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Teacher Notes

Escaping Oxygen Introduction

In this activity, children will use a dissolved oxygen (DO) probe to investigate how different temperatures of water affect the amount of dissolved oxygen present in water. Using a thermometer will afford them the opportunity to watch the dissolved oxygen change as the temperature increases.

Students will investigate and observe water at different temperatures change in amounts of dissolved oxygen while gaining skills and confidence in:

- using a scientific measurement tool, the dissolved oxygen probe
- making explanations and predictions from evidence and drawing logical conclusions
- using a spreadsheet and graphing capacity of a computer to represent and analyze data.
- identifying variables that can affect the outcome of an experiment.

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Discussion Guide

Have the students think about an aquarium with fish. If an aquarium is available have the students observe it. Ask the students what they often see in an aquarium (sand, fish, snails, aerator or bubbler, thermometer, etc.).

Allow the students to observe an aerator in action. Ask the students to think about what the aerator is doing and why this is important to fish. (As the aerator continues to bubble, oxygen is being forced into the water. Fish need oxygen to breathe.) Turn the aerator off and allow the students to observe.

Challenge the students to explain why they cannot see the oxygen once the aerator is turned off. If no one comes up with the explanation, propose that just as some solids such as salt dissolve in water so that the particles cannot be seen, gases like oxygen or carbon dioxide can be dissolved in water as well.

Propose that they will observe soda water (or seltzer water) as an example. Distribute small clear plastic cups of soda water to each student. Challenge the students to observe the soda water and report on their observations. (They will observe bubbles rising to the surface) Ask if they know what is in the bubbles. (Some students may know that the bubbles are a gas.) Ask the student to recall leaving a glass of soda out for an extended period of time and what happen to the "fizz". Propose that the gas is "escaping" from the liquid into the air. (Some students may know that the gas in soda is carbon dioxide and that it is forced into the liquid under pressure.) Ask the students if they think the temperature of the soda water will affect how much gas escapes and how much remains dissolved.

Pour each student a small amount of soda water from a chilled bottle and warmed bottle. Allow the students to observe and taste the warm and cold soda water. They should observe that there are more bubbles escaping CO_2 gas in the warm solution or that the colder soda tastes "fizzier". Ask them to hypothesize what may have changed in the water to account for the taste difference. (As the temperature of water increases the gases dissolved in the water evaporate or escape at an increased rate. Therefore the amount of dissolved gases decrease.)

Tell the students that the air is made up of a number of different kinds of gases. Ask if they know which gas animals breathe from the air. Most students have probably heard that animals breathe oxygen. If one is available, direct the students' attention to the goldfish. Ask them to report on any evidence that the fish is breathing. Ask them to think about whether the temperature of the water would also affect the amount of dissolved oxygen that the goldfish has to breathe.

Have the students read "Thinking About the Question". After the class has had an opportunity to discuss these ideas, propose that we can measure the amount of oxygen dissolved in water with a probe.

You should have a bucket of aerated water at room temperature that will be used for all of the investigations. To aerate the water, place the bubbler (or aerator) in the water and bubble over night. Aerated water from this bucket should be heated for the investigations.

Hand out the dissolved oxygen probes to the class. Explain that this probe allows them to measure the amount of oxygen a solution contains. Have the students look at the membrane that is on the bottom of the electrode. Explain that the membrane must always be in the water

to determine the amount of oxygen it contains.

Direct the class to "Investigation I".

Challenge the class to predict what will happen to the amount of dissolved oxygen in water as the temperature increases. Ask them to discuss the question for a few minutes in their group and present their reasons for their prediction. Direct the class to "Investigation II".

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Additional Teacher Background

Like most gases, oxygen gas dissolves (or is soluble) in cold water more readily than warm water. At water's boiling point, the solubility of oxygen is about half that at freezing. Water absorbs more oxygen when it is agitated. This can occur when the water is in the presence of winds, currents, rapids, etc.

Dissolved oxygen (DO) is the concentration of oxygen molecules in water. Sensitive fish (pike, trout, black bass) require higher levels of DO than more tolerant species (carp, catfish, gar). Dissolved oxygen is reported in milligrams of gas per liter of water (mg/l) and as percent saturation. Percent saturation is found by dividing the measured DO concentrations by the saturated DO concentrations at that temperature and atmospheric pressure. Refer to your Vernier's DO probe instruction manual for saturated DO readings.

While the best data is always obtained if teachers calibrate the probe, a default calibration is provided for the dissolved oxygen probe. If the teacher wishes to calibrate the probe, refer to your Vernier's DO probe instruction manual. Be sure to wear plastic gloves while using the calibration bottle and chemicals provided with the probe. Be sure to dispose of the chemicals properly.

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Escaping Oxygen Suggested Timeline

The amount of time you spend on introductory discussions, data collection, and analysis, will determine your overall timeline. The following represents a possible timeline.

- One class period - Introductory Discussion
- One class period - Investigation I: Finding the amount of oxygen in room temperature water
- One class period - Investigation II: Finding the amount of oxygen in heated water
- One class period - Analysis

Additional days can be used for further investigations.

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