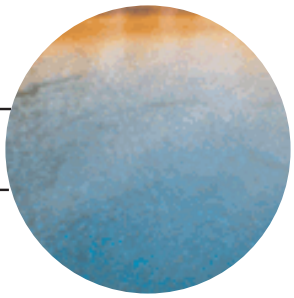
Does OXYGEN in the Water Matter?

ACTIVITY



Activity Overview

Life underwater needs oxygen to survive. The amount of oxygen in water (dissolved oxygen) is one of the best indicators of the health of an aquatic ecosystem. When there is very little or too much oxygen, the ecosystem is in serious danger. Humans are often responsible for polluting the water, which causes the amount of oxygen to change. Thousands of fish and plants die every year because improperly treated wastewater enters a body of water.

Perform an experiment to measure the dissolved oxygen level of your local aquatic site. First make field observations to determine if the aquatic site supports animal life and vegetation. Next, collect a water sample and measure the amount of dissolved oxygen using a Dissolved Oxygen Sensor connected to a TI CBL 2™ or Vernier LabPro, and a TI-73 Explorer™ . Take your measurements twice and find the average value.

What does your data tell you about the quality of the water? Are humans responsible for changing the level of dissolved oxygen that results in the poor health of an aquatic ecosystem? What conclusions can you draw about the role of dissolved oxygen on the health of your local ecosystem?

Image courtesy of NASA

Focus Question

How does dissolved oxygen affect the health of your aquatic ecosystem?

JASON

Does OXYGEN in the Water Matter?

Preparation

A. Prepare the Dissolved Oxygen Sensor for use.

1 Fill the membrane cap with DO Electrode Filling Solution.

a. Remove blue protective cap from the tip of the sensor.
b. Unscrew the membrane cap from the tip of the sensor.
c. Using a pipet, fill the membrane cap with 1 mL of DO Electrode Filling Solution.
d. Carefully thread the membrane cap back onto the electrode.
e. Place the sensor in a 250 mL beaker containing about about 75 mL of distilled water.

Remove membrane cap | Add electrode filling solution | Replace membrane cap

2 Connect the Dissolved Oxygen Sensor to the TI CBL 2™ or Vernier LabPro and TI-73 Explorer™.

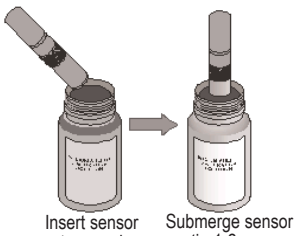
a. Plug the Dissolved Oxygen Sensor into Channel 1 of the TI CBL 2™ or Vernier LabPro.
b. Use the link cable to connect the TI-73 Explorer™ to the interface.
c. Firmly press in the cable ends.

3 Set up the TI-73 Explorer™.

a. Turn on the TI-73 Explorer™ and start DATAMATE. (*For instructions on DATAMATE, see Appendix A)*.
b. Press [CLEAR] to reset the program.
c. If CH 1 displays DO (MG/L), proceed to Step 4. If it does not, continue with this step to set up your sensor manually.
d. Press [1] to go to the setup screen.
e. Press [ENTER] to select CH1.
f. Select D. OXYGEN (MG/L) from the SELECT SENSOR menu.
g. Select OK to return to the main screen.

4 Calibrate the Dissolved Oxygen Sensor.

a. With the sensor still in the water, wait 10 minutes while the sensor warms up. The sensor must stay connected to the interface at all times to keep it warmed up. If disconnected for a period longer than a few minutes, it will be necessary to warm it up again.
b. Select SETUP from the main screen.
c. Zero-Oxygen Calibration Point
   - Select CALIBRATE, then CALIBRATE NOW.
   - Remove the sensor from the water and place its tip into the Sodium Sulfite Calibration Solution. **Important:** No air bubbles can be trapped below the tip of the sensor or the sensor will sense an inaccurate dissolved oxygen level. If the voltage does not rapidly decrease, tap the side of the bottle with the sensor to dislodge the bubble. The readings should be in the 0.2- to 0.5-V range.
   - When the voltage stabilizes (~1 minute), press [ENTER].
   - Enter "0" as the known value in mg/L and press [ENTER].



