BIODEGRADABLE MATERIALS AND THEIR EFFECT ON DISSOLVED OXYGEN LEVELS

STUDENT LAB TEMPLATE

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Abstract

In this laboratory exercise, you will design and conduct an experiment to evaluate the effect of the presence of biodegradable materials on dissolved oxygen levels.

Objectives

After completing this exercise, you will be able to:

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

Correlation to the Topic Outline in the Course Description

I.B. The Cycling of Matter
III.A. Renewable and Nonrenewable Resources -- Water
IV. Environmental Quality

Introduction

In aquatic systems, aerobic microorganisms will consume biodegradable material for energy, and in doing so will also take up oxygen from the environment as part of the cellular respiration process. Scientists use dissolved oxygen levels as an indication of contamination by such pollutants as sewage, agricultural runoff, organic industrial effluents, etc.

Prelab Questions

- List dissolved organic materials and possible sources that may decrease oxygen levels as a result of decomposition when present in water.
- Why is the chemical methylene blue clear in the absence of oxygen and blue in the presence of oxygen? (Hint: Use some of the Internet research links listed below.)
- List possible organisms that may act as decomposers of dissolved organic material in aquatic systems.
- Develop a hypothesis for the effect of biodegradable materials on dissolved oxygen levels. What is your independent variable? Your dependent variable? Label and sketch a graph of the data you would expect based on your hypothesis.

Background Research Information Links

http://www.accessexcellence.org/AE/AEPC/WWC/1991/down_drain.html (This lab is adapted from the "Down the Drain" activity by Charlotte Freeman, 1991 Woodrow Wilson Biology Institute.)
http://www.cms.k12.nc.us/allschools/providence/keenan_files/APES/APES%20Labs/BOD.htm
http://www.epa.gov/maia/html/eutroph.html
http://www.epa.gov/ebtpages/water.html
http://www.forsea.org/PSP9.HTML
http://www.woodrow.org/teachers/chemistry/institutes/1988/system.html
http://chemmovies.unl.edu/Chemistry/DoChem/DoChem006.html

Group Size

Group sizes may be from two to four students.

Materials

- Biodegradable liquid
- Six test tubes with screw cap or cork -- at least 10 ml capacity
- 10 ml graduated cylinder
- Test tube rack (see-through)
- Six 1 ml pipettes
- Yeast
- Methylene blue (in dropper bottle)

Safety Measures

Methylene blue may be harmful if swallowed, inhaled, and/or in contact with skin. It may cause severe eye irritation.

Procedure

Using the materials above, develop a procedure to demonstrate the effect of varying concentrations of biodegradable material on dissolved oxygen levels. Show your procedure to your teacher for approval before conducting the experiment.

Data

Include your raw data and a graph (using a spreadsheet) of the data in your submitted report.

Analysis and Conclusion

1. What is the gas taken in by the microorganisms?

2. What is the gas given off by the microorganisms?

3. Where do microorganisms living in water get the oxygen that they use in decomposition?

4. Where do the green plants living in water get the carbon dioxide that they need?

5. Which part of your experiment represents the decomposers?

6. Which part of your experiment represents sewage or some other form of biodegradable waste dumped into water?

7. Write a conclusion as to what you learned by performing this lab. Be sure to include the following:

- Was the hypothesis supported or refuted? Why or why not?
- What were the sources of error in this experiment?
- What might be done differently to improve the quality of the data?