



HANDS-ON LAB

Aquatic Primary Productivity

Freshwater ecosystems are essential to our way of life, as we depend on these aquatic systems as sources of drinkable water. Freshwater ecosystems can be found in lakes, ponds, rivers, and streams, and they occur in either dynamic or standing bodies of water. A freshwater ecosystem includes all of the living organisms as well as the water, soil, rocks, and other nonliving things in its given area.

Like all ecosystems on Earth, the living organisms in a freshwater ecosystem require a source of energy. Primary producers (or autotrophs), such as plants, get their energy from sunlight. Photosynthetic organisms provide energy to other organisms when they are eaten as food. Primary productivity is defined as the rate at which the organisms of an ecosystem carry out cellular processes that make organic compounds from inorganic compounds within the ecosystem. Therefore, quantifying primary productivity helps us to understand energy usage and carbon cycling within an ecosystem.

In aquatic systems, primary productivity commonly is measured by quantifying the products of photosynthesis carried out by photosynthetic organisms in the ecosystem. A simple and common way to measure primary productivity is to measure the amount of oxygen (O_2) produced. In a freshwater ecosystem, this means measuring the levels of dissolved oxygen (DO) in the water. Dissolved oxygen can be measured by using an electronic DO probe and meter, or it can be measured by using the Azide-Winkler titration method.

Living organisms in an ecosystem are dependent on the amount of energy that is available in their environment. Measuring aquatic primary productivity can be used to determine the health of a freshwater ecosystem.

In this lab, you will design and conduct an experiment to determine the environmental factors that might affect the primary productivity of a freshwater ecosystem. You will determine the primary productivity of a freshwater ecosystem by using technology to measure the concentration of dissolved oxygen in water.

PREDICT

Make a prediction about how an environmental factor, such as light penetration, might affect the dissolved oxygen levels in a body of water as a measurement of the primary productivity of freshwater ecosystems.

POSSIBLE MATERIALS

- aluminum foil
- dissolved oxygen test kit or electronic DO probe
- Erlenmeyer flask, 2000 mL
- fluorescent lamp
- *Elodea*
- glass tubing (to fit hole in stopper)
- graduated cylinder, 50 mL
- plastic bottle, clear, 50 mL
- plastic bottles, opaque, 50 mL
- microscope
- microscope slides
- microscope slide covers
- pipette
- rubber flask stopper (with hole)
- rubber tubing (to fit end of glass tubing)
- triple-beam balance
- water sample from an outdoor source such as a lake or pond (collected and prepared according to directions for determining dissolved oxygen levels)
- weighing paper



PROCEDURE

1. Develop and conduct an experiment that will determine the effect of those factors on the levels of dissolved oxygen in water from a natural source. Limit the number of conditions you choose for your experiment to those that can be completed during the time your teacher has allotted for this lab. Consult with your teacher to make sure that the conditions you have chosen are appropriate.
2. Write out a procedure plan for your experiment. As you plan the procedure, make the following decisions:
 - Decide which water quality characteristics you will observe or measure.
 - Select the materials and technology that you will need for your experiment from those that your teacher has provided.
 - Decide what your control(s) will be.
 - Decide what safety procedures are necessary.
3. Have your teacher approve your plan.
4. Obtain the necessary materials and set up the apparatus you will use.
5. Take appropriate safety precautions.
6. Make objective observations.
7. Record observations and data in your Evidence Notebook and organize the information in appropriate tables and/or graphs. Be certain that the graphs and tables are properly constructed and labeled.
8. Clean all apparatus and your lab station. Return equipment to its proper storage area. Dispose of solutions in the containers designated by your teacher. Do not pour any solutions down the drain or put them in the trash unless your teacher directs you to do so. Dispose of plant materials according to your teacher's instructions. Wash your hands thoroughly after all work is finished and before you leave the lab.

ANALYZE

1. Summarize your findings and observations, including an analysis of data tables or graphs that you created.

Name:

Date:

2. For each ecosystem factor you tested, describe how it might have contributed to a change in dissolved oxygen in the water sample.

3. Share your results with your classmates. Which predictions were supported?

EXPLAIN

Write a conclusion that addresses the following points.

Claim What conclusions can you draw from your results? What conclusions can you draw from your classmates' results?

Evidence Give specific examples from your data to support your claims.

Reasoning Explain how the evidence you gave supports your claim. Describe, in detail, the connections between the evidence you cited and the argument you are making.

REFINE

1. Was your experiment a good model for showing the effects of environmental factors on the primary productivity of a freshwater ecosystem? Explain why or why not, and give examples of what might be missing from your model.

2. How did you use technology in your experiment? What advantage did it provide? If you did not use technology in your experiment, explain how the use of technology may have provided more accurate results.
