

Dissolved Oxygen in Water

(Optical Dissolved Oxygen Probe)

Aquatic life depends upon oxygen dissolved in water, just as organisms on land rely upon oxygen in the atmosphere. Molecular oxygen is used by organisms in aerobic respiration where energy is released during the combustion of sugar in the mitochondria. Without sufficient oxygen, they suffocate. Some organisms, such as salmon, mayflies, and trout, require high concentrations of oxygen in the water. Other organisms, such as catfish, midge fly larvae, and carp can survive with much less oxygen.

Oxygen dissolves at the interface between the water and the air or when aquatic autotrophs release oxygen as a byproduct of photosynthesis. Abiotic factors including temperature and pressure influence the maximum amount of oxygen that can be dissolved in pure water. Biotic life also influences the amount of oxygen that is dissolved.

The following table indicates the oxygen and temperature tolerance level of selected animals. The quality of the water can be assessed with fair accuracy by observing the aquatic animal populations in a stream. These assessments are based on known dissolved oxygen tolerance. If a stream has only species that can survive at low oxygen levels, it is expected to have low oxygen levels.

Animal	Temperature range (°C)	Minimum dissolved oxygen (mg/L)
Trout	5–20	6.5
Smallmouth bass	5–28	6.5
Caddisfly larvae	10–25	4.0
Mayfly larvae	10–25	4.0
Stonefly larvae	10–25	4.0
Catfish	20–25	2.5
Carp	10–25	2.0
Water boatmen	10–25	2.0
Mosquito	10–25	1.0

OBJECTIVES

- Measure the concentration of dissolved oxygen in water using an Optical DO Probe.
- Determine the effect of temperature on the amount of dissolved oxygen in water.
- Apply the results to predict the effect of water temperature on aquatic life.

MATERIALS CHECKLIST

Chromebook, computer, **or** mobile device
Graphical Analysis 4 app
Go Direct Optical Dissolved Oxygen
Go Direct Temperature
two 250 mL beakers
100 mL beaker
polystyrene foam cup
1-gallon plastic milk container
hot and cold water
ice
goggles

PROCEDURE

1. Launch Graphical Analysis. Connect the Optical Dissolved Oxygen Probe and Temperature Probe to your Chromebook, computer, or mobile device.
2. Set up the data-collection mode.
 - a. Click or tap Mode to open Data Collection Settings.
 - b. Change Mode to Event Based.
 - c. Change Event Mode to Selected Events.
 - d. Select Average sensor reading over 10 seconds.
 - e. Click or tap Done.
3. Click or tap Collect to start data collection.
4. Obtain two 250 mL beakers. Fill one beaker with ice and cold water. Place the polystyrene foam cup into the second, empty beaker.
5. Place approximately 100 mL of cold water and a couple small pieces of ice, from the beaker filled with ice water, into a clean plastic one-gallon milk container.
6. Seal the container and vigorously shake the water for a period of 2 minutes. This will allow the air inside the container to dissolve into the water sample.
7. Pour the water into the polystyrene foam cup.

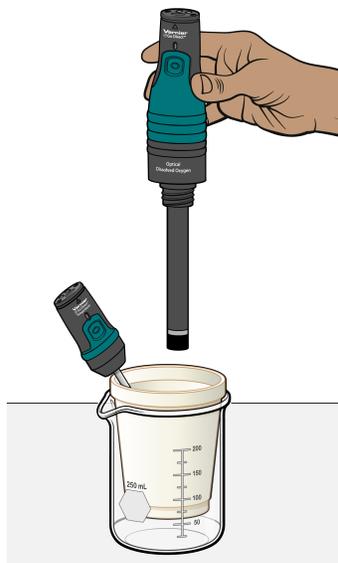


Figure 1

8. Place the Temperature Probe in the polystyrene foam cup as shown in Figure 1.
9. Place the shaft of the Optical DO Probe into the water.
10. Monitor the dissolved oxygen readings displayed on the screen. Give the dissolved oxygen readings ample time to stabilize (90–120 seconds).
11. When the readings have stabilized, click or tap **Keep**. **Important:** Do not remove the probes until the 10-second averaging period is complete.
12. Remove the probes from the water sample.
13. Pour the water from the polystyrene foam cup back into the milk container. Seal the container and shake the water vigorously for 1 minute. Pour the water back into the polystyrene foam cup.
14. Repeat Steps 8–13 until the water sample reaches room temperature.
15. Fill a second beaker with very warm water about 40–50°C. When the water in the polystyrene foam cup reaches room temperature, add about 25 mL of the very warm water prior to shaking the water sample.
16. Repeat Steps 8–13 until the water temperature reaches 35°C.
17. When all samples have been taken, click or tap **Stop** to stop data collection.
18. Click or tap **View**, , and choose **Table**. Record the dissolved oxygen and temperature readings in Table 2.

Experiment 19

19. Create a single graph of dissolved oxygen vs. temperature to help you answer the questions.
 - a. Click or tap View, , and choose 1 Graph.
 - b. Plot dissolved oxygen concentration on the y-axis and temperature on the x-axis. To change what is plotted on each axis, click or tap the axis label and select the correct column.

DATA

Table 2	
Temperature (°C)	Dissolved oxygen (mg/L)

QUESTIONS

1. At what temperature was the dissolved oxygen concentration the highest? Lowest?
2. Does your data indicate how the amount of dissolved oxygen in the water is affected by the temperature of water? Explain.
3. If you analyzed the invertebrates in a stream and found an abundant supply of caddisflies, mayflies, dragonfly larvae, and trout, what minimum concentration of dissolved oxygen would be present in the stream? What maximum temperature would you expect the stream to sustain?
4. Mosquito larvae can tolerate extremely low dissolved oxygen concentrations, yet cannot survive at temperatures above approximately 25°C. How might you account for dissolved oxygen concentrations of such a low value at a temperature of 25°C? Explain.
5. Why might trout be found in pools of water shaded by trees and shrubs more commonly than in water where the trees have been cleared?