

### Dissolved Oxygen and Decomposition

**Time:** 2 class periods over one week

**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, 4, 5, 6, 7

**Objective:** Students will know the relationship between dissolved oxygen levels and the amount of organic matter in the water.

**Lesson Outline:**

1. Students brainstorm the impact of organic material on water quality.
2. After collecting detritus, students set up an experiment to observe the impact of decomposition on dissolved oxygen (or different water quality parameters, if time permits).
3. Students present and discuss results.

**Materials:** For each group of students:

- about 5 g of leaves, sticks, and other detritus. (Students can be asked to bring this in ahead of time or you can collect them during class. The experiment works faster if wet leaves are used, such as those found at the bottom of a pond. If you use leaves from a natural environment, you don't have to worry about getting pond water.)
- Dissolved oxygen kits or meter, other water quality test kits as desired.
- pond water (or water that you know has some organisms in it)
- Plastic containers (small plastic terrariums work well; teachers have also used old water containers that contain a spout at the bottom to more easily obtain the DO water sample)
- plastic wrap
- scale
- graduated cylinder

**Engage:** Show students a picture of piles of leaves, or ask them to think about their yards in the fall. How is their yard different from a forest? What happens to all of the detritus that ends up in a stream, pond, or lake? Allow students to brainstorm for a few moments. Depending on their understanding of decomposition, they may know that aquatic organisms feed on detritus, slowly breaking it down. They may not know how that process affects the dissolved oxygen levels.

**Explore:** Each group of students should receive a bag of dried leaves, and they should use the scale to measure a fixed amount (5 g works well). Allow students to design the basics of the experiment themselves. Most students will submerge the leaves in their measured water sample, and cover it with plastic wrap. Encourage the creation of control groups. If you are interested in having them measure other parameters, they can do that as well.

Leave the containers in a well-lit space for at least a week (this works within 3 days if using partially decomposed leaves). Allow students to check the DO at pre-determined time periods, and run the experiment for about two weeks. With careful measurement, DO levels drop to less than 1 mg/L by the end of two weeks. Encourage students to be careful when obtaining the water samples to test, especially if they are using a kit that requires them to pour water into a bottle. If possible, have them submerge the bottle in the water sample instead of pouring it from the container.

**Explain:** When decomposition takes place in an aquatic ecosystem, oxygen is depleted because the bacteria and other decomposers require it in order to function. Without the action of moving water (currents, waves) and by sealing off the interface between the air and the water's surface, no additional oxygen can enter into the water. Thus, dissolved oxygen levels are quickly depleted. Encourage students to think about how this would change in different aquatic ecosystems, and how this is connected to the process of eutrophication.

**Extend:** If you had easy access to an outdoor stream, you can create leaf packs from the dried leaves and place them for two weeks in the stream. Be sure to have students weigh the samples beforehand. Carefully remove the leaf packs from the stream, placing them in a bag or other closed container. Return them to the classroom, where students can observe the leaves for signs of predation. Allow the leaves to dry (best to use a dry oven) and re-weigh the leaves. Students should see a response. For more information on this procedure, see the lesson titled "Decomposition in Freshwater" on Learn NC at <http://www.learnnc.org/lessons/HeatherLanier5232002011>.

You can also measure Biological Oxygen Demand (BOD) if time permits. There is an inverse relationship between BOD and DO levels, and this is a good way for students to think about the metabolic requirements of aquatic organisms.

**Evaluate:** Students should complete a lab report and be able to discuss their results in class.

**Comments:**