

Eutrophication

Time: 10 min. each day for 2 weeks, with 2 periods for set-up and clean-up

National Benchmarks: Benchmarks 5A: Diversity of Life; 5D Interdependence of Life; 5E: Flow of Matter and Energy; 9B: Symbolic Relationships; 9D: Uncertainty; 12B: Computation and Estimation; 12D: Communication Skills; 12E: Critical-Response Skills.

National Science Content Standards: *Science as Inquiry: A*; *Life Science: C*: Biological Evolution; The Interdependence of Organisms; Matter, Energy, and Organization in Living Systems; *Science and Technology: E*: Abilities of Technological Design; Understandings about Science and Technology; *Science in Personal and Social Perspectives: F*: Population Growth; Natural Resources: Environmental Quality; Natural and Human-induced Hazards; Science and Technology in Local, National, and Global Challenges

New York State Standards: 1, 2, 3, 4, 5, 6, 7

Objectives: Students will know the difference between a ‘pulse’ and a ‘press’ event with regards to eutrophication and be able to graph the growth of algae over time.

Lesson Outline:

1. Students discuss the implications of excess nutrients.
2. Students set up an experiment to observe eutrophication.
3. Every few days, students spend time counting algae under a microscope (alternatively, students can compare water color after a set amount of time)

Materials: 3 mason jars per group, fertilizer, graduated cylinders, pipettes, slides, microscopes (or filter paper), and pond water. Option: turbidity probe.

Preparation: You will need to obtain pond water for this experiment; if that is not possible you can substitute distilled water with added algae. You will also need a place for students to place their jars. This can be by a window or under grow lights.

Engagement: Ask students if they think it can be harmful to have too much of a resource? Examples for us include food and water. Discuss with students ways in which too much of a resource can be harmful to aquatic ecosystems.

Exploration: Have students set up experiments in groups. Each group will get three mason jars and a sample of pond water. Students should stir pond water and then pour the same amount into the three mason jars. Students should make observations about the amount of algae in each jar. Each student should obtain a slide and a microscope, and spend some time counting the number of algal cells they see. A turbidity probe is another option. Students should record their data in a data table. If you don’t want to follow the procedure on the lab sheet with the microscope, you can ‘quantify’ the color of the water in the following manner: filter a sample of the pond water (generally 150-200 mL) through a paper filter, and then take a picture of the filter for future reference. The filter paper can be kept for later comparison as well.

Students will then add the amount of recommended fertilizer to jar 2, which will be the pulse jar. Jar 3 will be the press jar. Jar 1 will be the control and no fertilizer will be added. Student should place their jars in a place with adequate sunlight and will observe them for the next two weeks. Each time the students observe their jars they should fill out another data table and add more fertilizer to the press jar.

Explanation: Students should notice a spike in algal growth in jars 2 and 3. This can lead to a class discussion of algal blooms and their effects. Within the last century, humans have more than doubled the amount of fixed nitrogen that is pumped into the atmosphere every year. In addition to acid rain, nitrogen pollution contributes to the formation of ground level ozone (which can cause breathing problems), too much nitrogen in forests, groundwater contamination, and [eutrophication](#) of coastal waters.

Eutrophication is a process in which the ecosystem is enriched by nutrients, encouraging excess plant growth. This plant growth often strips the water of necessary oxygen, since microbes use up the oxygen as they decompose the excess plant material. Although eutrophication is a natural form of succession which usually takes hundreds or thousands of years, it can be enhanced through human inputs of nutrients. We call this ‘cultural eutrophication’. As the pond becomes covered with surface vegetation, the organic matter settles at the bottom, slowly filling up the pond and causing low dissolved oxygen levels as decomposition takes place.

By increasing the amount of nutrients in an ecosystem, human activity can increase the rate of eutrophication. Fertilizers (including lawn fertilizer), pollution from sewers or septic tanks, agricultural runoff, and runoff from impervious surfaces can increase nutrient loads to the point where a pond becomes toxic. Algal blooms, anoxic conditions, and decreased biodiversity can result. Students have probably seen hyper-eutrophic ponds or lakes in the area, which are easy to spot, since they are often covered with a green layer of algae or other plant material.

Extension: After some time students should notice that jar 2 will recover from the large amount of algae while jar 3 will not. This can lead to a class discussion of the effect of a one time pollution incident verse the continued pollution of a body of water.

Students can use the ‘Ponds and Eutrophication’ reading as background for this lab.

Evaluation: Students can graph their data, making a graph of amount of algae vs. time and plotting all three lines on one graph. They should submit the graph along with the experimental results and answers to the discussion questions.

Comments: