Lesson 1-Introductory Lesson-What is dissolved oxygen and how is it important to an aquatic ecosystem?

Introduction

Dissolved oxygen is one of the best indicators of the health of a water ecosystem. Dissolved oxygen can range from 0-18 parts per million (ppm), but most natural water systems require 5-6 parts per million to support a diverse population. When organic matter such as animal waste or improperly treated wastewater enters a body of water, algae growth increases and the dissolved oxygen levels decrease as the plant material dies off and is decomposed through the action of the aerobic bacteria. Decreases in the dissolved oxygen levels can cause changes in the types and numbers of aquatic macroinvertebrates which live in a water ecosystem.

Objectives:

Students will be able to:

•explain why dissolved oxygen is important in aquatic ecosystems.

•evaluate the optimal dissolved oxygen levels for living organisms.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Materials:

Fresh water sample from a local stream or pond

1000 milliliter beaker or large container

3 500 milliliter beakers or jars to set up miniature water ecosystems

Dissecting microscope and hand lenses

Graduated cylinder

Dissolved Oxygen test kit (Chemical)

Petri dishes

Pipettes

Fish tank pump and tubing with a t-connection so the tubing can provide air to 2 beakers

Air regulator for beaker 2 or a paper clip

Procedure:

Working with a partner:

1. Take an approximate 1000 ml sample of the water sample from a local stream or pond.
2. Pour a portion of the sample into a petri dish and examine it under low power on the microscope or with a hand lens.
3. Provide a detailed description of the water sample. What types of organisms are found? Are the organisms living?

4. Test the dissolved oxygen levels of the water sample.
   Initial dissolved oxygen reading:

5. Separate the water sample into the three beakers or jars and label as follows:

   Beaker 1-Control-no aeration
   Beaker 2-Slight aeration
   Beaker 3-Increased aeration

6. Place beaker 1, the control, in an area where it will not be disturbed for a 24 hour period.
7. Place beaker 2, slight aeration, and beaker 3, increased aeration, side by side.
8. Plug in the fish tank pump and place the tubing in beakers 2 and 3.
9. To reduce the amount of air generated to beaker 2, the tubing may be crimped slightly with a paper clip or a regulator may be used.

Note: Beaker 2 should be receiving less air than beaker 3.

10. Place beakers 2 and 3 in an area where they will be undisturbed for a 24 hour period and the air pump can remain plugged in and running.
11. Based on the initial levels of dissolved oxygen, hypothesize how the biodiversity of each water sample will change over the 24 hour period. Will the organisms increase or decrease? Make sure your hypothesis includes a statement about the dissolved oxygen levels.

Hypothesis:

12. After the 24 hour period, place a portion of each of the water samples from beakers 1, 2 and 3 in a petri dish and examine it under low and high power on a dissecting microscope. Provide a detailed description of each sample. Record your description in the appropriate column in the data table
13. Test the dissolved oxygen level of each sample and record the number in the appropriate column in the data table

Data Table:

Beaker	Dissolved Oxygen Levels	Detailed Description of Sample
1 No Aeration		
2 Slight Aeration		
3 Increased Aeration		

After the observations are complete, answer the following questions:

Conclusions:

1. Does the data collected support your hypothesis? Why or why not?

2. Write a short paragraph explaining how each water sample changed based on the dissolved oxygen levels. What can you conclude about the dissolved oxygen levels and biodiversity?

3. Research the effects of decreased levels of dissolved oxygen on aquatic plants and animals. Describe the causes of decreased oxygen levels and determine how these causes can be reduced or eliminated.

Lesson 2-How does organic material break down and effect the oxygen levels of an aquatic ecosystem?

Objectives:

Students will be able to:

•evaluate the relationship between oxygen levels and the amount of organic matter in an aquatic ecosystem.

•explain the relationship between oxygen levels, bacteria and the breakdown of organic matter using an indicator solution.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Materials:

3 different water samples (dishwater, well water, rain water, pond water, etc.)

3 test tubes

graduated cylinder

test tube rack

methylene blue in a dropper bottle

Note: Bacteria act on methylene blue indicator solution and cause it to change from blue to a colorless liquid. The more bacteria a water sample contains, the faster the color of the methylene blue breaks down.

After discussing the procedure with your partner, write a hypothesis about the relationship between the amount of organic matter, the amount of bacteria and the oxygen levels in a water sample.

Hypothesis:

Procedure:

Working with a partner:

1. Label three test tubes 1, 2 and 3. Put 5 ml of a different water sample in each tube.
2. Add 20 drops of methylene blue to each test tube. Put the test tubes in a test tube rack and observe them at 10 minute intervals for 1 hour. Record your observations in the data table.

Data Table:

Test Tube	Type of Water Sample	After 10 minutes	After 20 minutes	After 30 minutes	After 40 minutes	After 50 minutes	after 60 minutes
1							
2							
3							

Conclusions:

1. Does the data collected support your hypothesis? Why or why not?

2. In which test tube did the blue color disappear first?

3. Which water sample contains the most organic matter? Which contains the least organic matter?

4. Which water sample contains the most oxygen? Which water sample contains the least oxygen?

5. Least 3 possible sources of organic matter in each positive sample.

6. Write a short paragraph explaining the relationship between oxygen levels, bacteria and the breakdown of organic matter. What can you conclude about the dissolved oxygen levels and the amount of bacteria found in a water sample?

Lesson 3-Design an experiment to test the effects of increases or decreases in dissolved oxygen levels on aquatic plants and animals

Objectives:

Students will be able to:

•design an experiment which will effectively test how increases or decreases in dissolved oxygen levels effect plants and animals.

•explain the outcome of the experiment in written and oral form.

Note: Students should be working in groups of two or three to complete this experiment.

Materials:

Dissolved oxygen test kit (Chemical)

assorted glassware

air pumps and tubing

assorted plants and animals

Note: Students will provide a detailed list of materials as they design their experiments.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Question to be investigated:

Examples:

1. How do increases or decreases in dissolved oxygen levels effect the breathing rate of goldfish?
2. How does an increase or a decrease in dissolved oxygen levels effect the biodiversity of a pond water sample?
3. How do dissolved oxygen levels effect the growth of algae or plants?
4. Can certain macroinvertebrates survive at low levels of dissolved oxygen?

Note: Working with a partner, students should develop their own question to be investigated.

Question:

Hypothesis related to the question to be investigated:

Working with a partner, write a hypothesis related to the experimental question. Remember, a hypothesis is a tentative solution to the problem.

Hypothesis:

Procedure:

Develop a step by step plan on how the experiment will be carried out. Make sure to include a time line.

Set up the experiment: This is a trial run. At this time, any problems which may be encountered in the experimental design may be corrected.

Data Collection:

The data collected should be presented in table form.

Analyze the data collected:

Conclusions:

Written Report:

Write a brief report to explain the experiment.

Does the data collected support the hypothesis? Why or why not?

Explain any sources of error which may have interfered with the data collection and the final results.

Oral Presentation:

This should be a brief presentation of the written report.