This lesson plan was created by a teacher participating in the Research Experiences for Teachers (RET) program from the Precision Microbiome Engineering Research Center. Are you interested in spending part of your summer in a lab getting paid to do microbiome research and create lesson plans?

Learn more here: https://premier-microbiome.org/for-teachers-ret/

Lesson Plan created by Charlie Hiatt

AG Tier 3 (Grade 3)

Unit Title: Let's Build Up Some "STEAM"

Lesson Title: Where are Bacteria?

Purpose/Central Focus of Lesson:
Students will learn about bacteria and how to reduce the spread of harmful bacteria through hygienic practices.

Student Learning Targets:
Learn the difference between animal and bacterial cells. Learn about skin as an organ. Learn relative vocabulary. How to increase good hygiene awareness and practices.

Standard Alignment:
Structures and Functions of Living Organisms 3.L.1 Understand human body systems and how they are essential for life: protection, movement and support. 3.L.1.2 Explain why skin is necessary for protection and for the body to remain healthy 3.L.1.2 Students know that the skin is the largest organ of the human body, that it covers and protects the human body from external conditions and forces. Students know that the skin contains nerve receptors that provide information about external conditions.

Prior Academic Learning and Prerequisite Skills:
Knowledge of the existence of microscopic organisms.

Culturally Inclusive Instruction:
Research diseases that have affected cultures around the world.

Instructional Materials:

Bread
Ziplock bags
Pre-made agar plates (optional)
Soap
Hand sanitizer

Procedures:

Motivation/Hook:
Ask students if they think they have things living on their skin, then discuss. After establishing that microscopic organisms live on skin, have students participate in an optical illusion that appears to make skin crawl.

Stare at the spinning pinwheel for approximately 20 seconds while placing your righthand down on a table or flat surface. After the 20 seconds, keep your hand still and then look at your hand without moving it. If done correctly, the hand appears to have things crawling on or below the skin or moving in a weird way.

(60) pinwheel illusion - YouTube

The above illusion can be projected or have students search for it on YouTube.

Activation of Prior Knowledge:
Ask students if they know what an organism is. Students should understand that an organism is a living thing or life form.

Ask students what they know about cells. Students should understand that cells are the smallest structures that can sustain life. Cells carry out all life processes through organelles. Organelles are tiny organs within the cell that carry out functions like making proteins and disposing of waste.

Ask students to describe the parts of a city or town and why they are important. Explain that cities have different departments and services that carry out various functions important to the residents that live within it. A cell is like a tiny city with organelles conducting various functions that sustain life.

Make sure that students understand the differences between animal cells (eukaryotes) and bacterial cells (prokaryotes).

Major differences:

Prokaryotes – single celled organisms, cells that do not contain a defined nucleus.
Example: bacteria cell
Eukaryotes – animal cells that contain a nucleus.
Examples: Muscle cells, skin cells

Humans are made up of eukaryotic cells. Humans are multicellular organisms, meaning we are comprised of many different specialized cells working together.

Ask students what they know about their skin and discuss. If it is not covered in the discussion, explain to students that their skin is their largest organ and one of its main functions is to protect us from harmful bacteria (pathogens).

Although some bacteria can be harmful, most bacteria are beneficial to us. These bacteria are called commensals. Commensals live within our body systems and carry out beneficial functions such as aiding in digestion.

Depending on student responses, the teacher should relay that bacteria are single-celled organisms. Yes, the organisms have everything they need contained in one cell to sustain life!

Show illustration of the relative size of bacteria located in the lesson plan folder and discuss. After discussion, it may be relevant to note that a virus is at least 10 x smaller than a bacterial cell.

Here it may be beneficial to compare single-celled organisms to multi-celled organisms like the human body. The link below provides an organized comparison of various cells.

Major Differences Between Plant, Animal and Bacterial Cells (collegedunia.com)

Delivery of Lesson Content:
Show students images of bacteria located in lesson plan folder and discuss.

Introduce the parts of a bacterium cell using the website below by projection and oral introduction. Then have students review the tutorial on their own. You could have students pair up and take turns reading to each other or conduct the tutorial individually.

Bacteria Cell Tutorial

Animal Cell - Tutorial - Science - Sheppard Software

After completing these two tutorials have a class discussion about the differences and similarities between bacterial and animal cells. Students can use the T chart in the resources folder delineate between the two.

Explain to students fungal cells are eukaryotic but have some differences from animal cells. See Animal vs Fungal Cell illustration in the resources folder. Students may use the Animal vs. Fungal T-chart to document the differences.

Introduce vocabulary using Cell Vocabulary document from the unit resources.

Teacher may have students copy words and definitions or give them a handout with the words and definitions already present and conduct vocabulary activities. See below for suggestions.

Suggested vocabulary activities:

1. Make flash cards and quiz each other. This could be done with index cards or virtually. See below for a virtual flash card creator.
    a. https://www.cram.com/

2. I have, who has……
3. Create your own crossword puzzle:
   crossword puzzle
4. Write a sentence using the word
5. Charades or Pictionary
6. Have students come up with their own vocabulary activity!

