uBEATS Teacher's Guide:

Hemostasis-The process of preventing and stopping bleeding

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Hemostasis-The process of preventing and stopping bleeding" 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

- List the three major steps of hemostasis.
- Explain the roles of platelets and fibrin mesh in the process of hemostasis.
- Discuss the function and importance of clotting factors.

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Introduction

Hemostasis, defined as a series of reactions that occur to halt bleeding, is a crucial mechanism that is easily taken for granted. Here, we will delve into the steps, and importance, of this response.

In our bodies we have a network of tubular structures known as blood vessels that function to carry blood to all of our different tissues. Making sure that blood is being transported efficiently throughout our bodies is crucial because blood carries with it the necessary oxygen and nutrients that our organs need in order to function properly. For example, a constant supply of blood to our brain is important in keeping our brain working. But what happens when a blood vessel is damaged and the flow of blood to our tissues is disrupted? How do we fix this damage? A process known as hemostasis is immediately put into motion by our bodies to repair this damage in order to quickly restore proper blood flow. Essentially, this series of reactions function to form a plug where the damage in the blood vessel was made in order to halt the bleeding and prevent a person from bleeding out their entire blood volume following an injury. This process is essential because if we lose too much blood, we cannot maintain consciousness or keep our organs working. This incredibly vital physiological response is fast, localized, and carefully controlled. Hemostasis is a complex response that involves the action of cytoplasmic fragments known as platelets, and many different clotting factors. Both platelets and clotting factors are already normal components of our blood plasma. We have these substances always flowing through our blood vessels in our blood plasma, which is one of the reasons this process is so speedy and efficient. The process of hemostasis involves three major steps that we will explore in greater detail during this module: vascular spasm, platelet plug formation, and coagulation

Prior Knowledge

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

Core Idea LS1.A. Structure and Function

- ***By the end of grade 12***. 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. A Framework for K-12 Education.

Science and Engineering Practices NGSS

- Constructing explanations and designing solutions

Crosscutting Concepts NGSS

Structure and function

Key Terms/Vocabulary

Hemostasis, platelets, vascular spasm, blood vessel, lumen, endothelium, smooth muscle, pain receptors, chemical signals, vasospasm, vasodilation, vasoconstriction, cytoplasm, blood plasma, platelet plug, protein, collagen, adherence, nitric oxide, prostacyclin, von Willebrand factor, adenosine diphosphate, serotonin, thromboxane A2, aggregation, positive feedback loop, coagulation, coagulation cascade, clotting factors, thrombin, fibrinogen, fibrin, fibrin mesh.

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 daily. 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

Biology Structure and Function: Anatomy & Physiology SC.HSP.6.6.E.

- Develop and use a model to explain the relationship between the cardiovascular/respiratory systems and other body systems.

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 at home to discuss the variety of injuries that have been experienced within their own family and the healing processes involved with those injuries.

- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - Hemostasis is a complex series of reactions that occur to halt bleeding in response to a break in a blood vessel.
    - The first step of hemostasis is vascular spasm, in which blood flow is reduced within the damaged blood vessel.
    - The second step is plugging the leak by way of platelet interactions.
    - The final step of hemostasis involves the “coagulation cascade” which reinforces the platelet plug. Thirteen clotting factors are activated in sequence to glue the platelets together and form an insoluble mesh.

Enrichment

- For information about Healthcare Career Opportunities, see Careers in Healthcare
- Students should be watchful in current events for recent advancements in medicine.
- For a lab investigation Involving polymers (which students call “slime”) that can be involved with wound healing, read Medical Applications of Cross-Linked Hydrogels from the Journal of Chemical Education.
- To make connections in your community, contact local hospitals, healthcare clinics, blood banks, the American Red Cross, nurses, doctors, medical laboratories.