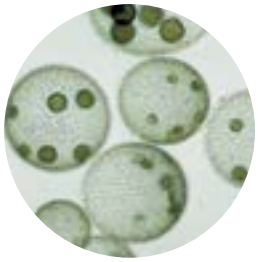
Survival: Swim to the Light

A Carolina Essentials™ Investigation



Overview

This investigation examines the phenomenon of **phototaxis**, movement away from or toward light. Students may be familiar with time-lapse photography of plants growing toward light, a phenomenon known as **phototropism**. For this lab, students will gather observations of algae in full light, change habitat conditions by reducing light, and apply their observations to support or refute a claim concerning algae survival with regard to light.

Life Science
Grade: 3

Essential Question

Can all organisms survive equally well in the same habitat?

Investigation Objectives

1. Observe how algae react when the amount of light in their habitat changes
2. Explain how a decrease in light affects the survival of each type of algae

Next Generation Science Standards* (NGSS)

PE 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Construct an argument with evidence.	**LS4.C: Adaptation** • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Safety Procedures and Precautions

Ensure that students understand and adhere to safe laboratory practices when performing any activity in the classroom or lab. Demonstrate the protocol for correctly using the instruments and materials necessary to complete the activities, and emphasize the importance of proper usage. Use personal protective equipment such as safety glasses or goggles, gloves, and aprons when appropriate. Model proper laboratory safety practices for your students and require them to adhere to all laboratory safety rules. Ensure that students wash their hands before and after conducting the lab exercises.

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TIME REQUIREMENTS

PREP	ACTIVITY
40 min	See below

Teacher Prep: 40 min
Student Activity:
Observation: 1 hr 15 min
Reaction to darkness: 30–45 min
Observation: 2 hr 15 min

MATERIALS (PER GROUP)

Carolina standard grade culture tubes with caps, 1 or 2 packs of 12

Volvox globator, 1 tube per 4 groups or pairs of students

Spirulina major, 1 tube per 4 groups or pairs of students

Chlamydomonas, 1 tube per 4 groups or pairs of students

Aluminum foil, 10 cm × 15 cm piece per group or pair

10-oz clear plastic cup, 1 per group or pair

3 disposable pipets

Dual plastic magnifier, 1 per group or pair

Light bank (optional)

Colored pencils

FOR EXTENSION ACTIVITIES

Alga-Gro® Freshwater Medium

Alga-Gro® Seawater Medium

HELPFUL LINKS

Algae Care Guide

Care and Handling of Protozoa and Protists

Carolina® Protozoa and Invertebrates Manual

Culturing Algae

Protozoan Care Guide

Algae Culture Kit

Algae Observation Kit

Algae Photosynthesis Study Kit

REFERENCE KITS

Euglena Phototaxis Kit

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Teacher Preparation and Disposal

The day before the lab activity, prepare a culture tube of algae per group or pair of students. To prepare the tubes:

1. Cut off the narrow tips of 3 dropping pipets.
2. Use a separate pipet for each tube of algae.
3. Using the pipet, gently mix each algae tube. If the algae has clustered at the bottom or top of the tube, gently break up and redistribute the algae.
4. Pipet 7 to 10 ml of each algae culture into 4 clean culture tubes. Each tube should have 3 species present. Loosely cap the tubes and stand the tubes in plastic cups for distribution to students.
5. Student algae tubes should be stored under a light source at approximately 22° C.
6. Cut the pieces of aluminum foil (10 cm × 15 cm).
7. During the investigation, project the Algae Background Data Table.

Disposal

In most municipalities, the algae may be washed down the sink after students have completed the initial investigation. The culture tubes can be washed in hot water without detergent if they will be used again for cultures. Local regulations may require treating cultures with a 1:10 bleach solution before disposal. Check your school and local regulations.

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Student Procedure

1. Label the cup with your name or group number.
2. Use the magnifying glass to look at algae. Do not shake up the tube.
3. Draw your observations. Pay attention to algae color and position in the tube.
4. In 2 or 3 sentences, describe what is in the tube.
5. Wrap the tube in aluminum foil. The top of the foil should be slightly below the top of the water. The bottom of the tube should be covered.
6. Recap the tube.
7. Place the tube in the cup. Put the cup in a window or under a light source for 30 to 45 minutes. Do not shake the tube.
8. Answer the following questions.
   a. Name the organisms and their important traits.

      Chlamydomonas, Volvox, Spirulina. *All live in water, and all make their own food by photosynthesis.* Chlamydomonas *and* Volvox *can swim.* Spirulina *can't swim.*

   b. Identify the habitat and the important characteristics of the habitat.

      The habitat is everything in the test tube. It is water at room temperature. Some light can get through the tube.

   c. In this experiment, what is the system being investigated?

      The system is the light, habitat, and organisms.

   d. What do algae need to survive?