Explain to students that bacteria come in many different forms and vary in their function. Explain that most bacteria are actually beneficial, but some can be harmful. Return to the previous discussion regarding bacteria being present on their skin. Explain that because our skin is our first line of defense against harmful bacteria, it is important to have good hygiene regarding skin care.

One way to practice good skin hygiene is to wash your hands often and thoroughly. Tell students that they are going to participate in a lab that may demonstrate the extent of bacteria on our bodies and in the environment. Further, the lab may reveal results from hygiene practices.

How does soap reduce bacteria? Soap has polar characteristics that allow it to isolate and mechanically remove bacteria. However, if you wash your hands long enough, soap can actually puncture bacterium cell membrane thereby destroying it. For more in-depth information, read the article below:

How Soap Kills Germs

How Hand Sanitizer Works

Explain that one way to capture a sample of bacteria is by transferring bacteria from skin to a piece of bread by physical contact. Refer to the Bacteria Lab sheet as a guide in this activity which provides structure using the scientific method. The link below provides information on the lab and illustrations of what to expect.

Bacteria Lab

Next, for comparison, have students wash their hands and then repeat the previous procedure.

Let the samples incubate and document changes by photographing bacterial growth on the bacteria lab sheet. Refer to the Bacteria Lab Teacher lab sheet for directions and examples.

Explain to students that fungal growth is common when conducting this experiment. It is important to note that fungal growth is usually indicated by fussy looking growth. Students should not make the mistake of thinking all the growth on the bread is bacterial.

Guided or Individual Practice:
Have students state the problem, guide them or give them the problem and fill out the “problem” portion of the Bacteria Lab sheet. Refer to the Bacteria Lab Sheet Teacher Copy for direction.

Next, have student fill out the hypothesis section of Bacteria Lab Sheet. Also, see Bacteria Lab Sheet Teacher Copy for directions and examples.

Disclaimer: Make sure you have permission from the district or school because it involves microbial growth.

Lab instructions:

1. Give students a piece of plain white bread and have them spread their fingers slightly and press their hands into a piece of bread.
2. Place the used piece of bread in a plastic sandwich bag and seal it up.
3. Label the outside of the bag with a number, initials, and the treatment given.
4. Continue the experiment in this way by varying the treatment to each slice of bread and labeling them.
5. Observe over the coming days and weeks and document.
6. **Do not open the samples because this may contaminate the air. Dispose of properly by putting closed samples in a sealed waste bag and put directly in the dumpster.**

"PLUS" Extensions:
Students will play the bacteria cell game linked below.

Bacteria Cell Game

Have students create a Venn Diagram to compare and contrast various types of cells. Look below for an example:
Cell Venn Diagram

The Venn Diagram could also be used to compare fungal cells with other cells.

Closure:
Have a class discussion regarding their findings and how they related to their hypothesis.
Now that students have some knowledge about microbes, inform them that when microbes make you sick they require specific treatment.

For example, strep throat is a bacterial infection that should be treated with antibiotics.
The Corona Virus is a virus that does not respond to antibiotic medicine so to treat it, scientist have development antiviral medications. Lastly, fungal infections should be treated with antifungal medications.

Assessments:

Completed lab sheet
Paragraph explaining what they learned, what challenges they faced, what was the best or worst part of the experience.
Vocabulary test

Supplemental Lesson Plan Elements

Differentiation:
English Language Learners: Partner with a fluent speaking student if possible.
Exceptional Children: Collaborate with a student partner. One on one attention.
Highly Gifted: Design an experiment or lab centered around bacteria, skin, or hygiene. Design a vocabulary activity.
Underperforming Students: Have them suggest related activities that may help them learn the content to build ownership.

Accommodations:
Extended Time: Provide as needed
Read Aloud: Computer reads text aloud. Provide a digital copy of instruction and lab sheet.
Language Demands & Support: Google translate
Other: Provide other accommodations as needed.

Extension:
Experiment with different types of bread to determine if the growth rate of bacteria varies. Use the same Shepard software to learn about animal and plant cells. Animal Cell Game Plant Cell Game Have students create a 3D or 2D model of a cell. Have them relate the cell organelles to cities. What part of a cell would be analogous to city hall? Answer: the nucleus. More examples: Parts of a cell related to a city **Conduct a role play activity**: One group of students will be the patients and another group will be the doctors. The doctors will examine their patients and try to determine a diagnosis and subsequent treatment. When examining the patients, the patients are to read off their symptoms. The doctor then finds those symptoms from a master list of diseases to diagnose and treat the illness. See Disease Role Play Activity document in folder to for an example of how to facilitate this activity. **To extend this activity, research and add more diseases and symptoms or assign this task to the students but the teacher should guide or give suggestions for the examples. This is due to the graphic nature of some diseases and their effect on the human body.**

Technology:
Projector for instructions