Insert sensor at an angle | Submerge sensor tip 1-2 cm.

continued on page 3

ACTIVITY

Materials*

- TI-73 Explorer™
- TI CBL 2™ or Vernier LabPro
- TI-73 DataMate
- Dissolved Oxygen Sensor
- 250 mL beaker
- Pipet (comes with sensor)
- Calibration bottle (comes with sensor)
- Distilled water
- Sodium Sulfite Calibration Solution (comes with sensor)
- DO Electrode Filling Solution (comes with sensor)
- Paper tissue
- Temperature Sensor

Dissolved Oxygen Sensor

Temperature Sensor

*This activity was written for use with the TI-73 Explorer™ but can be easily adapted for use with the TI-83 and the TI-83 Plus. Appendix A explains how to transfer DataMate on your device and how to use DataMate for data collection.

JASON

Adapted from "Experiment 5 — DO," *Water Quality with Calculators*, written by Johnson, Robyn L., Holman, Scott, and Holmquist, Dan D., published by **Vernier Software & Technology**, 2002.

continued from page 2

Preparation

d. Saturated DO Calibration Point
   - Rinse the sensor with distilled water and gently blot dry.
   - Unscrew the lid of the calibration bottle provided with the sensor.
   - Slide the lid and the grommet about 1/2 inch onto the sensor body.
   - Add water to the bottle to a depth of about 1/4 inch and screw the bottle into the cap. **Important:** Do not touch the membrane or get it wet during this step.
   - Keep the sensor in this position for about a minute. The readings should be above 2.0 V. When the voltage stabilizes, press ENTER.
   - Using the local barometric pressure and air temperature values provided by your teacher and Table 1 on page 5, determine the 100% Dissolved Oxygen Capacity.
   - Enter the 100% Dissolved Oxygen Capacity value (in mg/L) and press ENTER.
   - Select OK to return to the setup screen.
   - Select OK to return to the main screen.

B. Connect the Temperature Sensor to the CBL 2™.

a. Plug the Temperature Sensor into Channel 2 of the CBL 2™
b. Press 1 to go to the setup screen.
c. Press the ▼ once, then press ENTER to select CH 2.
d. Select Temperature from the SELECT SENSOR menu.
e. Select the correct Temperature Sensor (in °C) from the TEMPERATURE menu.

C. Set up the data collection mode.

a. To select MODE, press ▲ ▲ and press ENTER.
b. Select SINGLE POINT from the SELECT MODE menu.
c. Select OK to return to the main screen.

JASON

Adapted from "Experiment 5 — DO," *Water Quality with Calculators*, written by Johnson, Robyn L., Holman, Scott, and Holmquist, Dan D., published by **Vernier Software & Technology**, 2002.

Does OXYGEN in the Water Matter?

Procedure

1 Make field observations.

a. Make observations at your aquatic site about weather, type of aquatic site, signs and condition of animal life, signs and condition of vegetation, and signs of pollution.
b. Record your observations in your Journal.

2 Collect your dissolved oxygen (DO) and temperature data.

a. Rinse the tip of the dissolved oxygen sensor thoroughly with water.
b. Place the tips of the dissolved oxygen and temperature sensors directly into the water at the site, 4 to 6 cm deep.
c. Gently stir the sensors in the water. **Note:** It is important to keep stirring until you have collected your values.
d. When the readings stabilize, select START to begin sampling. Continue stirring the sensors.
e. After 10 seconds, values representing the dissolved oxygen level and the temperature of your sample will appear on the TI 73 Explorer™ screen.
f. Record these values in the table.
g. Press ENTER to return to the MAIN SCREEN.
h. Take a second reading by repeating steps a through f.
i. Record the values for your second reading in the table.

Water Sample Dissolved Oxygen and Temperature Values		
Reading	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**
1		
2		
Average		

✧ To repeat the experiment, press ENTER to return to the MAIN SCREEN of DataMate and repeat STEP 2.

ACTIVITY

Observations & Conclusions

A. What observations did you make at your aquatic site (weather, description and type of site, signs and condition of animal life, signs and condition of vegetation, signs of pollution)?

B. Compare your dissolved oxygen levels with your observations. Based on your observations and the information provided in the research article, identify the factors that influenced your dissolved oxygen levels.

C. If the temperature of the water was higher than your recorded temperature, how would the dissolved oxygen level change? Why?

D. Find examples of watersheds (local or outside of your area) that are affected by dissolved oxygen levels. Describe efforts that are being done to maintain or change dissolved oxygen levels.

JASON

Adapted from "Experiment 5 — DO," *Water Quality with Calculators*, written by Johnson, Robyn L., Holman, Scott, and Holmquist, Dan D., published by **Vernier Software & Technology**, 2002.

Does OXYGEN in the Water Matter?