      Light, carbon dioxide, some other nutrients, water, and a fairly warm temperature.
9. Get your cup and tube from the window or light bank. Be careful not to shake the tube.
10. Use the magnifying glass and look at the tube of algae carefully. Do not shake it.
11. Draw your observations. Pay attention to the color and position of the algae in the tube.
12. In 2 or 3 sentences, describe the algae in the tube in detail. Include any changes in location or depth of color of the algae.

Clean Up: Tighten the cap on the tube of algae and place it in the cup. Return the cup and tube to the location your teacher identified. Throw away the aluminum foil.

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Teacher Tips

You may wish to pre-label the cups and have them placed on student desks before students arrive to minimize mixing within the tube.

Introduce students to algae by showing them pictures or projecting the lab algae through a document camera.

Check to see that the algae tube is wrapped tightly and that the foil covers the bottom of the tube. About $^{1}/_{8}$ inch of algae solution should be above the foil line. You may want to model this step for students.

Project the algae background data table.

After 15 to 20 minutes, go over the questions from step 8 with students. Make a summary chart on the board. This helps students identify evidence for making an argument or supporting a claim.

Before students answer the Analysis and Discussion questions, you may wish to show several students' algae sketches to the entire class.

Extensions: Continue to keep the algae tubes wrapped. The algae will turn brownish and go into a dormant state. Returning the tube to full light will bring the algae out of dormancy.

Change the manipulated variable to salinity. Spirulina *is salt tolerant, but* Chlamydomonas *and* Volvox *are not.*

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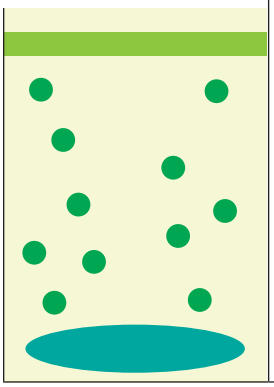
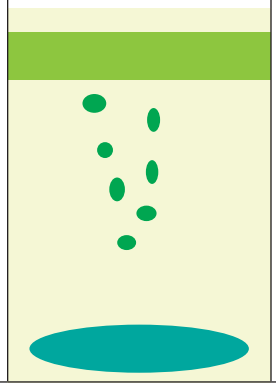
Data and Observations

Observation 1	Description 1	Observation 2	Description 2
	Chlamydomonas *should appear as a narrow, bright yellow-green band at the top of the tube.* Volvox *appear as small spheres interspersed throughout the tube and are more of a kelly green.* Spirulina *looks like a leafy blue-green blob at the bottom.* *Tube water will look yellow-green.*		Chlamydomonas *should appear as a wider, bright yellow-green band at the top of the tube.* Volvox *appear as small spheres moving through the tube toward the top.* Spirulina *will show little change. You may see some fairly large trapped bubbles forming in the spirulina.* *Tube water will look yellow-green.*

Analysis and Discussion

1. Explain how the habitat changed.

   The habitat changed when the aluminum foil was placed around the tube. The foil is blocking out the light from the sides and bottom of the algae tube. The only place light can enter is the top of the tube.

2. How did the change affect the algae? Use your observations

   Lack of light made Chlamydomonas and Volvox swim to an area where they could get enough light to photosynthesize. Chlamydomonas *and* Volvox *swim toward the light. The bright yellow-green band of* Chlamydomonas *got wider, and I could see the* Volvox *swimming toward the top of the tube.*

3. Which algae adapted to the habitat change the best? What evidence supports your claim.

   Chlamydomonas *and* Volvox *adapted to the habitat change the best. Within 30 to 45 minutes they were both swimming toward the light so they could continue photosynthesis and live.*

4. Which algae was least adaptable? Support your claim with observations.

   Spirulina *did not seem to react to the lack of light at all. It did not change its position from the bottom of the tube.*

5. Use your observations to make an argument for or against this claim: For algae to survive well, they must be able to move up and down through the water column to absorb light for photosynthesis. Algae that cannot move through the water column easily are less likely to survive.

   Points students should make in their argument:

   a. Algae must have light to photosynthesize.

   b. Without photosynthesis, algae have no food.

   c. As the amount of light in the habitat changes, algae must move within the water column so they have enough light to photosynthesize.

   d. Algae that cannot move or move very quickly will not survive well because they will not be able to make enough food to survive.

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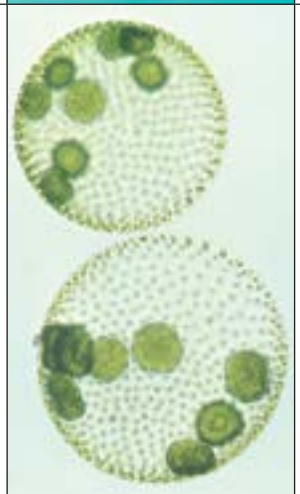
Algae Background Data

Name	Picture	Type	Color	Motion
Chlamydomonas		Single Cell	Bright Yellow-Green	2 Whip-Like Structures Called Flagella
Volvox Globator		Colony	Kelly Green	Flagella
Spirulina Major		Strands of Cells	Blue-Green	None

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