Name: Hydro 6 Practice 5

Water Properties: Dissolved oxygen

The U.S. Geological Survey (USGS) has been assessing the quality of water bodies for decades. Millions of measurements and analyses have been made. Some measurements, such as temperature and pH are taken almost every time water is sampled and investigated, no matter where in the U.S. the water is being studied. Another common measurement often taken is dissolved oxygen (DO), which is a measure of how much elemental oxygen (O_2) is dissolved in the water. DO can tell a lot about water quality. The elemental oxygen dissolved in lakes, rivers, and oceans is crucial for the organisms and creatures living in it. As the amount of dissolved oxygen drops below normal levels in water bodies, the system can no longer effectively support aquatic life.

Dissolved oxygen

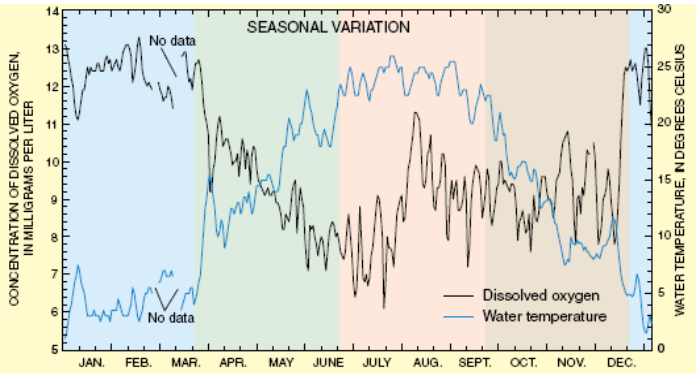
Although water molecules contain an oxygen atom, this oxygen is not available because it is bonded to hydrogen, making water. This makes it unavailable to aquatic organisms living in natural waters. The aquatic organisms use elemental oxygen, O_2, that is dissolved in the water. This elemental oxygen enters a stream mainly from the atmosphere. More atmospheric oxygen will be trapped into the water in churning water. As green aquatic plants undergo photosynthesis, oxygen is also released into the water. The dissolved oxygen is breathed by fish and zooplankton and is needed by them to survive.

A small amount of elemental oxygen (O_2), up to about five molecules of oxygen per million of water, is actually dissolved in water. If one considers the mass of O_2 and the mass of H_2O, this equates to about 10 g O_2 per 1,000,000 g H_2O

$$\frac{5\ molecules\ O_2}{1{,}000{,}000\ molecules\ H_20}\ \ Or\ \frac{10g\ O_2}{1{,}000{,}000g\ H_2O}$$

The dissolved oxygen cannot be seen in a sample of water… for two reasons: 1) O_2 is colorless, and 2) the amount that is dissolved is very low. This is the same as for a closed bottle of a soft drink - the carbon dioxide dissolved in the soda is "unseeable", until the bottle is shaken and then opened up!

Dissolved oxygen, temperature, and aquatic life and water quality



MEAN DAILY DISSOLVED-OXYGEN CONCENTRATION AND WATER TEMPERATURE, PASSAIC RIVER BELOW POMPTON RIVER AT TWO BRIDGES, N. J., JANUARY-DECEMBER 1998

As this chart shows, the concentration of dissolved oxygen in surface water is controlled by temperature and has both a seasonal and a daily cycle. Cold water can hold more dissolved oxygen than warm water. In winter and early spring, when the water temperature is low, the dissolved oxygen concentration is high. In summer and fall, when the water temperature is high, the dissolved-oxygen concentration is low.

Dissolved oxygen in surface water is used by all forms of aquatic life; therefore, this **constituent** typically is measured to assess the "health" of lakes and streams. Oxygen enters a stream from the atmosphere and from ground-water discharge. The contribution of oxygen from ground-water discharge is significant, however, only in areas where ground water is a large component of streamflow, such as in areas of glacial deposits. Photosynthesis is the primary process affecting the dissolved-oxygen/temperature relation; water clarity and strength and duration of sunlight, in turn, affect the rate of photosynthesis. Dissolved-oxygen concentrations fluctuate with water temperature seasonally as well as **diurnally** (daily).

Dissolved oxygen is inversely related to water temperature, depends on exposure to air, and can be affected by the presence of bacteria. Rapidly moving water, such as in a mountain stream or large river, tends to contain a lot of dissolved oxygen, whereas **stagnant** water, or water that is near the bottom (away from the air) in a deep body of water, contains less. Bacteria in water can consume oxygen as organic matter **decays**. Thus, excess organic material in lakes and rivers can cause **eutrophic** conditions, which is an oxygen-**deficient** situation that can cause a water body "to die." Aquatic life can have a hard time in **stagnant** water that has a lot of rotting, organic material in it, especially in summer , when dissolved-oxygen levels are at a seasonal low. Water near the surface of the lake– the **epilimnion–** is too warm for them, while water near the bottom–the **hypolimnion–** has too little oxygen. Conditions may become especially serious during a period of hot, calm weather, resulting in the loss of many fish. You may have heard about summertime fish kills in local lakes that likely result from this problem.

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Reading Guide: Dissolved Oxygen

Reading Vocabulary: Define each of the following words

Eutrophication	
Stagnant	
Decay	
Epilimnion	
Hypolimnion	
Constituent	
Diurnal	

1. What are two ways (*processes and/or sources*) that elemental oxygen gets into water?

2. Write an example of the amount of oxygen dissolved in water. Be sure to include units in your answer.

3. Complete the chart to show the amount (high or low) of dissolved oxygen in different water conditions.

	Fast Moving Water	**Slow Moving Water**	**Water with High Organic Matter**	**Cold Water**	**Warm Water**
Dissolved Oxygen Level (High or Low)					

4. Why is dissolved oxygen used to measure the health of an aquatic ecosystem?