Name_____ Period _____Date_____

Dissolved Oxygen:
Comparing Oxygen Levels in Various Aquaria Samples

Objective

The learner will compare the levels of dissolved oxygen in water at two different temperatures.
The learner will determine the impact of GloFish® fluorescent fish on the availability of oxygen in a sample of water.

Introduction

Nearly all living organisms need oxygen in order to survive. Oxygen is used within the cells of eukaryotes in the process of cellular respiration. Terrestrial organisms breathe oxygen from the air while aquatic organisms (such as fish) obtain oxygen from water. Surface agitation and the process of photosynthesis can increase the amount of gaseous oxygen dissolved in water (known as dissolved oxygen).

In this activity, you will compare the levels of dissolved oxygen in three water samples: one taken from an aquarium with GloFish, another taken from an aquarium with aquatic plants, and the last one taken from an aquarium with both GloFish and aquatic plants.

National Standards Addressed

Life Science C—Interdependence of Organisms

Materials For Classroom

Water sample held at 10 ºC
Water sample held at 15 ºC
Water sample held at 20 ºC
10 gallon aquarium containing 15 GloFish®
10 gallon aquarium containing aquatic plants
10 gallon aquarium containing 15 GloFish and aquatic plants
Dissolved oxygen test kit
Water sampling bottle

Safety Precautions

Refer to the safety precautions included with the dissolved oxygen test kit being used in this activity.

Students should wash hands thoroughly after working with water samples.

Procedures

Part A: Comparing Dissolved Oxygen Levels in Water of Different Temperatures

1. Obtain a water sampling bottle and fill it with water from the 10 ºC container.
2. Perform the dissolved oxygen test following the instructions provided with the test kit supplied by your teacher.
3. Record the amount of dissolved oxygen present in Table 17.1.
4. Empty the sampling bottle and rinse thoroughly.
5. Repeat the dissolved oxygen test using water samples that have been held at 15 ºC and 20 ºC.
6. Record the amount of dissolved oxygen present in the 15 ºC and 20 ºC sample in Table 17.1.
7. Obtain data from other lab groups to determine class average ppm dissolved oxygen for each of the three samples.
8. In the space provided (see Graph 17.2), prepare a line graph of your individual and class dissolved oxygen data. Include axes labels and units on your graph.

Part B: Comparing Dissolved Oxygen Levels in Water with Differing Populations

1. Predict which water sample will contain the highest levels of dissolved oxygen: aquarium water containing GloFish®, aquarium water containing aquatic plants, aquarium water containing aquatic plants and GloFish.
2. Obtain a water sampling bottle and fill it with water from the aquarium containing GloFish.
3. Perform the dissolved oxygen test following the instructions provided with the test kit supplied by your teacher.
4. Record the amount of dissolved oxygen present in Table 17.3.
5. Empty the sampling bottle and rinse thoroughly.
6. Repeat steps 3 and 4 of Part B using water samples from the each of the two remaining aquariums.
7. Prepare a labeled bar graph (see Graph 17.4) depicting the amount of dissolved oxygen in each of the three samples.

Data

Table 17.1	Individual Group Dissolved Oxygen ppm	Class Average Dissolved Oxygen ppm
10 ºC Water Sample		
15 ºC Water Sample		
20 ºC Water Sample		

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Graph 17.2 - Dissolved Oxygen Levels at Three Temperatures

Table 17.3	Dissolved Oxygen ppm
GloFish® Water Sample	
Plant Water Sample	
GloFish & Plant Water Sample	

Graph 17.4 - Dissolved Oxygen Levels in Three Water Samples

Discussion Questions:

1. Describe the relationship between the temperature of water and the presence of dissolved oxygen as observed in Part A of the activity.

2. Which would most likely contain the highest ppm of dissolved oxygen: a flowing stream or a pond (assuming equal temperatures)? Explain your answer.

3. Explain why low levels of dissolved oxygen would be harmful to GloFish® in an aquarium.

4. Which water sample tested in Part B contained the highest levels of dissolved oxygen? Account for this difference.

5. Three aquaria were set up. One contained GloFish, the second contained GloFish along with aquatic plants, while the third was identical to the second except that the plants were continually exposed to a light source. The dissolved oxygen levels were tested initially and then three days later. Explain what the test results would show in terms of the changes in dissolved oxygen levels.

6. Research and then explain the relationship between oxygen levels in the water and the process of photosynthesis.

Elaborations and Extensions

If possible, have students test live water samples in nature. Have students take readings to compare still bodies of water to ones that are flowing.

Have students look up a percent saturation monograph on the internet and use it to calculate the percent saturations of the three water samples using the data collected in Part A.

Dissolved Oxygen:
Comparing Oxygen Levels in Various Aquaria Samples
Answer Sheet

Intended Grade Level
9^{th}, 10^{th}, 11^{th} and 12^{th}

Teacher Information
Water samples used in Part A should be equally aerated prior to the activity. Dissolved oxygen test kits are available for purchase from biological supply companies or some pet stores. Dissolved oxygen probes and CBL's could be substituted for chemical test kits.

Discussion Questions and Possible Answers

1. Describe the relationship between the temperature of water and the presence of dissolved oxygen as observed in Part A of the activity.

   Colder water samples can hold more oxygen than warmer samples. The 10 ºC sample contains more oxygen than the 15 ºC and the 20 ºC samples.

2. Which would most likely contain the highest ppm of dissolved oxygen: a flowing stream or a pond (assuming equal temperatures)? Explain your answer.

   The flowing stream would have higher levels of dissolved oxygen due to the mechanical agitation at the surface of the water. This churning and moving of the water will allow more contact with the surface oxygen which should increase the levels of dissolved oxygen in the water compared to the still water in the pond.

3. Explain why low levels of dissolved oxygen would be harmful to GloFish® in an aquarium.

   Like other fish, GloFish need oxygen in order to perform cellular respiration. Cellular respiration provides energy for the cells of a living organism. Low levels of oxygen would reduce cellular respiration and could eventually be fatal.

4. Which water sample tested in Part B contained the highest levels of dissolved oxygen? Account for this difference.

   The aquarium containing the aquatic plants has the highest dissolved oxygen levels due to the presence of photosynthetic organisms that give off gaseous oxygen.

5. Three aquaria were set up. One contained GloFish, the second contained GloFish along with aquatic plants, while the third was identical to the second except that the plants were continually exposed to a light source. The dissolved oxygen

levels were tested initially and then three days later. Explain what the test results would show in terms of the changes in dissolved oxygen levels.

The third aquarium (containing GloFish® and plants with continual light exposure) would have the highest levels of dissolved oxygen at the end of the three days. The first aquarium containing only GloFish will have the lowest levels of dissolved oxygen.

6. Research and then explain the relationship between oxygen levels in the water and the process of photosynthesis.

   In the process of photosynthesis, water is split to obtain electrons. Oxygen is given off as a by-product. The oxygen given off by the plants increases the amount of dissolved oxygen in the surrounding water.