Grade 8

Module 2: Evolving Germs

Class Question:

Scientist (Your Name):

Teacher's Name:

SciTrek Volunteer's Name:
**Introduction:**

In this experiment, you will observe how different variables can affect the growth of bacteria. Each group will learn how to plate the bacteria on the agar plates. Throughout the experiment, you will see how bacteria will start to grow inside your agar plates. After the bacteria have had time to grow, you will measure the amount of bacteria growth on each of the agar plates. You will then compare this to the amount of growth on your control plates to see if the variables used had an effect on the amount of bacteria growth.

**Vocabulary:**

- **Bacteria:** single-celled organism that can be spherical, spiral, or rod shaped. They do not have a nucleus or other membrane-bound organelles.

- **Agar plate:** a sterile Petri dish that contains agar that is used to culture bacteria and fungi. Agar is a medium used for culture and is gel like.

- **Antibiotic:** a compound that blocks the growth and reproduction of bacteria.

- **Ampicillin:** an antibacterial that will kill any bacteria. If you have ever had an ear infection and gotten the pink bubblegum medicine from your doctor that is what this is.

- **Fluconazole:** a medicine that kills fungus (another type of organism). If you have ever had athlete's foot, this is what you spray on your feet to get rid of it.

- **Antibiotic resistance:** evolution of populations of pathogenic bacteria that antibiotics are unable to kill. (Eg: ampicillin)

- **Constant:** a variable that purposely cannot be changed during an experiment.

- **Control experiment:** when the person conducting the test only changes one variable at a time in order to isolate the results that came from specific changes.

- **Variable:** any item, factor, or condition that can be controlled or changed.

- **Colonies:** A group of bacteria or yeast come together to form a large mass called a colony that is visible to the human eye.
**DAY 1: Bacteria Observations**

**Observations:** Describe the appearance of the plates (streaks of colonies, no colonies, thick colonies, etc)

Plate A Bacteria +Ampicillin: 

Plate B Bacteria +Fluconazole: 

Plate C Bacteria Control: 

Keeping in mind that there was an organism streaked on each plate, describe the effect of each drug on the organism.

<table>
<thead>
<tr>
<th>Effect of Fluconazole on Bacteria</th>
<th>Effect of Ampicillin on Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Why would you expect to see a different effect on the organism?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________
Experimental Design

<table>
<thead>
<tr>
<th>Variables</th>
<th>Constants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think about what other substance (besides antibiotic/antifungal) you could add to positively or negatively impact the growth of the bacteria. List them below.</td>
<td>What are some constants in your experiment (variables that will not change in any trial)?</td>
</tr>
</tbody>
</table>

Control Plating

Plating Your Practice Plate: Every group will need their own control plates.

1. Take an agar plates and label.
   a. Label on the bottom (side with agar)
   b. Example: Teacher, P__, Group __, B, Experiment #, Date
2. Take a plastic swab and dip it in ethanol and shake it to dry
3. Take the sterile swab and dip it into the bacterial culture and gently streak the bacteria labeled agar plates. Streaking in a zigzag manner (4 streaks)
4. Rotate plate 90° and streak another 4 streaks in a zigzag
5. Double check your labeling
6. Give your plates to a SciTrek volunteer to be put in the incubator overnight

Question: Based on the variables compiled by your group, write a question for Experiment 1.

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

THINK: What would you want to change about the plates, why would you want to, and what would happen?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
DAY 2: Procedures, Vocab Review & Discovery Activity

**General Procedure:** Write the steps that you will take to do each of your experiments. Be sure to include amounts and specific steps.

1. __________________________________________________________________________________________
   __________________________________________________________________________________________

2. __________________________________________________________________________________________
   __________________________________________________________________________________________

3. __________________________________________________________________________________________
   __________________________________________________________________________________________

4. __________________________________________________________________________________________
   __________________________________________________________________________________________

5. __________________________________________________________________________________________
   __________________________________________________________________________________________

6. __________________________________________________________________________________________
   __________________________________________________________________________________________

7. __________________________________________________________________________________________
   __________________________________________________________________________________________

8. __________________________________________________________________________________________
   __________________________________________________________________________________________

**Vocab Review:** Now’s a good opportunity to review important vocabulary for this experiment. Go to https://quizlet.com/_243pk3 to review the vocabulary!
Discovery Activity: Look at the picture on the screen. Write down some observations you have about this picture. Try to be as specific as possible. Next, write a question about why or how that observation is there.

<table>
<thead>
<tr>
<th>Observations:</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The leaves are yellow.</td>
<td>Why are the leaves yellow?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DAY 3: Experiment 1

Results from Control Experiment: Use the % of coverage template to analyze your results

<table>
<thead>
<tr>
<th>Control</th>
<th>% of coverage on plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria (B) Control</td>
<td></td>
</tr>
</tbody>
</table>

Draw the colonies on your plates.

Hypothesis: What do you think will happen to your experimental plates?

