Does OXYGEN in the Water Matter?

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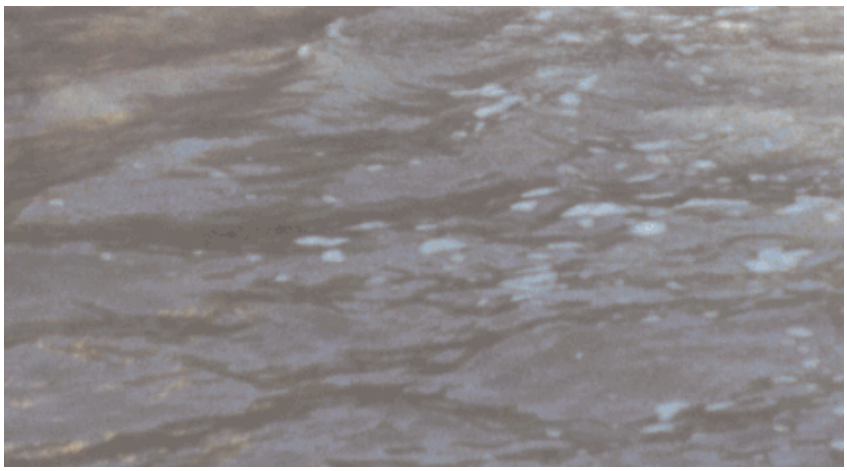
Activity Overview

Dissolved oxygen is one of the best indicators of the health of a water ecosystem. Aquatic animals and plants use oxygen for respiration. Changes in dissolved oxygen levels in the water, often caused by humans, can threaten aquatic life. Thousands of fish and plants die every year because improperly treated wastewater enters a body of water.

Students test their local aquatic site to determine the level of dissolved oxygen in the water. They collect a water sample from a local aquatic site and measure the amount of dissolved oxygen using a Dissolved Oxygen Sensor connected to a TI CBL 2™ or Vernier LabPro, and a TI-73 Explorer™. They take a second dissolved oxygen reading of their sample and find the average value. They record their data in a table.

Conclusion: Low or high dissolved oxygen values indicate poor water quality, which may have a negative impact on animals and plants.

This activity is part of a series of activities to help students determine the water quality of a local aquatic site.



Activity at a Glance

Grade: 4-9
Subject: Science
Category: Life Science, Earth Science, Physical Science
Topic: Living Things, Plants, Animals, Ecology, Water Quality, Chemical Properties

Time required

- One 45-minute period

Level of complexity

- Medium

Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- Dissolved Oxygen Sensor
- 250 mL beaker
- Pipet (comes with sensor)
- Calibration bottle (comes with sensor)
- Distilled water
- Sodium Sulfite Calibration Solution (comes with sensor)
- DO Electrode Filling Solution (comes with sensor)
- Paper tissue
- Temperature Sensor

Dissolved Oxygen Sensor

Temperature Sensor

* This activity was written for use with the TI-73 Explorer™. However it can be easily adapted for use with the TI-83 and the TI-83 Plus. Appendix A explains how to transfer DataMate on your device and how to use DataMate for data collection.

JASON

Adapted from "Experiment 5 — DO," *Water Quality with Calculators*, written by Johnson, Robyn L., Holman, Scott, and Holmquist, Dan D., published by **Vernier Software & Technology**, 2002.

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Concept Background

- Most aquatic species need a minimum of 5mg/L of dissolved oxygen to survive.
- Oxygen levels that remain below 1 to 2 mg/L for a few hours can cause the death of many fish.
- Plants need oxygen too! They take in oxygen during respiration.
- Water temperature, photosynthesis, waste discharge, and salinity are some of the factors that affect dissolved oxygen.
- Waste discharge decreases the amount of dissolved oxygen and causes many aquatic species to die.
- Aquatic sites with good water quality have dissolved oxygen levels between 8 and 10 mg/L. When the level is between 4 and 5 mg/L the site is polluted.

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National Education Standards

Content Standard A: Science as Inquiry.
Students should learn about scientific inquiry and develop the abilities necessary to do it.

Content Standard B: Physical Science.
Students should develop an understanding of properties and changes in matter, motions and forces, and the transfer of energy.

