uBEATS Teacher's Guide:

Immunology Overview

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Immunology Overview" 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

- Differentiate between innate and adaptive responses of the immune system.
- Explain how the body distinguishes between its own cells and infectious disease agents.
- Describe autoimmune diseases.

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Introduction

How would it feel if you had the flu for the rest of your life? That would be awful but thanks to your immune system, that won't happen. Humans have one of the most complex immune systems of all living things. Our immune system can be trained to have surgical-like precision when it comes to killing pathogens. The healthier your immune system is, the better it will be at knocking out sicknesses. So, what is the immune system? What are the specialized cells that kill any pathogen in our body? What happens when our immune system malfunctions? These are the topics we will dive into to give you a better understanding of what is going on in your body to protect your life.

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.

Core Idea LS1.B. Growth and Development of Organisms

- ***By the end of grade 12***. In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. As successive subdivisions of an embryo's cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. In sexual reproduction, a specialized type of cell division called meiosis occurs that results in the production of sex cells, such as gametes in animals (sperm and eggs), which contain only one member from each chromosome pair in the parent cell. 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

Immune system, immunity, immunology, innate response, adaptive response, autoimmune, epithelial barrier, phagocyte, macrophage, neutrophil, lymphocyte, dendritic cell, antigen, antigen presenting cell (APC), T-Cell, B-cell, T-helper cell (Th), cytotoxic T-cell (CTL), naïve T-cell, antibodies, opsonization, pathogen-associated molecular pattern (PAMP), damage –associated molecular pattern (DAMP), receptor cell, major histocompatibility complex (MHC), polypeptide, apoptosis, Multiple Sclerosis (MS), Type 1 Diabetes, Type 2 Diabetes, pancreas, insulin, Human Immunodeficiency Virus (HIV), vaccine.

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

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 their own experiences with childhood illnesses and vaccines.

- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - The innate immune system is natural or "native" within our bodies; the adaptive immune system includes T-cells which are called "naïve" before they encounter new pathogens.
    - The immune system distinguishes normal molecular patterns from the molecular patterns associated with pathogens.
    - The immune system also distinguishes normal molecular patterns from those associated with damaged cells.
    - Autoimmune diseases, such as Multiple Sclerosis, occur when the immune system attacks its own healthy cells.
    - Type I Diabetes is an autoimmune disease which attacks a person's own pancreas and its ability to produce insulin; this is different from Type II diabetes in which the body does not use its insulin properly.
    - HIV is not an autoimmune disease; instead, it is an acquired deficiency in the immune system that results from an attack by a virus.
    - Vaccines work with the body's adaptive immune system to safely combat particular diseases.
    - Antigens are the molecules that stimulate an immune response; antibodies are the proteins produced by the immune system as a response to the antigens.

Enrichment

- For information about Healthcare Career Opportunities, see the UNMC Health Career Book.
- Students should be watchful in current events for recent news about vaccines.
- For an example of a laboratory activity, see Using Balloons to Teach Immunology.
- To make connections in your community, contact local hospitals, healthcare clinics, nurses, doctors, medical laboratories.