usually classified into 5 types: neutrophils, eosinophils, basophils, lymphocytes, and monocytes.
    - Monocytes in the blood stream can migrate out into the tissue where they can differentiate into macrophages which travel by amoeboid movement and engulf foreign substances and cellular debris. They also move to sites of injury and play a role in both inflammation and anti-inflammatory processes.
    - Platelets are produced by megakaryocytes which are large cells (10 times larger than a red blood cell) located in the red bone marrow. The platelets, in turn, are only about 20% the size of a red blood cell.
    - Plasma is a yellowish-colored liquid, carrying solids, liquids, and gases throughout the body. Plasma itself accounts for 55% of the blood volume.
    - One of the chemicals carried by blood plasma is urea, which is produced in the liver and then transported by the blood to the kidneys. The kidneys filter the urea from the blood and metabolize a product called urine.
    - There are many different blood group systems, each identified according to cell-surface antigens directed by genes. The main blood group system is called ABO, in which a person can be positive for the A antigen, the B antigen, both, or neither. This gives us 4 different blood types: A, B, AB, O. Another system is based on the presence or absence of the Rhesus antigen. A person is typed as either Rh+ or Rh-. Combining these 2 systems gives us the 8 main blood types: A+, A-, B+, B-, AB+, AB-, O+, O-. The student must be aware, however, that there are many more antigens that genes can direct on the surface of red blood cells and platelets, thereby creating more variations in blood types.
    - Anemia is when blood does not have enough healthy red blood cells or hemoglobin. There are hundreds of types of anemia which can be categorized

into three groups: anemia caused by loss of blood; anemia caused by not having enough red blood cells being produced; anemia caused by the red blood cells being destroyed.

- Sickle cell anemia is often associated with African ancestry, but the evolution of the disease is not related to geographical or political boundaries. It has been found that the gene for sickle cell anemia also provides resistance to malaria. Not all parts of Africa have the ecological conditions favorable to malaria. On the other hand, there are non-African areas in India, the Middle East, and the Mediterranean where the incidence of sickle cell anemia is high, along with the incidence of malaria.
- Blood clotting is normally a healthy function that plugs a leak in the system. When the clot remains at the site of its origin, blocking the flow of blood through the vessel, the clot is called a thrombus and the disorder is called thrombosis. If the clot breaks loose and travels elsewhere in the circulatory system, the clot is then called an embolus. If the embolus becomes stuck in the heart, lungs, or brain, that dangerous condition is called an embolism, which blocks the delivery of oxygen.

Enrichment

- For information about Healthcare Career Opportunities, see the UNMC Health Career Book.
- Students should be watchful in current events for recent stories about blood types, blood disorders, and medicine.
- To make connections in your community, contact the American Red Cross, local hospitals, healthcare clinics, nurses, doctors.
- An example of a classroom lesson about blood components is Grade11 Blood Components.
- For a fun game about removing bacteria and viruses from blood, try Sepsis Educational Game.