What is Dissolved Oxygen (DO)?

DO is the measurement of the number of free oxygen molecules in water. It does not measure the amount of oxygen in the water molecule (H_2O). Dissolved oxygen is used as an indicator of the health of a water body, **where higher dissolved oxygen concentrations are correlated with high productivity and little pollution**. Oxygen from the atmosphere dissolves in river and lake water, and it is this oxygen that fish and other aquatic animals use to breath. Dissolved oxygen can be added to water by plants during **photosynthesis**, through **diffusion** from the atmosphere, or by **aeration**. The unit of measurement is ppm ($mg.L^{-1}$) or as a percent dissolved oxygen (%DO).

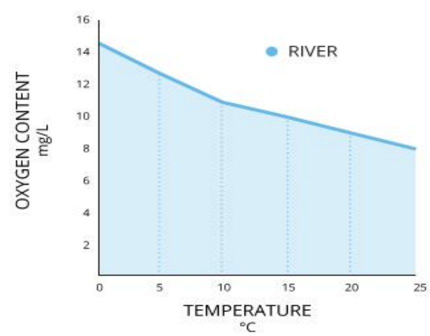
Each type of fish living in the water requires a different amount of dissolved oxygen to live.

0 – 4.0	4.0 – 6.5	6.5 – 9.5	9.5 – 12
All fish are dead	**Very few fish can live**	**Most big fish can live, but some small fish can't**	**All fish can live**

Dissolved Oxygen (mg/L)

Factors affecting the solubility of dissolved oxygen.

1. **Atmospheric pressure:** Higher atmospheric pressure allows bodies of water to retain more dissolved oxygen.
2. **Temperature:** A body of water with lower temperature can contain more dissolved oxygen because oxygen molecules have less movement. The



increased movement of oxygen molecules in warmer water allows them to escape out of the water into the air.

3. **Depth of the water:** The shallower the water, the higher the concentration of DO because wind creating waves on the surface increases DO.
4. **Salinity:** can also affect how much DO is in water. Freshwater contains more oxygen than saltwater because of the charge a salt molecule carries. Salt molecules are attracted to water molecules and easily dissolved in water. If salt is present, oxygen cannot attract water molecules, therefore as salinity levels increase in a solution, DO decreases.
5. **Bioactivity:** Lower bioactivity of microorganisms in water leads to a higher concentration of DO, because microorganisms feeding on organics and decaying matter use oxygen in their respiration.

Measuring Dissolved Oxygen.

Dissolved oxygen can be measured by colorimetry, a sensor and meter or by titration

Winkler method.

The Winkler Method uses titration to determine dissolved oxygen in the water sample. A sample bottle is filled completely with water (make sure there are no air bubbles or space left at the top). The dissolved oxygen in the sample is then "fixed" by adding a series of reagents that form an acid compound that is then titrated with a neutralizing compound that results in a color change. The point of color change is called the "endpoint" which coincides with the dissolved oxygen concentration in the sample.

Procedure:

1. Carefully fill a 300-mL glass Biological Oxygen Demand (BOD) stoppered bottle brim-full with sample water.

2. Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. Squeeze the pipette slowly so no bubbles are introduced via the pipette.

3. Add 2 mL of alkali-iodide-azide reagent in the same manner.

4. Stopper the bottle with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settled to the bottom, mix the sample by turning it upside down several times and let it settle again.

5. Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place.

6. In a glass flask, titrate 200 mL of the sample with sodium thiosulfate (0.2N).

7. Add 2 mL of starch solution so a blue color form.

8. Continue slowly titrating until the sample turns clear.

9. calculate the concentration of DO in the sample using the following formula:

$$DO = \frac{\text{Volume of Sodium Thiosulfhate} \times 0.2 \times 1000}{\text{Volume of sample taken}}$$