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What is dissolved oxygen?

Dissolved oxygen describes oxygen molecules which have actually dissolved in water. Sometimes people confuse bubbles in water with dissolved oxygen, but in reality the dissolved form of oxygen cannot be seen. Oxygen is not very soluble in water. Under normal circumstances, about 12 parts of oxygen can dissolve in a million parts of water (12 mg/liter). Oxygen can only enter water from two sources: it either dissolves into water from contact with the atmosphere or is produced by plants during photosynthesis.

Why is dissolved oxygen in water important?



All fish and other animals that live in water, such as snails, aquatic insects, and crayfish, require oxygen to survive. Most animals require concentrations of at least 5 parts per million. Some animals, such as trout, require water relatively high in oxygen. Others, such as carp and many native Utah fish can survive in water quite low in oxygen. Therefore, a change in oxygen concentration in water may affect the composition of aquatic communities.

Dissolved oxygen concentration also affects the chemicals in the water. For example, in the presence of oxygen, some metals such as cadmium solidify and sink out of the water. Without oxygen, these metals dissolve into the water in a form which is far more dangerous to animals.

Nutrients in water also change form depending on oxygen concentrations. Without oxygen, phosphorus in lake sediments may dissolve back into the water and contribute to over-fertilizing the lake.

Understanding Your Watershed

How do natural influences affect the dissolved oxygen concentrations in water?

The maximum amount of oxygen that can dissolve into water is affected by water temperature, elevation of the water body, and the salinity (saltiness) of the water. An increase in any of these will result in lower concentrations of dissolved oxygen. Because of this, the dissolved oxygen concentration of a stream or lake will vary throughout the year simply because temperatures rise and fall seasonally.

Turbulent water, such as found in river rapids, can mix so much oxygen into the water that it becomes supersaturated. In contrast, the deep portion summer lakes and reservoirs, or water bodies that freeze, may be so isolated from the atmosphere that the oxygen concentration drops to zero.

Although aquatic plants produce oxygen during the day, they also use oxygen at night during respiration. Therefore, at night, oxygen levels may drop in water containing large numbers of aquatic plants, because no photosynthesis can occur without the sun. Because of this, the best time (although, not a very convenient time) to determine whether a water body is oxygen stressed is just before the sun rises.

How do human activities affect the dissolved oxygen concentrations in water?

Microorganisms such as bacteria decompose organic waste in water—a process which requires oxygen. Organic waste is anything that was once part of a plant or animal, such as leaves and manure. If there is a lot of organic waste in the stream, then the microorganisms multiply and use more oxygen than can be replaced in the stream.

Organic wastes may come from a variety of sources:

- Untreated sewage;
- Runoff from dairies, feedlots, and other agricultural operations;
- Lawn clippings, top soil, and other materials from around our homes;
- Land clearing activities such as logging or construction;
- Storm water runoff from agricultural fields and urban areas.

Removal of the trees and plants that grow along the edge of streams and rivers decreases shading, resulting in warmer water temperatures. This can indirectly cause lower dissolved oxygen concentrations because warm water holds less oxygen.

Phosphorus or nitrogen added to water can also indirectly affect oxygen concentrations. These nutrients may over-fertilize the water, resulting in excess aquatic plant growth. When these plants die and decay they consume oxygen, leading to a drop in concentration.

Understanding Your Watershed

How do you measure dissolved oxygen in water?

Dissolved oxygen in water must be measured either directly in the stream or lake or immediately after collecting a sample. This is because oxygen concentrations can change dramatically in a sample bottle due to changes in temperature or to continued use of the oxygen by bacteria in the water.

Dissolved oxygen is usually measured with a field probe or is collected in a special bottle and chemically “fixed” before being taken back to a laboratory for analysis. This is so the dissolved oxygen concentrations do not change. Field tests used by volunteer monitors usually do not have the accuracy to produce results of the quality necessary for watershed studies. These tests, however, can be very useful for educational, demonstrational, or screening purposes. For more information on simple dissolved oxygen testing, see USU’s Water Quality Extension website at <http://extension.usu.edu/waterquality/>.



What do the results mean?

The State of Utah has set minimum dissolved oxygen concentrations to protect fish and other aquatic animals. These minimum concentrations vary according to the designation of the stream as a warm or cold water fishery, a non-game fishery, or simply waters that support aquatic life.



The minimum concentration for Utah streams designated as cold water fisheries is 6.5 mg/liter (parts per million).

The minimum concentration for Utah streams designated as warm water fisheries is 5.5 mg/liter (parts per million).

NOTE: These minimum values are for a 30-day average to account for daily and weekly fluctuations.



For more information, contact USU Water Quality Extension at 435-797-2580, or visit our website at <http://extension.usu.edu/waterquality/>