What Is Dissolved Oxygen?

In Lesson 5 you studied solutions. One type of solution that was mentioned had a gas solute and a liquid solvent. The study of dissolved oxygen refers to this type of solution. **Dissolved oxygen,** as the name implies, is oxygen gas dissolved in water.

Solubility of Gases in Water

All gases will dissolve in water to some extent, but some gases dissolve better than others. For example, carbon dioxide (CO_2) gas is about 200 times more soluble in water than oxygen (O_2) gas. Nitrogen (N_2) gas is only half as soluble as oxygen gas. Despite differing solubilities of gases, they all follow two basic laws, one in regard to temperature and the other in regard to pressure.

Effect of Temperature on Gas Solubility

Lesson 5 stated that solids generally dissolve better in water as the temperature increases. Gases, however, do just the opposite. As the temperature rises, less gas will dissolve in water.

Temperature of One Liter of Water (°C)	Amount of Oxygen That Will Dissolve (mg/L)
10	48
20	45
30	38
40	32
50	26

Using the preceding table, notice that oxygen gas is almost twice as soluble in water at 10°C than it is at 50°C. As shown in the table, if the water temperature is 10°C, 48 mg of oxygen gas will dissolve in 1 liter of water. Another way to communicate this information is to say that the solubility of oxygen gas at 10°C is 48 mg/L. The unit for dissolved oxygen is mg/L.

Effect of Pressure on Gas Solubility

Air has a mass. In fact, the air that surrounds the earth has enough mass that every square inch of the earth's surface has on it a force of 14.7 pounds. The

amount of force exerted over a unit area is called **pressure.** Air pressure is often measured in pounds per square inch. Other units for air pressure are **atmosphere** (atm) and mm (or inches) of mercury. 1 atm equals 760 mm (29.92 inches) of mercury. In this lesson, the unit used for pressure will be atmosphere.

As pressure increases, more gas will dissolve in water. As shown in the following table, as pressure increases, the amount of oxygen that will dissolve in one liter of water increases.

Air Pressure on One Liter of Water (atm)	Approximate Amount of Dissolved Oxygen (mg/L)
1	46
2	88
3	129
4	170

What Other Factors Affect the Amount of Dissolved Oxygen in Water?

You learned in Lesson 3 that the decay process requires oxygen gas. Several types of circumstances often increase the amount of decaying material in a waterway. If a river or stream has a large amount of decaying vegetation such as leaves or aquatic microorganisms, then the amount of dissolved oxygen is reduced. Sometimes people dump raw sewage, garbage, grass, and other decayable substances in a river or stream. As these objects decay, the amount of dissolved oxygen falls.

Some natural processes act to increase the amount of dissolved oxygen. Aquatic plants produce oxygen gas if sufficient sunlight is available. The oxygen gas dissolves in the water, helping replenish oxygen that is removed. If the water has high turbidity, however, light may not reach aquatic plants.

Water that "splashes" into the air has more dissolved oxygen than water that does not. Water in a rapidly flowing mountain river or stream that splashes against rocks will have more dissolved oxygen than the water of a calm, slow-moving body of water.

As you have already learned, the seasons of the year, time of day, and water depth also affect the temperature of the water, and thus the amount of dissolved oxygen in the water. At lower depths, water is under greater pressure, which also increases the amount of dissolved oxygen the water at those depths can contain.

Dissolved Oxygen Requirements for Fish

Just as you need an adequate amount of oxygen gas in the air to live, so fish and other aquatic life need adequate amounts of oxygen gas to be dissolved in water. Different species of fish require differing amounts of dissolved oxygen. Trout and salmon need 8 to 15 mg/L of dissolved oxygen. Some Mississippi River fish—such as buffalo, carp, and catfish—require 4 to 8 mg/L of dissolved oxygen, so they will survive in waters in which trout or salmon would die.

Questions

1. Using your own words, describe what is meant by dissolved oxygen.
2. How is the solubility of gases in liquids affected by changes in temperature?
3. How is the solubility of gases in liquids affected by changes in pressure?
4. Describe one way that the level of dissolved oxygen can be decreased in a waterway other than by changing temperature or pressure.
5. Explain why daily and seasonal variations in levels of dissolved oxygen are common.
6. What might be done to help insure that a sufficient amount of dissolved oxygen is present in a waterway?

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As a human being, you are unable to use oxygen that is dissolved in water. If you could, you would be able to breathe under water.

An underwater diver must use an oxygen tank. So far, no one has invented a device that can take dissolved oxygen out of the water in a way that humans can use that oxygen for breathing while underwater. Reflect on this. In the future, maybe you will invent such a device.