Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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www.esi.utexas.edu

Microbes: beneficial or harmful?

Lesson Plan for Grades __9-12___
Length of Lesson: _1_ hr _30_ min (2 days)

Authored by: _Maisha Rumman_ for UT Environmental Science Institute
Date created: 05/05/2015

Subject area/course: Biology

Materials:

1. Autoclave
2. Agar plates
3. E Coli Liquid culture
4. L shaped glass rod
5. Forceps
6. Filter paper
7. Normal soap
8. Antibacterial soap
9. Hand sanitizer
10. Incubator
11. Small oil lamp or anything that will provide a small flame

TEKS/SEs:

(11) Science concepts. The student knows that biological systems work to achieve and balance. The student is expected to:

- (C) summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems

Lesson objective(s):

- Students will learn microbiology techniques to solve questions
- Students will explain the whether microbes are beneficial or harmful

Differentiation strategies to meet diverse learner needs:

- The teacher should ask students whether they prefer to read or watch videos to learn about concepts and then have students learn in the way they prefer. However, the teacher should sometimes also assign them to improve on methods of learning that they don't feel comfortable with so they may improve (for example, if a student prefers reading, have them watch a video and take notes to improve their listening skills)
- Students with learning disabilities as well as ELL students should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.

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ENGAGEMENT

- Teacher will pose this question to students: "Are microbes beneficial or harmful? And based on this answer, should we use more antibacterial products such as antibiotic soap or use fewer antibiotic products?"
- Students in groups will discuss within their table and take a vote and record the number of students who voted yes or no (teacher can use pollev.com to poll the students if all students have a phone or tablet)
- Teacher will then have one student from each category explain their answer

EXPLORATION

- The teacher will tell students that they will experiment and see whether normal soap or antibiotic soap is better at inhibiting bacterial growth
- Before starting the exploration, they will read the procedure and form a hypothesis on whether they think soap type will cause a difference in the inhibition of bacterial growth

Setup process performed by the teacher

- 2 days before starting the exploration, the teacher label agar plates and the E. Coli liquid culture should be ordered ahead of time in order for use on the day of the experiment
- Additionally, a day or two before the experiment, the teacher will use a hole puncher to make holes from filter paper (enough to have one circular piece for each trial, so make about 30 pieces so there are many extras just in case of a mistake). Then these circular pieces should be placed on a piece of foil and wrapped and then autoclaved

Experiment (can by performed by students or teacher, if teachers are not comfortable allowing students to handle this procedure)

- For the procedure, students will set up agar plates, streak bacteria on them, and place a filter paper containing different either antibiotic soap, normal soap, or hand sanitizer. Each group will be assigned to a different soap type and will only have to perform three trials.
- Instructions:

1. Transfer 100 microliters of E. Coli from the liquid medium onto an LB agar plate
2. Then, a glass rod should be sterilized by first dipping in alcohol (70% isopropyl or ethanol) and then touching it to a flame
3. Next, the glass rod will be used to spread the liquid culture evenly across the agar plate
4. Once the liquid has been evenly spread, use sterilized forceps to pick up the circular filter paper and dip it into either antibacterial soap, normal soap, hand sanitizer, or no soap at all for control
5. Then, the filter paper should be carefully placed in the middle of one of the four sections of the agar plate
6. The glass rod can be cleaned by placing it in the alcohol and touching it once again to the flame
7. Repeat steps 1-6 for trial 2 and trial 3
8. In the last section of the agar plate, place a filter paper in sterilized water instead of soap in the middle of the section.
9. Place the lid back on the agar plate and place it in upside down in the incubator

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- After students they are done with streaking and putting the plates in the incubator, they will be assigned an article or video about how microbes are beneficial or harmful. They will take notes and then present to the class what they learned.
    - https://www.youtube.com/watch?v=qpa9JvIwfHQ&feature=youtu.be
    - http://www.thehealthyskinblog.org/skin-flora-our-protective-shield/

- The next day, they will measure the zone of inhibition and take an average for each group. They will conclude whether antibacterial soap or normal soap is more effective at inhibiting growth of bacteria. Although the students can't make a very convincing argument for which one is better because they may not know statistical testing, teachers should explain that there is a way to tell whether the zones of inhibition from different soap agents are different or not
    - Note: antibacterial soaps are generally better at inhibiting growth of bacteria compared to normal soaps—thus, the zone of inhibition for antibiotic soaps should be larger

EXPLANATION

- Each group will then present on what they learned from their article or video about beneficial or harmful microbes
- After they have gathered results from the experiment, groups will come up to present on their hypothesis, results and conclusion

