Dissolved Oxygen (DO)

What is dissolved oxygen?

Just like animals and humans living on land, animals that live in water need oxygen to survive. Oxygen from the atmosphere dissolves in river and lake water, and it is this oxygen that fish and other aquatic animals use to breathe. When water in creeks and rivers pours over rocks, oxygen can enter into the water. The picture below shows rapids in a glacial stream from Ellesmere Island.

Photo credit: Jenny Graydon

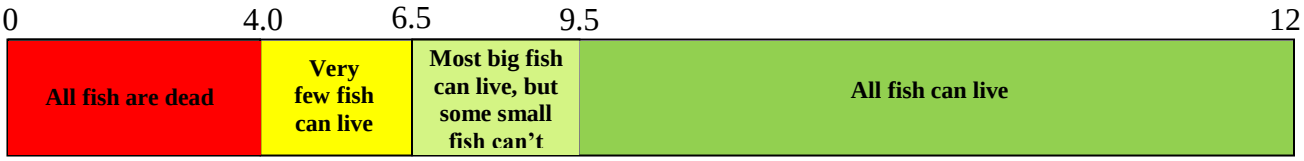
Oxygen levels depend on whether water is flowing or not, whether there are rocks or other obstacles for water to flow over, how many plants are growing in the water, and the temperature of the water. There is more oxygen in cold, flowing water with many obstacles and a moderate amount of plants. Plants take up carbon dioxide and release oxygen, but if there are too many plants all of the oxygen will be used up when bacteria decompose them after they die. Oxygen levels are higher in very cold water compared to very warm water. This might make us think that water in the winter has lots of oxygen but this is actually not true. During the winter, ice covers lakes and rivers and very little oxygen enters the water from the atmosphere– the lake is effectively sealed up.

Oxygen in lakes changes with depth. In deep lakes that do not get very much wind, oxygen levels go down as we get deeper. In all lakes, oxygen is generally low right at the bottom where water meets the lake sediment or mud. This is because there are many bacteria and animals that live and breathe in the sediment. These bacteria and animals decompose dead material that sinks to the bottom and use up oxygen. In some lakes and ponds that have very low oxygen, we install aerators to keep oxygen levels high. This is quite common in lakes that are stocked with fish and in lakes that receive sewage inputs.

Why does dissolved oxygen matter?

Fish and other animals that live in the water need oxygen to live. Natural lakes and rivers generally cannot have too much oxygen. On the other hand, if oxygen levels are too low in the water, fish and other animals may suffocate and die. For example, oxygen cannot enter the water when it is covered in ice, so fish can often suffocate towards the end of the winter. The chances of winter fish kills are even higher if the fish are living in a polluted or overgrowing (overproductive) system. In polluted systems, overgrowth of animals, plants and bacteria cause the oxygen to be used up quickly, sometimes causing fish to suffocate. Most natural lakes and rivers in the Arctic do not have overgrowth of animals, plants and bacteria, so "fish kills" at the end of winter or during the warmest parts of the summer are rare. However, large-scale industrial development, heavy use of fertilizers and dumping of human waste can pollute water quickly and lead to oxygen starvation.

Each type of fish living in the water requires a different amount of dissolved oxygen to live. For example, Northern Pike cannot survive in less than about 6 milligrams of dissolved oxygen per liter of water (6 mg/L). If dissolved oxygen levels decrease to about 3-4 mg/L, even the strongest fish may suffocate.



How do we measure dissolved oxygen?

Dissolved oxygen is best measured directly in the water using a calibrated dissolved oxygen sensor. This sensor can measure the amount of dissolved oxygen directly in the water as mg/L or as a percent dissolved oxygen (%DO). Water at lower temperatures should have higher mg/L of dissolved oxygen and higher %DO while warmer, polluted waters will have lower mg/L and %DO. Healthy water should generally have dissolved oxygen concentrations above 6.5-8 mg/L and between about 80-120 %.

References/For More Information

Hach Company' H_2O University. 2007. *Important Water Quality Factors*. http://www.h2ou.com/h2wtrqual.htm#Oxygen

Horne, A. J., and Goldman, C. R. 1994. Limnology, 2nd edition. McGraw-Hill, Inc. 576 pp.

U.S. E.P.A. Dissolved Oxygen and Biochemical Oxygen Demand. http://water.epa.gov/type/rsl/monitoring/vms52.cfm

Wetzel, R. G. 1983. Limnology, 2nd edition. Saunders College Publishing. 760 pp.