

Where Does All the Oxygen Go? Inquiry-Based Lab

Biochemical Oxygen Demand

Dissolved Oxygen levels in water affect the kinds and numbers of living plants and animals. Animals are affected by changes in oxygen levels.

What influences the concentration of oxygen dissolved in waters?

Dissolved oxygen concentrations are affected by factors such as **temperature, salinity and dissolved organic matter**. Dissolved organic matter enters in sewage waste water from sewage treatment plants urban and agricultural runoff wastes from food processing industries, meatpacking plants, and dairies wastes from lumber mills, paper plants and other industries, and decaying aquatic plants and animals

All of these waters are "**nutrient-rich**", containing proteins, carbohydrates and fats. Once in the water, these materials are attacked by **decomposers which use them for food**. Decomposers are often bacteria and fungi. In the process of breaking down the nutrients, **decomposers use a great deal of oxygen**. If there are lots of wastes and decomposers, the oxygen dissolved in the water may be used up by the decomposers. This leaves no oxygen for other animals and plants. Under these conditions, many organisms die. To make matters worse, their decaying bodies are fed upon by the decomposers.

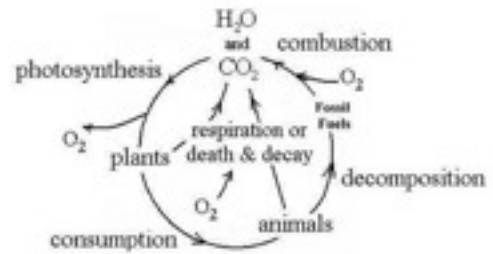
Pre-Lab Questions:

What are two sources of dissolved organic matter in runoff from urban areas?

- a.
- b.

What are two sources of dissolved organic matter in runoff from agricultural areas?

- a.
- b.



The Organic Carbon Cycle

Part 1: Using a Model System to Study the Oxygen Demand of Sewage

You could learn a lot by studying actual sewage wastes, but these can be dangerous since they may contain disease-causing microorganisms. Therefore, in this activity you will use a **simple model that employs yeast, powdered milk, and methylene blue instead of an actual sewage-waste river-water system**. Yeast are microorganisms that use sugar as a source of food energy. They will represent the decomposers present in sewage and natural waters. Powdered milk contains sugar and will represent the nutrient-rich wastes of sewage. Methylene blue is an indicator dye. It is blue when oxygen is present and colorless when oxygen is absent.

Objectives:

After completing this exercise, you will be able to:

- * Understand the affect of biodegradable pollutants on water quality*
- * Design and conduct an experiment*
- * Interpret data*
- * Suggest additional studies*
- * Do serial dilutions*

Pre-Lab Questions:

1: List dissolved organic materials and possible sources that may decrease oxygen levels as a result of decomposition when present in water

2: List possible organisms that may act as decomposers of dissolved organic material in aquatic systems.

Procedure: Develop a **procedure and hypothesis** for the effect of biodegradable materials on dissolved oxygen levels using **YEAST, MILK and METHYLENE BLUE**. What is your independent variable? Your dependent variable? Label and sketch a graph of the data you would expect based on your hypothesis. Create a data table.

Start by making a milk solution. In a 50ml beaker, add two level teaspoons of powdered milk to 40 ml of water. Label this beaker “milk”. In another beaker, make a yeast solution by mixing two level teaspoons of dry yeast with 40 ml of water. Be sure the yeast is well mixed. Stir it again just before you use it. Label this beaker “yeast”. Use 3 test tubes to test your procedures.

Materials Available:

- * Biodegradable Liquid (milk)
- * 6 Test Tubes with Corks
- * 10ml Graduated Cylinder
- * Test Tube Rack
- * 50ml Beakers (2)
- * 1 ml pipettes
- * Yeast
- * Methylene Blue
- * Ice/Water heater

Conclusion: Type up your **background information, hypothesis, materials, procedures, data table and graph and summarize your findings in a conclusion statement.** *Include the following post-lab questions in your conclusion.*

Post Lab Questions:

Which test tube contained the most food for the decay organisms (decomposers)? Which tube had the least food? Explain.

Your test tubes may have had a ring of blue color at the surface even after the remainder of the liquid had changed color. What might account for this?

In which tube did the change occur most rapidly? Is this what you expected? Why?

Develop an explanation that accounts for the differences in time needed for the change to occur in each of the three tubes.

What effect would an increase in temperature have on these mini-systems? How could you find out?

How would your systems have been affected if more decomposers (yeast) had been present at the beginning of your experiment?

Decay organisms often reproduce rapidly when conditions are favorable and nutrients are plentiful. What do you think would happen to the supply of dissolved oxygen in a river if the decay organisms began to multiply?

