



uBEATS Teacher's Guide:

Bacterial Cultures

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS Bacterial Cultures 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

- Compare methods of cultivating bacteria in a laboratory.
 - Identify techniques for maintaining a pure culture.
 - Give examples of safety concerns regarding the culturing of bacteria.
-



Introduction

Do you want to be the detective of medicine in search for the mysterious bacteria and disease? Interested in learning about the microbial world and all of its wonders? This introductory module will be the beginning of your new journey into the microscopic world that surrounds us all.

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

Culturing bacteria, growth media, nutrient agar, broth culture, nutrient broth, agar slant, agar plates, blood agar, chocolate agar, MacConkey agar, LB agar, alpha hemolysis, beta hemolysis, gamma hemolysis, non-selective media, lactose fermentation, anaerobic, pure culture, inoculation, dilution method, streak plate method, pour plate method, serial dilution, spread plate method, antimicrobial assay, aseptic technique, refrigeration, paraffin method, cryopreservation, lyophilization, metabolism, sublimation.



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 of 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 2024 [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 reflect on bacterial culture experiments that they performed/observed during middle school and high school, especially those for science fairs. What were the purposes, techniques, and safety concerns of those experiments?
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
 - Bacteria are living creatures that have specific environmental needs and food requirements. Culturing bacteria depends on providing the unique conditions needed for particular species. For example:
 - LB agar (lysogeny broth) is a nutritionally rich medium that is routinely used for culturing *Escherichia coli* in the laboratory.
 - Blood agar distinguishes the abilities of different bacteria to break open blood cells and degrade the hemoglobin. Blood agar is especially helpful in culturing *Streptococcus* species.
 - Chocolate agar contains no chocolate – it gets its name from the brown color that results from blood agar that has already had its blood cells ruptured by heating. Chocolate agar is used for growing fastidious respiratory bacteria, such as *Haemophilus influenzae* and *Neisseria meningitidis*.
 - MacConkey agar differentiates intestinal bacteria based on their ability to ferment lactose.



- When studying bacteria that affect humans, the temperature of the cultures are usually maintained at human body temperature.
- Different culture media are used for different purposes. The nutrient agar can be gel or liquid, plate or test tube, selective or non-selective, and some agars can differentiate between different characteristics.
- Nutrient broth can be shaken to ensure complete oxygenation, or it can be unshaken to produce a variation of oxygen levels at different depths.
- A pure culture is necessary for studying one species at a time, without interference from other species.
- Laboratory safety when growing and storing bacterial cultures is critical in two directions:
 - Aseptic technique must be used to prevent unwanted microorganisms from getting into and contaminating the pure cultures being grown in the lab.
 - Aseptic technique must also be used to prevent escape of bacteria from the growth chambers and the spread of infection among lab workers, hospital patients, etc.
- Aseptic technique is not the same as sterilization, which is the elimination of all life forms. Aseptic technique is the prevention of unwanted contamination

Enrichment

- For information about career opportunities, see UNMC's [Careers in Healthcare](#) handbook.
- Students should be watchful in current events for recent stories about bacterial infections.
- An example of a classroom activity could be [Growing Bacteria in Petri Dishes](#).
- To make connections in your community, contact the American Red Cross, local hospitals, healthcare clinics, nurses, doctors, veterinarians, scientific laboratories.