



uBEATS Teacher's Guide:

Bacteria

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS “Bacteria” 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

- Distinguish between prokaryotes and eukaryotes.
 - List a variety of bacteria shapes.
 - Explain how bacteria reproduce.
 - Discuss diseases caused by bacteria.
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Introduction

This module compares the cell structure of bacteria to other kinds of organisms, as well as describing the types of symbiotic relationships bacteria can have with other organisms. The student first experiences a pre-module quiz to stimulate curiosity about the topic. The subjects explored during the module include bacterial structure, bacterial functions, and diseases caused by bacteria.

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

Bacteria, prokaryote, eukaryote, nucleus, membrane, chromosome, DNA, organelle, protein synthesis, symbiosis, mutualism, commensalism, pathogenic, cocci, bacilli, spirilla, Gram stain, peptidoglycan, phospholipid, lipoprotein, lipopolysaccharide, ATP, cytosol, antibiotics, flagella, cilia, chemotaxis, nucleoid, plasmids, ribosomal subunits, asexual reproduction, binary fission, origin of replication, recombination, transformation, conjugation, transduction, lyse, viral vector, bacteria colony, exponential growth, *Streptococcus*, *Staphylococcus*, *E. coli*, MRSA (methicillin-resistant *Staphylococcus aureus*).



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 various infections experienced by members of the family.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
 - Prokaryotes are generally considered to be unicellular; however, some single-celled bacteria can work together in a colony in which functions are divided for efficiency.
 - Multicellular organisms are eukaryotes; however, many eukaryotes are single-celled, such as yeast and amoeba.
 - Symbiosis ("living together") includes three kinds of relationships. Mutualism is when both species gain an advantage from the relationship. Commensalism is when one species benefits while the other is neither harmed nor helped. Parasitism is when one species gains advantage at the expense of the host.
 - A parasite is pathogenic when it causes disease in the host.
 - A bacterium's nucleoid is not a nucleus. Although most of the DNA is located within the bacterial nucleoid, the nucleoid is more a region rather than being a membrane-enclosed organelle.
 - The DNA within the nucleoid is not arranged in strings called chromosomes. Instead, the DNA molecule in the nucleoid is arranged as a circular strand.
 - Additional non-essential DNA is located outside of the nucleoid as circular plasmids.



- Ribosomes in bacteria are smaller than those in eukaryotes, but in both cases the ribosome has one side that is larger than the other. The specific make-up of the subunits can be used as targets for antibiotics.
- During recombination, a bacterium receives new DNA into its genome, in addition to the DNA it has already inherited from the parent cell.
- There are three ways DNA can be added to a bacterium. In conjugation, two bacteria are in direct contact, and DNA is passed from one to another. In transduction, DNA is injected into a bacterium by a virus. In transformation, DNA found in the environment is taken into the cell through the cell membrane.
- *Escherichia coli* is normally a helpful bacterium in the lower intestine. It becomes a problem when ingested and infects other parts of the digestive system.

Enrichment

- For information about Healthcare Career Opportunities, see the [UNMC Health Career Book](#).
- Students should be watchful in current events for recent stories about strep infections, staph infections and antibiotic-resistant infections.
- 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