

TRI - BUBBLES

You will measure and analyze the dissolved oxygen (DO) content in varying salinity water samples at 5°C temperature intervals using temperature and dissolved oxygen probes.

Grade Level: 9-12

Subjects:

Tech Algebra II, Algebra I, Algebra II, Algebra II Honors, Analysis, Calculus, Chemistry I, Honors Biology I, Biology I

SOL's covered by this lab include

- Mathematics (A.6, A.7, A.8, and All.9)
- Science (BIO.1, BIO.3, CH.1, and CH.5)

At the completion of this lab the student will be able to:

- describe the relationship between the temperature of a water solution and the amount of dissolved oxygen
- describe the relationship between varying salinity levels in a water solution and the amount of dissolved oxygen
- graph the data and determine the slope of the line at all temperature intervals studied.

Materials (per student group)

Casio 9850G, Casio EA-100 data analyzer with temperature and dissolved oxygen probes, 3 - 600 ml beakers, hot plate or Bunsen burner, standard mercury thermometer, distilled water, Instant Ocean synthetic salt, ice

Solution Preparation

For this experiment salinity levels of 30 ppt and 15 ppt are chosen to approximate sea water and a brackish water mixture. Mix these solutions of 9.0 g of salt per 300 ml of water and 4.5 g of salt per 300 ml of water. It is suggested that these solutions be prepared ahead of time in bulk quantities for the class and be agitated to ensure that oxygen is present in the solutions and be allowed to cool in a refrigerated environment to reach an initial cold temperature.

Procedure

1. Arrange the three beakers and label as 0 ppt, 15 ppt, and 30 ppt .
2. Insert the temperature probe into the EA-100 in the site marked CH1 and the dissolved oxygen probe in site CH2
3. Turn on the EA-100. It should be in communications mode as evidenced by the word DONE on the left side of the screen. (If DONE and SAMPLING are alternately flashing on the left side of the screen, press the MODE button one time to get the EA-100 back into communications mode)
4. Set up the EA-100 to take 10 samples of information. To get into set up mode press the SHIFT button and then the MODE button. You will see the three words READY, SAMPLING and DONE flashing on the left side of the screen. Press the DataLOG key until you see the time .000 sec appear on the screen and then press the TRIGGER button. Again press the DataLOG button until you see the number 10 and again press TRIGGER. Now hit DataLOG until you see the number 0 and once again press TRIGGER. You are now ready to collect the temperature and DO samples.
5. Pour 300 ml of distilled water into the beaker labeled 0 ppt and place a mercury thermometer in it to find the initial temperature. If the temp is above 10°C add a small quantity of ice to cool the water to 10°C. Insert the two probes into the beaker and hit the trigger one time.
6. Place the beaker on the hot plate and plug in the hot plate to slowly warm the beaker of water. Watch the mercury thermometer until the temp. rises to 15°C and again press the TRIGGER button.
7. Repeat at 5°C intervals to 55°C.
8. Upon completion of the tenth reading the EA-100 should say DONE on the left side of the screen. Now connect the EA-100 to the calculator to link the data into the statistical lists. Firmly insert the link cables into the calculator and the EA-100.
9. With the calculator on, enter into the program menu. Highlight the RECEIVE program with the arrow buttons and press the EXE button. The calculator will have a small square in the upper right corner as it processes the information. It will read Done when the temp. and DO information have been stored into list 1 and list 2 in the statistical tables. We will use this information later.
10. Carefully pour out the water as it is still warm.
11. Fill the beaker labeled 15 ppt with 300 ml of 15 ppt solution and repeat steps 5 - 7.
12. When finished, go back into the calculator program menu and select the program RECEIVE2 from the program menu. You may need to scroll down the program menu list with the down arrow to get to the correct programs.
13. Repeat the process again with 300 ml of 30 ppt solution. When finished connect the calculator to the EA-100 and select the program RECEIVE3 from the program menu and press EXE. The calculator will say Done when finished.

Assessment

1. How does temperature affect the amount of dissolved oxygen in water solutions?
2. How does salinity affect the amount of dissolved oxygen in water solutions?
3. What other chemical and biological factors within a freshwater or marine biome may affect dissolved oxygen concentration?
4. As the temperature and salinity increase, what do you observe about the slope of the temperature intervals?
5. How does this data support the kinetic molecular theory of matter? How does it demonstrate the solubility of gases in liquids?

Application

Design an experiment that would measure the dissolved oxygen content as a factor of light intensity.

Closure

Oxygen is critical to the maintenance of the life processes of nearly all organisms. Its concentration and distribution in the aquatic environment are dependent on chemical and physical factors and are greatly affected by biological and chemical processes.

Math is fun

Chemical and physical factors which affect the DO concentration researched in this lab are salinity and temperature. Generally as temperature and salinity increase, the solubility of oxygen in water decreases.