Science Standard C: Life Science
Students should develop an understanding about the structure and function of living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and the diversity and adaptations of organisms.

English Language Arts Standard 3
Students should apply strategies to comprehend, interpret, evaluate, and appreciate text.

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Classroom Management Tips

- This test can be conducted on site or in the lab.
- On-site measurements are recommended.
- Obtain the water sample from below the surface of the water and as far away from shore as is safe. If suitable areas of the stream appear to be unreachable, samplers consisting of a rod and container can be constructed for collection.
- The Dissolved Oxygen Sensor requires 10 minutes while the sensor warms up. The sensor must stay connected to the interface at all times to keep it warmed up. If disconnected for a period longer than a few minutes, it will be necessary to warm it up again.
- When taking readings in cold (0 to 10°C) or warm (25 to 35°C) water, allow more time for the dissolved oxygen readings to stabilize. Automatic temperature compensation in the Dissolved Oxygen Sensor is not instantaneous and readings may take up to 2 minutes to stabilize depending on the temperature.
- You may consider setting up the sensor and TI-73 Explorer™ for data collection and calibrating the sensor in advance. Calibration must be performed prior to going to the field. (*See preparation, Steps 1 through 4.*)
- This activity works well with students working in groups or as a data collection station at the aquatic site.
- Provide your local barometric pressure and air temperature to your students. They will use these values to calibrate the dissolved oxygen sensor (Preparation Step 4).
- Encourage students to answer the questions in Observations and Conclusions in a *Journal*.
- Create your own student questions for use on your student's TI graphing devices using the Texas Instruments StudyCard applications. For more information go to http://education.ti.com/us/product/apps/studycards/screesources.html.

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Vocabulary

Diffusion The movement of molecules (e.g., oxygen molecules), from an area of higher concentration (e.g., the air) to an area of lower concentration (e.g., the water).

Dissolved Oxygen The amount of oxygen dissolved in water. It is usually measured in milligrams per liter (mg/L).

Ecosystem A group of organisms together with its environment, seen as a unit.

Gas bubble disease This disease is most frequently seen in heavily planted or Algae-ridden aquariums or ponds. In such a scenario, oxygen production can be so great that it upsets the proper balance of dissolved gases in the water causing very small gas bubbles to form inside of the fish. If these bubbles move to the blood stream they can be fatal.

Habitat The environment where a particular plant or animal is normally found.

Invertebrate An animal without a backbone.

Photosynthesis The process by which plants harness the energy of the sun to make food. In photosynthesis, plants absorb carbon dioxide (CO_2) and give off oxygen (O_2). Thus, there is an overall accumulation of carbon (C) in the plant.

Respiration The process occurring in living organisms, whereby food is oxidized to release energy.

Salinity The amount of dissolved salt in water.

Watershed An area of land that delivers runoff water, sediment, and dissolved substances to surface water bodies, such as rivers or lakes. All watersheds consist of boundaries, a basin, and collection areas.

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Observations & Conclusions

A. What observations did you make at your aquatic site (weather, description and type of site, signs and condition of animal life, signs and condition of vegetation, signs of pollution)?
Answers will vary.

B. Compare your dissolved oxygen levels with your observations. Based on your observations and the information provided in the research article, identify the factors that influenced your dissolved oxygen levels.
Aquatic sites with good water quality have dissolved oxygen levels between 8 and 9 mg/L. Levels between 4 and 5 mg/L or lower indicate poor water quality. Dangerously low or high dissolved oxygen levels put aquatic animals and plants at risk. Students may observe effects of "abnormal"dissolved oxygen levels on site. Factors like water temperature, photosynthesis and respiration, pollution, and aeration may affect dissolved oxygen levels.

C. If the temperature of the water was higher than your recorded temperature, how would the dissolved oxygen level change? Why?
When the water of an aquatic site is warm, dissolved oxygen levels drop. Oxygen dissolves better in cold water.

D. Find examples of watersheds (local or outside of your area) that are affected by dissolved oxygen levels. Describe efforts that are being done to maintain or change dissolved oxygen levels.
Answers will vary.

JASON