ACTIVITY

Table 1: 100% Dissolved Oxygen Capacity (mg/L)

Table 1: 100% Dissolved Oxygen Capacity (mg/L)												
	770 mm	760 mm	750 mm	740 mm	730 mm	720 mm	710 mm	700 mm	690 mm	680 mm	670 mm	660 mm
0°C	14.76	14.57	14.38	14.19	13.99	13.8	13.61	13.42	13.23	13.04	12.84	12.65
1°C	14.38	14.19	14	13.82	13.63	13.44	13.26	13.07	12.88	12.7	12.51	12.32
2°C	14.01	13.82	13.64	13.46	13.28	13.1	12.92	12.73	12.55	12.37	12.19	12.01
3°C	13.65	13.47	13.29	13.12	12.94	12.76	12.59	12.41	12.23	12.05	11.88	11.7
4°C	13.31	13.13	12.96	12.79	12.61	12.44	12.27	12.1	11.92	11.75	11.58	11.4
5°C	12.97	12.81	12.64	12.47	12.3	12.13	11.96	11.8	11.63	11.46	11.29	11.12
6°C	12.66	12.49	12.33	12.16	12	11.83	11.67	11.51	11.34	11.18	11.01	10.85
7°C	12.35	12.19	12.03	11.87	11.71	11.55	11.39	11.23	11.07	10.91	10.75	10.59
8°C	12.05	11.9	11.74	11.58	11.43	11.27	11.11	10.96	10.8	10.65	10.49	10.33
9°C	11.77	11.62	11.46	11.31	11.16	11.01	10.85	10.7	10.55	10.39	10.24	10.09
10°C	11.5	11.35	11.2	11.05	10.9	10.75	10.6	10.45	10.3	10.15	10	9.86
11°C	11.24	11.09	10.94	10.8	10.65	10.51	10.36	10.21	10.07	9.92	9.78	9.63
12°C	10.98	10.84	10.7	10.56	10.41	10.27	10.13	9.99	9.84	9.7	9.56	9.41
13°C	10.74	10.6	10.46	10.32	10.18	10.04	9.9	9.77	9.63	9.49	9.35	9.21
14°C	10.51	10.37	10.24	10.1	9.96	9.83	9.69	9.55	9.42	9.28	9.14	9.01
15°C	10.29	10.15	10.02	9.88	9.75	9.62	9.48	9.35	9.22	9.08	8.95	8.82
16°C	10.07	9.94	9.81	9.68	9.55	9.42	9.29	9.15	9.02	8.89	8.76	8.63
17°C	9.86	9.74	9.61	9.48	9.35	9.22	9.1	8.97	8.84	8.71	8.58	8.45
18°C	9.67	9.54	9.41	9.29	9.16	9.04	8.91	8.79	8.66	8.54	8.41	8.28
19°C	9.47	9.35	9.23	9.11	8.98	8.86	8.74	8.61	8.49	8.37	8.24	8.12
20°C	9.29	9.17	9.05	8.93	8.81	8.69	8.57	8.45	8.33	8.2	8.08	7.96
21°C	9.11	9	8.88	8.76	8.64	8.52	8.4	8.28	8.17	8.05	7.93	7.81
22°C	8.94	8.83	8.71	8.59	8.48	8.36	8.25	8.13	8.01	7.9	7.78	7.67
23°C	8.78	8.66	8.55	8.44	8.32	8.21	8.09	7.98	7.87	7.75	7.64	7.52
24°C	8.62	8.51	8.4	8.28	8.17	8.06	7.95	7.84	7.72	7.61	7.5	7.39
25°C	8.47	8.36	8.25	8.14	8.03	7.92	7.81	7.7	7.59	7.48	7.37	7.26
26°C	8.32	8.21	8.1	7.99	7.89	7.78	7.67	7.56	7.45	7.35	7.24	7.13
27°C	8.17	8.07	7.96	7.86	7.75	7.64	7.54	7.43	7.33	7.22	7.11	7.01
28°C	8.04	7.93	7.83	7.72	7.62	7.51	7.41	7.3	7.2	7.1	6.99	6.89
29°C	7.9	7.8	7.69	7.59	7.49	7.39	7.28	7.18	7.08	6.98	6.87	6.77
30°C	7.77	7.67	7.57	7.47	7.36	7.26	7.16	7.06	6.96	6.86	6.76	6.66
31°C	7.64	7.54	7.44	7.34	7.24	7.14	7.04	6.94	6.85	6.75	6.65	6.55

JASON