SciREN
Lesson Plan

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Overview

This lesson encourages students to learn more about the different types of microorganisms that live among humans and allows them to plan their own strategy to restrict the growth of potentially disease-causing germs. Students will take samples of microorganisms present in their environment and develop, calculate, and test their own antimicrobial combination.

Students will culture bacteria from their environment, measure how various cleaning products affect bacterial growth, and quantify the results. This plan will teach students how to design an experiment, collect data, quantify results, form conclusions based on data, and communicate their findings with an audience.

Introduction

Bacteria are some of the simplest forms of living things. They are so small they cannot be seen without a microscope. On a single drop of water, you can fit 2 billion averaged-sized bacteria! Bacteria are single cells and they may be round, rod shaped or shaped like a spiral. They can also stick together to form strands. Some types of bacteria will grow on agar. Once it lands on the agar, it divides resulting in two bacteria. These divide again, giving rise to four and this will continue until there is a mass of millions or even more! This mass is called a colony. These can be observed without a microscope and they differ in color, shape and size depending on the type of bacteria. Bacteria can be found almost everywhere. In the air, in food, on your skin, inside of your body… There are even bacterial species who live underground or at the bottom of the ocean.

Even though each bacterium weighs next to nothing, the weight of all bacteria in the world is almost one billion tons. That is equivalent to the weight of 50 million blue whales! Estimates say that there are around 39 trillion bacterial cells in the body while there are 30 trillion human cells. In a way, we are more ‘bacteria’ than human! Without bacteria, some of the important global cycles could not exist. Some species help recycle and transform elements in the earth, the atmosphere and oceans. Cyanobacteria are in charge of taking carbon dioxide and turning it into oxygen just like plants! Half of the primary production of oxygen on Earth happens in the ocean thanks to these bacteria.

Only some bacteria are actually harmful! (less than 1%) and they can live both inside and outside of the body. Early in the 1900’s scientists discovered that many common diseases are caused by bacteria. Robert Koch discovered that a bacterium called *Bacillus anthracis* was the cause of Anthrax and *Mycobacterium tuberculosis* causes tuberculosis. *E. coli* is transmitted through contaminated poultry or foods. Some *E. coli* is not harmful but other species can cause food poisoning.

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NC Teaching Standards Addressed Common Core NC Essential Science Next Gen	**Life Sciences:** 7.L.1 Understanding processes, structures and functions of living organisms that enable them to survive, reproduce and carry out the basic functions of life. (sub standard 1) 8.L.1 Understand the hazards caused by agents of diseases that affect living organisms (sub standards 1 and 2) Bio 1.2 Analyze the cell as a living organism (sub standard 1 and 3) **Common Core Math:** NC.6.SP.4 NC.6.SP.5 NC.7.RP.2 NC.7.SP.3
Learning Objectives	**Students will be able to:** - Describe different types of bacteria - Employ lab techniques to culture bacterial samples from the environment - Predict effectiveness of antimicrobial cleaners - Measure, explain, and illustrate the effects of treatments on bacterial growth - Summarize and interpret findings in graphs and data tables
Appropriate Grade Levels	6-8
Group Size	10-30
Setting	Indoor classroom or lab setting
Approximate Time of Lesson	Day 1: Introduction and swabbing, 30min – 1hour Day 2: Students count bacterial colonies, 30min Day 3: Students graph the results and form conclusions, 1hour Day 4: Students present their findings to the class, 30min
Resources Needed for Students	- Swabs - Plates (petri dishes with LB agar) - Cleaning products - Tubes - Sterile water (bottled water) - Gloves - Sharpies - Hand soap/sanitizer - Bleach and spray bottle for clean up
Resources Needed for Educators	- Incubator - PowerPoint (download here) - Worksheets (download here)
Apps/Websites	- Internet/YouTube

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Lesson Activity

Introduction

See the powerpoint included. Teachers will introduce what bacteria look like, where they are found, how many are present in humans and the environment, and various functions of bacteria. This section should culminate in discussing beneficial versus disease-causing bacteria. From here, teachers may have students discuss and brainstorm common ways of preventing bacterial growth and infection (i.e. taking antibiotics, washing hands, cleaning kitchen counters, etc.). This will lead directly into the activity where students will grow bacteria taken from their environment either with no cleaning product present or after they treat their sample with a cleaning product of their choice.

Background

Some cleaning products kill bacteria while others limit bacterial growth. These differences may impact bacterial growth in the activity depending on which cleaning supplies are detected. Additionally, teachers may opt to spray the plates with cleaning product rather than sterilizing the sample by dipping the swab in cleaning product. Teachers may allow students to choose the swab location and cleaning product, have all students swab the same location and use the same cleaning product, or divide the class into groups and record data as a class.

Step by Step Activity

1. Students will record background information, the protocol, materials, and hypotheses in a lab notebook format.
2. Students are given a tube with a small amount of sterile water, two cotton swabs, and two agar plates.
3. Students dip the first swab in the water, rub the swab on the selected surface or object, and then rub the swab on the plate. Students then dip the second swab in water, rub the swab on the selected surface, dip the swab in the cleaning product, and rub the swab on the second plate.
4. Plates are incubated on the desktop at room temperature or in a 37°C incubator overnight. Note: if the plates are incubated at room temperature, bacterial growth will be slower and the plates may need to sit two or three days for visible colonies to form.
5. Students count the colonies on their plates and record their results in the worksheet. Teachers may have the students write their results on the board so that they may use data from the whole class for their analysis.
6. Students will graph the data in a bar graph and compare bacterial growth between untreated plates and plates treated with cleaning supplies. Students will be able to form conclusions from these data about which cleaning supplies limit bacterial growth and which cleaning supplies are most effective. Teachers may have students make presentations and describe their results to the class.
7. Teachers may have students brainstorm future experiments to test bacterial resistance or the mechanism of growth inhibition.

Reflection/Assessment

Teachers will assess the worksheet for understanding of the topic.

Final Product/Assessment

- Completed worksheet
- Presentation of data
- Lab notebook record keeping