uBEATS Teacher's Guide:

Microbiology Introduction

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Microbiology Introduction" 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

- Discuss the history of microbiology.
- Discuss the observation of microorganisms using microscopes.
- List the different classifications of microorganisms.

ubeats@unmc.edu

Introduction

Microbiology is the study of microscopic organisms or microorganisms which cannot be seen by the unaided eye. A person who studies microbiology is a microbiologist. There are many different types of microbiology including pharmaceutical, medical, and food microbiology. In this module we will introduce and discuss the history of microbiology, early and modern technology used in microbiology, and the six most common types of microorganisms.

Prior Knowledge

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

Core Idea ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World A Framework for K-12 Education

- Modern civilization depends on major technological systems, including those related to agriculture, health, water, energy, transportation, manufacturing, construction, and communications. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Widespread adoption of technological innovations often depends on market forces or other societal demands, but it may also be subject to evaluation by scientists and engineers and to eventual government regulation. New technologies can have deep impacts on society and the environment, including some that were not anticipated or that may build up over time to a level that requires attention or mitigation. Analysis of costs, environmental impacts, and risks, as well as of expected benefits, is a critical aspect of decisions about technology use.

Science and Engineering Practices NGSS

- Constructing explanations and designing solutions

Crosscutting Concepts NGSS

- Influence of Science, Engineering, and Technology on Society and the Natural World

Key Terms/Vocabulary

Microbiology, organism, microorganism, pharmaceutical, microscope, cell, bacteria, blood cells, muscle fibers, spermatozoa, smallpox disease, cowpox disease, immunity, variolation, inoculation, vaccination, tuberculosis, anthrax, cholera, Germ Theory of Disease, penicillin, antibiotic, antibiotic resistance, DNA, double helix, virus, polio, CRISPR, technology, Gram stain, Petri dish, agar, light microscope, compound microscope, glass lens, confocal microscope, fluorescent, electron microscope, electrons, electromagnetic lens, Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), DNA sequence, electrophoresis, symbiotic, pathogen, nucleus, sexual reproduction, asexual reproduction, fungus, yeast, mold, mycelia, protozoa, parasite, algae, photosynthesis, oxygen, carbohydrates, archaea, methanogens, halophiles, thermophiles.

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 family routines of hand-washing and other practices intended to reduce the spread of microorganisms within the home.

- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - The human body provides the living conditions for many microorganisms.
    - Microorganisms are not all bad—many of them are beneficial to our health.
    - Special tools are necessary in order to see microorganisms.
    - The “compound” light microscope gets its name from the fact that the user looks through two lenses at the same time--the eyepiece lens at the top magnifies the light traveling up through the objective lens at the bottom of the microscope tube.
    - Before recent discoveries by scientists, people did not understand how diseases spread from one person to another.
    - Scientists organize microorganisms into six different categories: bacteria, fungi, viruses, protozoa, algae, archaea.
    - Microbiologists purposely feed and grow colonies of microorganisms in order to study them, but they must take precautions to prevent their escape.

Enrichment

- For information about Healthcare Career Opportunities, see UNMC’s Careers in Healthcare.
- Students should be watchful in current events for recent stories about diseases caused by microorganisms.
- All students should be aware of safety concerns involving microorganisms in the laboratory. An example of an online resource is Microorganisms Safety Guide.
- For an entertaining story about early work in microbiology, try The Wacky History of Cell Theory.
- To make connections in your community, contact the American Red Cross, local hospitals, healthcare clinics, nurses, doctors, veterinarians.