ELABORATION

- For the elaboration, students will write about a career path in the field of microbiology and explain what this career path entails
- Students will be allowed to research by themselves online or they can be provided links if they are not comfortable looking by themselves
- Links below can be used by students:
    - http://www.aboutbioscience.org/careers/microbiologist
    - http://www.bls.gov/ooh/life-physical-and-social-science/microbiologists.htm
    - http://study.com/articles/Become_a_Virologist_Education_and_Career_Roadmap.html

EVALUATION

- Students will be evaluated based on their answers to worksheets and their presentations

SOURCES AND RESOURCES

- Dr. Lydia Contreras's Hot Science – Cool Talks Lecture # 96
- List any other sources you referenced to create this lesson plan, and if relevant, include the full web addresses for them.
- http://www.microbelibrary.org/component/resource/laboratory-test/3085-preparing-spread-plates-protocols

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- http://www.aboutbioscience.org/careers/microbiologist
- http://www.bls.gov/ooh/life-physical-and-social-science/microbiologists.htm
- http://study.com/articles/Become_a_Virologist_Education_and_Career_Roadmap.html

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EXPLORATION ACTIVITY or ACTIVITIES

Purpose

To explore whether antibiotic soap, normal soap, or hand sanitizer is the best inhibitor of bacterial growth

Materials

1. Autoclave
2. Agar plates
3. E Coli Liquid culture
4. L shaped glass rod
5. Forceps
6. Filter paper
7. Normal soap
8. Antibacterial soap
9. Hand sanitizer
10. Incubator

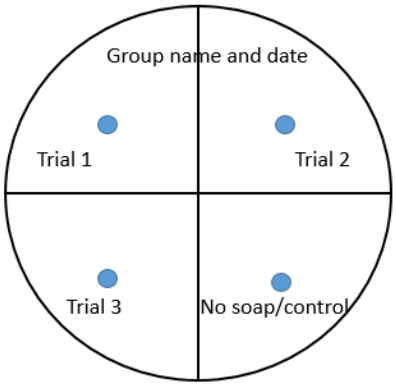
Safety Information

Students/teachers should be careful to wear gloves and not touch the E. Coli. If it gets on anything the student is working with such as a glass container or the table, wash the surface with bleach.

Procedure

Setup process performed by the teacher

- 2 days before starting the exploration, the teacher label agar plates (date, group name, and one plate separated into four sections—see diagram below). The blue dots represent where the filter paper should be placed.
- E. Coli liquid culture should be ordered ahead of time in order for use on the day of the experiment



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- Additionally, a day or two before the experiment, the teacher will use a hole puncher to make holes from filter paper (enough to have one circular piece for each trial, so make about 30 pieces so there are many extras just in case of a mistake). Then these circular pieces should be placed on a piece of foil and wrapped and then autoclaved

Experiment (can by performed by students or teacher, if teachers are not comfortable allowing students to handle this procedure)

- For the procedure, students will set up agar plates, streak bacteria on them, and place a filter paper containing different either antibiotic soap, normal soap, or hand sanitizer. Each group will be assigned to a different soap type and will only have to perform three trials.
- Instructions:

1. Transfer 100 microliters of E. Coli from the liquid medium onto an LB agar plate
2. Then, a glass rod should be sterilized by first dipping in alcohol (70% isopropyl or ethanol) and then touching it to a flame
3. Next, the glass rod will be used to spread the liquid culture evenly across the agar plate
4. Once the liquid has been evenly spread, use sterilized forceps to pick up the circular filter paper and dip it into either antibacterial soap, normal soap, hand sanitizer, or no soap at all for control
5. Then, the filter paper should be carefully placed in the middle of one of the four sections of the agar plate
6. The glass rod can be cleaned by placing it in the alcohol and touching it once again to the flame
7. Repeat steps 1-6 for trial 2 and trial 3
8. In the last section of the agar plate, place a filter paper in sterilized water instead of soap in the middle of the section.
9. Place the lid back on the agar plate and place it in upside down in the incubator
10. After students they are done with streaking and putting the plates in the incubator, they will be assigned an article or video about how microbes are beneficial or harmful. They will take notes and then present to the class what they learned.
    a. https://www.youtube.com/watch?v=qpa9JvIwfHQ&feature=youtu.be
    b. http://www.thehealthyskinblog.org/skin-flora-our-protective-shield/
11. The next day, they will measure the zone of inhibition using a ruler and take an average for each group. To measure the zone of inhibition, measure the distance from the circular filter paper to the part of the circle where bacterial growth is evident. They will then conclude whether antibacterial soap or normal soap is more effective at inhibiting growth of bacteria.