Experiment 1: ________________________________________________________________

Now plate experiment 1!
Day 4: Moth Activity

Moth Activity: During the industrial revolution, there was a large increase of the amount of pollution in the air due to the increase in the amount of factories in England. Because of this, some organism evolved to become darker colored.

One person will spread 30 white circles and 30 newspapers on a white background. The “predator” will then pick up as many circles as they can in 30 seconds, using forceps. The numbers that are left are doubled to represent the next generation. This will then be repeated with the newspaper background.

White Background:

<table>
<thead>
<tr>
<th>Generation</th>
<th>Starting Population</th>
<th>Final Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Newspaper</td>
<td>White</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Newspaper Background:

<table>
<thead>
<tr>
<th>Generation</th>
<th>Starting Population</th>
<th>Final Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Newspaper</td>
<td>White</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions:
Which circles survived more on the white background? What about on the newspaper background?
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

Why was the moth changing color an advantage?
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
DAY 5: Experiment 2

Results from Experiment 1:

<table>
<thead>
<tr>
<th>Conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables:</td>
<td></td>
</tr>
<tr>
<td>Controls:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>% of coverage on plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>B1 Variable</td>
<td></td>
</tr>
</tbody>
</table>

Draw the colonies on your plates.

Question

Based on the results of Experiment 1, and variables compiled by members of your group, write a question for Experiment 2.

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

Procedure Changes: What changes will you make to your procedure for Experiment 2?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

Hypothesis: What do you think will happen to your experimental plates in Experiment 2?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

Now plate experiment 2!
DAY 6: Experiment 3

Results from Experiment 2:

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Experiment 2</th>
<th>% of coverage on plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables:</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Controls:</td>
<td>B2 Variable</td>
<td></td>
</tr>
</tbody>
</table>

Draw the colonies on your plates.

**Question:** Based on the results of Experiment 1 and 2, and variables compiled by members of your group, write a question for Experiment 3.

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

**Procedure Changes:** What changes will you make to your procedure for Experiment 3?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

**Hypothesis:** What do you think will happen to your experimental plates in Experiment 3?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

**Now plate experiment 3!**

**Analysis**

After viewing your plates, what effect did your variable have on the growth of bacteria as compared to your control? Be sure to refer to your variable tested, total number of colonies, your control, and any sources of error in your answer.

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
**DAY 7: Simulation Game**

**Simulation Game:** Work in a group to design birds and see whether they survive natural selection

<table>
<thead>
<tr>
<th>Bird 1</th>
<th>Bird 2</th>
<th>Bird 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumage:</td>
<td>Plumage:</td>
<td>Plumage:</td>
</tr>
<tr>
<td>Body Size:</td>
<td>Body Size:</td>
<td>Body Size:</td>
</tr>
<tr>
<td>Beak:</td>
<td>Beak:</td>
<td>Beak:</td>
</tr>
</tbody>
</table>

Press continue and move through the environment. Look on the right side of the screen to take note of the environmental conditions.

<table>
<thead>
<tr>
<th>Seeds</th>
<th>Insects</th>
<th>Nectar</th>
<th>Predators</th>
<th>Foliage</th>
</tr>
</thead>
</table>

Allow the simulation to run and write down how many birds are alive at each of the following years:

<table>
<thead>
<tr>
<th>Years Passed</th>
<th>Bird 1 numbers</th>
<th>Bird 2 Numbers</th>
<th>Bird 3 Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>50,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Questions:
Did any of your birds go extinct? If so, why?
_______________________________________________________________________________________________________
_______________________________________________________________________________________________________

Look at your final birds. Do any of them look different than they originally did? If so, why?
_______________________________________________________________________________________________________
_______________________________________________________________________________________________________

What traits do you think were best for this environment?
_______________________________________________________________________________________________________
_______________________________________________________________________________________________________

DAY 8: Conclusions

Results from Experiment 3:

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Experiment 3</th>
<th>% of coverage on plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables:</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Controls:</td>
<td>B3 Variable</td>
<td></td>
</tr>
</tbody>
</table>

Draw the colonies on your plates.
Conclusion: Compile the data from all of your experiments

<table>
<thead>
<tr>
<th>Experiment</th>
<th>% of Coverage on Plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria Control</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td></td>
</tr>
</tbody>
</table>

According to your data, are there any patterns or trends that you observe? Cite specific data from the table above.

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

What experiment had the most colonies compared to the control? Why do you think there were more colonies in that experiment?

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

Why is it important to compare your experiments to the control?

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

If you have a plate that has less organisms than the control, what do you think happened?

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________

_______________________________________________________________________________________________________
SciTrek is an educational outreach program that is dedicated to allowing 2nd-8th grade students to experience the scientific process first hand. SciTrek partners with local schools to present student-centered inquiry-based modules that not only emphasize the process of science but also specific grade level content standards. Each module allows students to design, carryout, and present their experiments and findings.

For more information please feel free to visit us on the web at http://www.chem.ucsb.edu/scitrek/ or contact us by e-mail at scitrekadmin@chem.ucsb.edu.

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