

Guided Inquiry Lab: *The Effect of Fertilizer on Algae*

Question: How do excess nutrients affect the growth of algae?

Background

As primary producers, algae form the base of the food web in the upper layers of the ocean and in freshwater lakes and ponds. The term *algae* is used to describe a range of organisms, from large brown kelp found attached to rocks at the seashore to the tiny green algae found in fish tanks. Like other plants, green algae need nitrogen, phosphorus, and potassium in order to grow. All three nutrients must be available for the algae to thrive and reproduce.

Have you ever seen a pond with a thick, green layer of algae on its surface? This layer is a sign that the homeostasis of the ecosystem may have been disturbed by the presence of too much nitrogen or phosphorus in the water. Fertilizers and animal waste contain these nutrients, which can be transferred to bodies of water when rainfall flows downhill from farms.

In this lab, you will work with *Chlorella*, a type of algae that is commonly found in ponds and aquariums. You will select nutrient amounts and compare the growth of *Chlorella* when nutrients are limited and when nutrients are abundant.

Pre-Lab:

1. To which trophic level does algae belong?
2. How does algae obtain energy?
3. What are three important nutrients that algae need to grow?

Procedure

Part A Set-up

1. The test tube rack at your lab station should have 3 test tubes labeled Control, Fertilizer 1, and Fertilizer 2. Each test tube should have a sample of algae.
2. Decide how many drops of fertilizer to put in the two Fertilizer test tubes. Select between **one and six drops**. Record your plan in the Experimental Design Table on the lab sheet.
3. Use a dropper pipette to add drops of fertilizer solution to the test tube labeled Fertilizer 1 and 2 according to the Experimental Design Table on the lab sheet.
4. Loosely plug each test tube with a cotton ball to slow the evaporation of the water. Place each test tube in the properly labeled location in the test tube rack.
5. Clean work area and put away any unused materials. Wash your hands.

Name: _____
 Period: _____

Data:

Experimental Design	
	# Drops Fertilizer
Control	
Fertilizer 1	
Fertilizer 2	

Data Table						
Day	Control counts	Control average	Fertilizer 1 counts	Fertilizer 1 average	Fertilizer 2 counts	Fertilizer 2 average
1						
2						
3						
4						

Guided Inquiry Lab: *The Effect of Fertilizer on Algae*

Part B Days 1-4

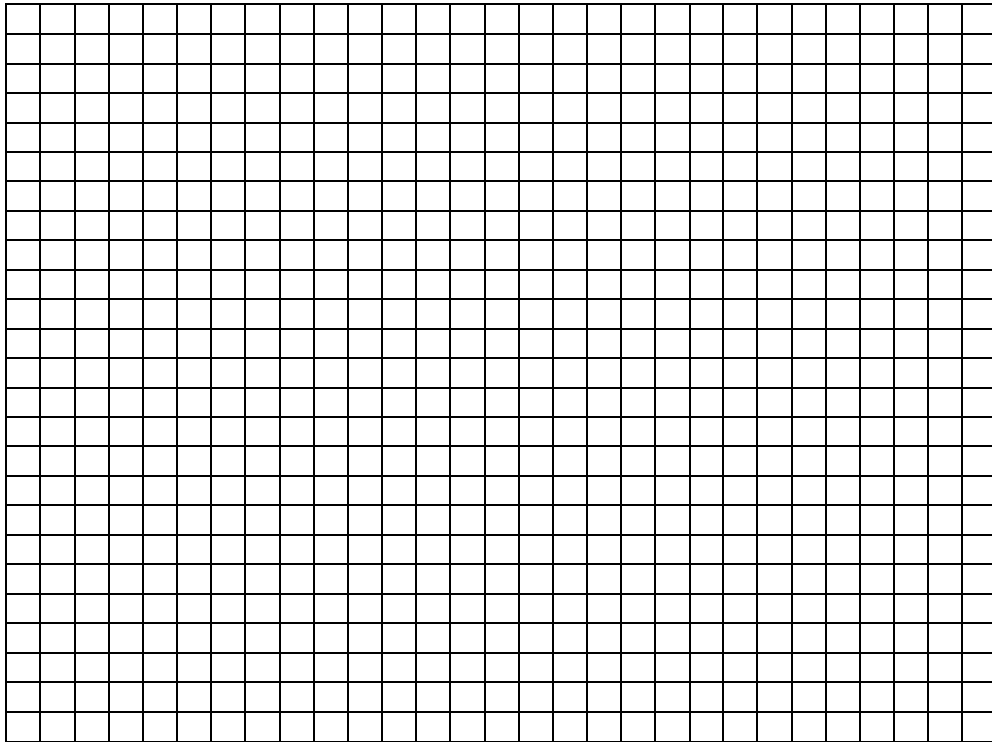
1. On the day after set up (Day 1), observe a small sample from the Control test tube under a light microscope:
 - Gently swirl the test tube so that the algae are mixed evenly in the water. If algae are collected in a pellet at the bottom of the test tube, then dislodge the pellet by holding your finger over the test tube and shaking the test tube carefully and vigorously.
 - When the algae are thoroughly mixed into the water, use the control dropper pipette to transfer **one drop** from the test tube onto a glass slide and cover with a coverslip.
 - Re-cover the algae test tube with a cotton ball when you are finished collecting your sample to slow the evaporation of water.
2. Examine the slide under high power. Count the number of *Chlorella* cells in the field of view. Record this number in the data table for the appropriate day.
3. Use the appropriate labeled Fertilizer dropper pipette and repeat steps 1-2 for the test tube labeled Fertilizer 1. Rinse the dropper pipette.
4. **Make sure to avoid cross-contamination.** Use the appropriate labeled Fertilizer dropper pipette and repeat steps 1-2 for the test tube labeled Fertilizer 2. Rinse the dropper pipette.
5. Repeat steps 1-4 each day for the next **four days** and submit your data into the class Google Document (QR Code provided in the class PowerPoint) so we are able to calculate class averages.
6. Clean your work area and put away any unused materials. Wash your hands.

Analyze and Interpret Data:

Type your answers for questions 1-4 in a separate document and submit through Turnitin.com

1. **Draw Conclusions:** Use the evidence you gathered in this experiment, explain what affect the addition of fertilizer had on the growth of your algae? *Hint:* Use the graph you create in question 5 as evidence to support your claim.
2. **Conduct an Investigation:** In this investigation, cotton balls were used instead of rubber stoppers. Unlike rubber stoppers, cotton balls allow gases to move through them. Why is the movement of gases into or out of the test tubes essential for the growth of algae? *Hint:* Review the carbon cycle.
3. **Draw Conclusions:** Nitrogen gas (N₂) makes up 78 percent of the atmosphere. In this experiment, which source of nitrogen—the atmosphere or the fertilizer—had the greater effect on the growth of the algae? Apply your knowledge of the nitrogen cycle to support your explanation.
4. **Predict:** Predict how the change in algae growth might affect other biotic factors in another aquatic ecosystem? For example, how might a thick layer of algae on the surface of Lake Washington affect producers that live on or near the bottom of the pond? How might it affect the consumers of the pond?

5. **Construct Graphs:** Make a graph of the number of cells you counted per sample per day (You should have three lines on your graph). Do not forget the labels on your graph!



6. **Develop a Model:** Draw a diagram AND write a caption to explain the role of algae in the carbon cycle. Include the energy source for the algae, as well as the movement of carbon into or out of the algae.