uBEATS Teacher's Guide:

Bacteria in the Human Body

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Bacteria in the Human Body" 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 beneficial functions of bacteria in the human body.
- Discuss methods of transmission of human diseases caused by bacteria.
- Compare treatment options for bacterial infections.

Introduction

Did you know that right now, your body is covered in bacteria? Microorganisms live on our skin and in our bodies. Why? Because our bodies are an excellent environment for these bacteria to thrive. You may be thinking... "Well, aren't bacteria bad?" Some bacteria are bad and can make you sick, but most of the bacteria in your body are there due to the symbiotic relationship between you and the bacterial colonies. You keep the colonies of bacteria safe and healthy, and in return, they help keep you healthy by carrying out specific tasks for your body. This collection of bacterial colonies is known as the "Human Microbiome." The microorganisms in the human microbiome outnumber the human cells in your body by as much as 10 to one. While this symbiotic relationship is very important to your health, any disturbance in the relationship can cause colonies of bacteria to turn against you, causing illness and even disease. In this module we will discuss the human microbiome and the beneficial or negative ways it can impact our health.

Prior Knowledge

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

Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics A Framework for K-12 Science Education

- Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete for limited resources, access to which consequently constrains their growth and reproduction. Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms.
- Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

Science and Engineering Practices NGSS

- Using mathematics and computational thinking

Crosscutting Concepts NGSS

- Scale, Proportion, and Quantity

Key Terms/Vocabulary

Bacteria, human microbiome, ecosystem, nutrition, immune system, metabolism, short-chain fatty acids, vitamins, biotin, inflammation, antimicrobials, lymphatic system, white blood cells, pathogenic, antibiotics, immunotherapeutics, prudency, phage therapy, predatory bacteria, bacteriocins, resistance.

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

Engineering in Health Sciences: SC.HSP.17.1.A

- Obtain, evaluate, and communicate information related to health science careers.

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 regarding beneficial bacteria on and in the body.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - Many people think of all bacteria as harmful, but beneficial bacteria live on our skin and inside our bodies to perform valuable functions.
    - The human microbiome is a complex ecosystem that involves balance in order to maintain health. This balance can be disrupted by poor diet, inadequate sleep, alcohol, tobacco, stress, and lack of exercise.
    - When the human microbiome is working properly, it assists us in matters of nutrition, metabolism, organ development, and maintenance.

- Our beneficial bacteria also strengthen our immune system to fight off invasions by pathogenic bacteria.
- Our beneficial bacteria can also produce antimicrobials which fight off invading organisms, including harmful bacteria, fungi, and parasites.
- Antimicrobials are not the same as antibiotics. Antibiotics are substances that attack bacteria. Antibiotics can damage the human microbiome by killing beneficial bacteria along with the bad bacteria.
- Antibiotics must be prescribed prudently to avoid overuse.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent stories about skin bacteria, gut bacteria, or other bacteria that are common among humans.
- An example of a classroom activity with bacteria can be found at Bacteria Are Everywhere!
- To make connections in your community, contact the American Red Cross, local hospitals, healthcare clinics, nurses, doctors, veterinarians.
- For additional information about bacteria in the human body, take a look at the links provided on the Citations pages of the module.