Eutrophication: The Aging of a Lake

Students will learn about eutrophication and algal growth from experiments they do in the classroom.

Grade Level: 8-12

Subject: Science

Duration: 2 45-60 min periods; one for set up and one for analysis, as well as brief observations and measurements over a 2-week period.

Objectives:

1) To teach students about the natural process of eutrophication.

2) To explain the difference between eutrophic and oligotrophic bodies of water.

3) To teach students about non-point source pollution, including erosion, fertilizer, salt, and sewage.

4) To show students how non-point source pollutants can greatly increase the rate of eutrophication

5) To show students some basic methods used for determining a lake's clarity.

Terms:

Eutrophic, oligotrophic, eutrophication, limpid, turbid, non-point pollution, watershed, phosphorus, nitrogen, erosion, run-off, sewage, septic system, algae, algae bloom, Secchi disk.

Materials:

8 two-liter plastic bottles with the tops cut off, phosphate-based dishwasher detergent, distilled water, tap water, lake water.

Background:

The acceleration of the eutrophication process by humans is one of the greatest threats to Lake George and other oligotrophic lakes. Eutrophication is the natural process by which a lake ages. In nature this process takes thousands or even millions of years. Slowly, erosion creates deltas at the base of the streams which feed a lake. As silt fills the lake its waters gradually change from oligotrophic (nutrient-poor) to eutrophic (nutrient-rich). The waters of oligotrophic lakes are usually very clear, while eutrophic lakes support much more algae growth. Eventually, this process turns a lake or pond into a wetland, which in turn becomes land.

Human activity can accelerate this process drastically. Erosion created by deforestation or construction can create deltas in months instead of centuries. When fertilizers from farms or lawns are washed into a body of water, they spur the growth of algae. Another prime source of nutrients for algae comes from sewage which carries dense concentrations of nitrogen and phosphorus when it spills into a lake. Increased algae growth can turn water cloudy, lower dissolved oxygen concentrations, and give water a foul taste and odor. During an intense algae bloom, the bacteria which feed on dead algae can lower dissolved oxygen levels so much that all the fish in the lake die.

Lake George is generally classified as an oligotrophic lake. Although oligotrophic lakes contain less biomass than eutrophic lakes, they usually have a far greater diversity of species. This greater diversity creates a food web that is better able to adapt to changing circumstances. The clear water of oligotrophic lakes is better suited to recreational activities like swimming and boating.

Unfortunately, the oligotrophic status of Lake George is on the verge of changing. Because of the high amount of human activity around the lake, phosphorus levels in the South Basin have risen greatly. Each summer, scientists with the Darrin Freshwater Institute now measure levels of phosphorus that exceed 10 ppm in the South Basin. This increase in nutrient levels also exacerbates problems like the invasion of the aquatic weed Eurasian watermilfoil.

The purpose of this lab is to allow students to see how increased levels of nutrients directly affect the growth of algae. They will keep subjective notes on the affect of algae growth on water. They will compare algae growth at different levels of nutrient-loading. At the end of the project, they will have seen the dramatic deterioration in water quality that can result from non-point source pollution.

Procedure:

1. Prepare the bottles: Cut the tops from 8 two-liter bottles. Fill one bottle with distilled water, one bottle with tap water, and 6 bottles with lake water.

2. Add phosphates to the 5 of the 6 bottles with lake water by adding the high-phosphate dishwasher detergent. Add 1g, 2g, 5g, 10g, and 50g. Label the bottles clearly, and mix well. Leave one bottle of lake water as the control.

3. Inoculate the bottles of distilled and tap water with algae by adding 100ml of water from Lake George.

4. Place the bottles together in a warm place that receives plenty of sunlight.

5. Observations: Appoint 1-2 students to record observations for each day on the Observation Chart. Students should record any subjective observations they have about the flasks. Things to look for include: overall appearance, turbidity, color, sediments, and odor.

6. Keep the water levels constant from day to day by adding enough water to replace the loss from evaporation. Unless your water is heavily chlorinated, tap water will do.

7. Class discussion: At the end of 2 weeks, gather the class and discuss the results. What was the relationship between nutrients and algae growth? What did the algae do to the quality of the water? What would be the best way to keep algae from growing in Lake George? Be sure to bring up the subject of non-point source pollution. How can it be prevented?

Options:

1. Teachers might elect to have students measure algae concentrations by preparing microscopic slides then counting the number of algae found in a microscopic field. This data could then be recorded and charted on a graph.

2. A bottle can be prepared identically to one of the others, but then placed in a dark area to the effect of no sunlight on algae growth.

3. Measurements of dissolved oxygen could be taken from the samples, then plotted on a graph.

4. Allow the experiment to go on longer… 4 weeks, 8 weeks, all year.