Microorganisms and Infection Lesson Plan: Based on a Microbiology Laboratory Externship at a Company Making Syringes

Grade Level: 10 **Number of Students:** 25 **Instructional Location:** Classroom

Lesson Goals

Central Focus of Lesson:
How can skills learned in the classroom be applicable to real-world scenarios and careers?

Standard(s) Addressed:

NGSS
MS-LS1-1. *Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.*
MS-LS2-1. *Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.*

Common Core State Standards - Math
Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Lesson Objectives and Demands

Content Objectives:
Describe how bacteria affect our own lives.
Determine, based on data analysis, the best way to sterilize objects such as our hands.
Understand the possible applications of microbial techniques in the medical field.

Language Objectives:
Describe the ideal conditions in which bacteria need to survive.
Explain possible diseases caused by bacteria.

Key Vocabulary in Lesson:
Bacteria, pathogen, Petri dish, agar, infection, anti-microbial, microorganism, growth factors, cell division, unicellular, binary fission, prokaryotic

Lesson Considerations

Materials:

- *Petri dishes*
- *Cotton swabs*
- *Markers and/or colored pencils*
- *Sink with hand soap*
- *Paper towels*
- *Antibacterial gel*
- *Other antibacterial media - students choose*
- *Student lab notebook*
- *Pre-assessment survey handout*
- *Lab demo book (includes pictures and steps of investigation procedures).*

Prior Academic Learning and Prerequisite Skills:
Students need to know proper basic lab and safety skills. Students also must know that all living things require certain environmental conditions in order to grow and divide, some conditions are more optimal than others. Students also must understand the basics of cell division and unicellular organisms.

Misconceptions:
Students may have difficulty distinguishing between bacteria and viruses. Students may also struggle with aseptic technique and why it is important to ensure accuracy of lab results.

Lesson Plan Details

Lesson Introduction -
Students are asked to complete a "do now," or pre-assessment, bacteria survey that consists of a couple short response questions and true or false questions relating to the topic of the lesson. The instructor can pick a question from the survey and ask the whole class to vote on a response. Students then watch a video: https://www.youtube.com/watch?v=NYgvCtrdu2U describing our relationship with bacteria. Students are asked to brainstorm where they might find the most bacteria and possible antimicrobial substances.

Learning Activities

Students will be conducting an investigation in this lesson. This procedure outlines the experimental set-up and trials to be completed by the end of class. Quantitative analysis of bacterial growth over time can be completed in later lessons.

Throughout this investigation, students study bacterial growth under certain conditions afforded by different sources: an unwashed hand, a hand washed with soap and water, a hand sanitized with antibacterial gel, and a hand sanitized with a solution determined by lab partners to be antimicrobial (that is available and safe to use in the lab). Students take samples from the different sources using cotton swabs and streak Petri dishes that support bacterial growth. After a week, students quantitatively compare the growth from each plate.

Investigation Procedure:

1. *Students form groups of three and are given lab materials. This includes the lab demo book created by the instructor which includes photos of how to streak Petri dishes.*
2. *Students are asked to determine which antimicrobial solution they would like to test in addition to soap and antibacterial gel.*
3. *Students are asked to predict which solution will be most effective in preventing bacterial growth and should record these predictions in their lab notebooks.*
4. *One student is asked to be the source of the bacteria, and the other will prepare the Petri dishes. The third student should oversee the procedures and ensure aseptic technique is followed (as outlined in the lab demo book).*
5. *Each group pre-labels four Petri-dishes, making sure they follow the same format as outlined in the lab demo book.*
6. *Students should begin with the "unwashed" Petri dish. From the source student, a second group member should gently rub a cotton swab on the surface of that student's palm, making sure to never put down the cotton swab.*
7. *The supervising student should remove the lid of the "unwashed" Petri dish containing agar.*
8. *The other student should gently rub the cotton swab sample taken from the unwashed hand back and forth on the agar in accordance with the pictures and guidance in the lab demo book.*
9. *The supervising student should immediately close the Petri dish.*
10. *These steps (6-9) should be followed identically for the remaining Petri dishes and the different growth conditions. Students should make sure they are using the correctly labeled dish for the growth condition they are currently testing.*
11. *Students must get instructor signatures ensuring they completed all steps of the procedure before cleaning up their lab stations.*

Closure -

Students are asked to brainstorm possible applications of the methods they used in their investigation to the medical and health fields. They are also asked to brainstorm what careers may require an understanding of microbiology and aseptic technique. These ideas may be compiled on a Jamboard platform. Students then go to: https://www.youtube.com/watch?v=lnsP4KjtPK0 for a virtual tour of a microbiology lab. They are asked to find materials they used in the investigation in the virtual lab.

Extension:

If time permits, students can practice quantitative analysis, to be done in the next class, of plates already showing growth (prepped by instructor).

Lesson Plan Appendix and Commentary Section

<table>
<tr><th colspan="2">Evidence and Formative Assessment of Student Learning</th></tr>
<tr><td rowspan="3">Assessment Strategy #1:

Students will be able to develop predictions about which antimicrobial solution will be most effective at minimizing bacterial growth.</td><td>Alignment with Objectives:
Determine, based on data analysis, the best way to sterilize objects such as our hands. Students need to develop predictions in order to effectively investigate which solution will be most effective.</td></tr>
<tr><td>Evidence of Student Understanding:
Assessment provides feedback of student understanding of both investigation procedures and the connection between antibiotics and bacterial growth.</td></tr>
<tr><td>Student Feedback:
Predications will be revisited and discussed once quantitative analysis is completed (next lesson).</td></tr>
<tr><td rowspan="3">Assessment Strategy #2:

Students will be able to brainstorm (list format) connections between what was learned in the classroom and real-world applications.</td><td>Alignment with Objectives:
Understand the possible applications of microbial techniques in the medical field.</td></tr>
<tr><td>Evidence of Student Understanding:
Students input and discussion indicate an understanding of how techniques can be used in the medical field.</td></tr>
<tr><td>Student Feedback:
Instructor will provide direct feedback during class discussion.</td></tr>
</table>

Utilizing Knowledge about Students to Plan and Implement Effective Instruction
Building on Personal/Cultural/Community Assets: *Lesson is built on students' prior knowledge of lab safety, as well as content knowledge of unicellular organisms and cell growth and division. Lesson also connects students' daily lives with content learned in the classroom, as well as introduces students to possible careers in the field of microbiology.*
Grouping Strategies: *Students will be put in groups of three randomly to ensure equal division of labor during the investigation.*
Planned Supports: *A demo lab notebook, which includes all steps of the investigation with associated pictures, are provided to all students. A video demonstrating the steps of the investigation also may be used. Students' tasks within the investigation can be meaningfully distributed between group members. Meaningful pairings of group members may also be used. Instructor should circulate constantly throughout the investigation to provide additional support.*

Acknowledgements
Sources: *Bacteria are Everywhere!* Teach Engineering. https://www.teachengineering.org/activities/view/nyu_bacteria_activity1