uBEATS Teacher's Guide:

Human Immune System

(Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS "Human Immune System" pathology module for grades 9-10.

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

- Explain the role of physical defenses (such as skin and mucous membranes) in fighting infections.
- List internal processes and cells that protect the body from invaders.
- Describe how the lymphatic system is involved in the defense of the body.

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Introduction

The human immune system is a complex system of physical barriers and internal functions that help keep you protected from infection and disease. The immune system is made up of the skin and various other organs and tissue as well as the lymphatic system. There are two main types of infections that your immune system fights against: intracellular and extracellular. An intracellular infection can involve a virus, bacteria or other parasite that has taken over a host cell and is using it to replicate. In a response to an intracellular infection, the objective is to completely destroy entire host cells. Host cells may be entirely consumed or injected with a lethal toxin. During an extracellular infection, pathogens do not require a host to move about through your body. A virus cannot cause an extracellular infection. These pathogens give off a signal known as a signature. Once this signature is recognized, a proper response is deployed. The cells of your immune system are diverse and powerful. They are like an army of hungry animals that feast on invading organisms called pathogens. These animals want to keep you safe and healthy.

For the sake of this module, let's think of your body as a zoo. It is full of happy, healthy residents who go about their daily zoo routine. Most of the animals in your zoo are quiet and docile, but when they need to protect the zoo they turn into ferocious hunters. Let's learn more about the physical makeup and inhabitants of your immune system zoo!

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 A Framework for K-12 Science Education

- ***By the end of grade 8.*** All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). Unicellular organisms (microorganisms), like multicellular organisms, need food, water, a way to dispose of waste, and an environment in which they can live.

  Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues or organs that are specialized for particular body functions.

Science and Engineering Practices **NGSS**

- Constructing explanations and designing solutions

Crosscutting Concepts **NGSS**

- Structure and function

Key Terms/Vocabulary

Immune system, physical barriers, internal functions, infection, disease, lymphatic system, intracellular, extracellular, virus, bacteria, parasite, host cell, pathogen, signature, skin, epidermis, dermis, hypodermis, mucous membranes, defensin, secretion, innate immune response, phagocyte, phagocytosis, macrophages, neutrophils, toxin, adaptive immune response, lymph, lymph vessels, lymph nodes, antigens, antigen-presenting cells, protein, carbohydrate, nucleic acid, fats, lymphocytes, B-cells, T-cells, antibodies, killer T-cells, helper T-cells, regulatory T-cells.

Science Standards

Nebraska Science Standards

Biology 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. Emphasis is on the basic principles of animal form and functions. Examples of basic principles could include animal nutrition, circulation, gas exchange, immunity, osmoregulation and excretion, hormonal and endocrine control, reproduction, development, neural control systems, and animal behavior.

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 family conversation about how their own bodies have fought off childhood diseases.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - The first line of defense against invading organisms consists of the physical barriers of skin and mucous membranes.
    - Once an invader has gotten through the physical barriers, the human immune system has an array of internal defenders to attack that invader. Phagocytes of several types can engulf and destroy pathogens. These are part of the innate immune response that goes into action immediately.
    - Some invaders, such as viruses, can get past the physical barriers and then avoid the innate defenders, eventually entering the body's cells themselves. When that happens, the adaptive immune response begins in the lymphatic

system. Antigens carried by the invaders are detected and carried to the lymph nodes for analysis. This initiates the production of antibodies which are specific to each foreign antigen.

- Antigens are the foreign molecules that stimulate an immune response; antibodies are the proteins produced by the immune system as a response to the antigens.
- The aggressive response of the human immune system sometimes works against us, particularly in situations of organ transplant in which the immune system attacks the new organ, treating it as an invader.
- In other cases, autoimmune diseases develop which mistakenly attack our own healthy cells as autoantibodies react to healthy cells or organs within the body.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent news about testing for COVID-19.
- Search the Internet for information about "herd immunity."
- For an example of a laboratory activity, see Using Balloons to Teach Immunology.
- Search the Internet for "Videos Human Immune System" to find instructive animations such as The Immune System Explained.
- To make connections in your community, contact local hospitals, healthcare clinics, nurses, doctors, medical laboratories.