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TEACHER PAGE(S)

Microbes Worksheet

Hypothesis:
Students can put one of two hypotheses: Soap type does have an effect on the inhibition of the growth of bacteria OR soap type does not have an effect on the inhibition of the growth of bacteria

Experiment: Explain, in your own words, what procedure was used to solve the question in the hypothesis
We spread E.Coli liquid culture onto agar plates and placed a circular filter paper (which was dipped into a soap type) onto the middle of one of the four sections on one agar plate. Of the four sections in one agar plate, one was a control where the filter paper was dipped in water. We performed three trials each for each treatment type. Our treatment types included: normal soap, antibiotic soap, hand sanitizer, and no soap. After allowing the bacteria to grow for a day, the zone of inhibition was measured. The greater the zone of inhibition, the more successful the treatment was at inhibiting growth of bacteria.

Results:

	Zones of inhibition measured for different soap types in *E. coli*			
	Normal Soap zone of inhibition (cm)	Hand sanitizer zone of inhibition (cm)	Antibiotic soap zone of inhibition (cm)	No soap zone of inhibition (cm)
	(answers will vary)	(answers will vary)	(answers will vary)	(answers will vary)
	(answers will vary)	(answers will vary)	(answers will vary)	(answers will vary)
	(answers will vary)	(answers will vary)	(answers will vary)	(answers will vary)
Average				

Based on the article you read or the video you saw about microbes, are they beneficial or harmful?
(an example of an answer, answers vary) Although some microbes are harmful, most of the flora on our skin are harmless and may actually give us benefit by keeping infections away. However, if the skin is damaged, these microbes can cause problems such as boils.

Conclusion: Based on your results from the experiment, what can you conclude about your hypothesis and why?
(an example of an answer, answers vary) It looks as if soap type does have an effect on the inhibition of the growth of bacteria because the averages are different. However, a statistical test needs to be conducted in order to be sure.

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TEACHER PAGE(S)

Explore a career path one can take in the field of microbiology and explain what the responsibilities are:

(an example of an answer, answers vary) A virologist is typically a person who studies viruses in humans, plants, insects, etc. Depending on where they work, they will have different duties. For example, if they work for a university as a professor, they are most likely both doing research on viruses and teaching at the same time. However, if they work for an industry they will most likely be developing a product such as viral medication.

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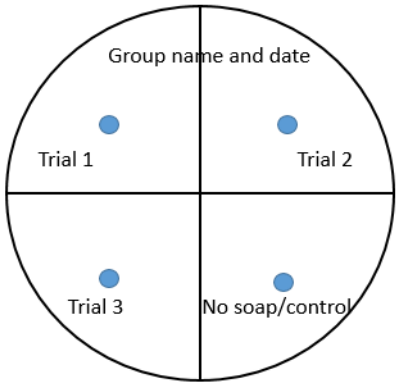
STUDENT PAGE(S)

Instruction Sheet

1. Transfer 100 microliters of E. Coli from the liquid medium onto an LB agar plate
2. Then, a glass rod should be sterilized by first dipping in alcohol (70% isopropyl or ethanol) and then touching it to a flame
3. Next, the glass rod will be used to spread the liquid culture evenly across the agar plate
4. Once the liquid has been evenly spread, use sterilized forceps to pick up the circular filter paper and dip it into either antibacterial soap, normal soap, hand sanitizer, or no soap at all for control
5. Then, the filter paper should be carefully placed in the middle of one of the four sections of the agar plate (see diagram below for how to position filter paper represented by the blue circle)



6. The glass rod can be cleaned by placing it in the alcohol and touching it once again to the flame
7. Repeat steps 1-6 for trial 2 and trial 3
8. In the last section of the agar plate, place a filter paper in sterilized water instead of soap in the middle of the section.
9. Place the lid back on the agar plate and place it in upside down in the incubator
10. After your group is done with streaking and putting the plates in the incubator, you will be assigned an article or video about how microbes are beneficial or harmful. Take notes on your worksheet because your group will have to present about the article or video at the end of class
    a. https://www.youtube.com/watch?v=qpa9JvIwfHQ&feature=youtu.be
    b. http://www.thehealthyskinblog.org/skin-flora-our-protective-shield/

11. The next day, measure the zone of inhibition using a ruler and take an average for each group. To measure the zone of inhibition, measure the distance from the middle of circular filter paper to the place where there is a transition from no bacterial growth to the start of bacterial growth.
12. Conclude whether antibacterial soap or normal soap is more effective at inhibiting growth of bacteria and record in your worksheet.

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STUDENT PAGE(S)

Microbes Worksheet

Hypothesis:

Experiment: Explain, in your own words, what procedure was used to solve the question in the hypothesis

Results:

	Zones of inhibition measured for different soap types in *E. coli*			
	Normal Soap zone of inhibition (cm)	Dishwashing Soap zone of inhibition (cm)	Antibiotic soap zone of inhibition (cm)	No soap zone of inhibition (cm)
Average				

Based on the article you read or the video you saw about microbes, are they beneficial or harmful?

Conclusion: Based on your results from the experiment, what can you conclude about your hypothesis and why?

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