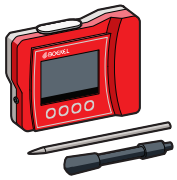

DO Lesson Plan Example

Overview:

Dissolved Oxygen (DO) is the measurement of the concentration of oxygen in an aqueous solution. The Open Source Bio Transmitter can measure and log DO values, display calculations, and control DO. Understanding DO and how it is measured is critical in the areas of Chemistry, Biology, Engineering, and Environmental Sciences.

Introductory Lesson Plan:

Materials required:
Boekel OSB Transmitter with DO Probe: Ward's Sci
Tank or Large Container: Ward's Sci - 867903
Aquatic Plant: Ward's Sci - 867503
Pack of 3 Zebra Fish: Ward's Sci - 878105

Consumables
Tap Water

Objectives:

- Basic understanding of DO
- Why is DO important?
- What can affect DO?

Lesson Plan

1) Explain that DO is a measurement of the concentration of oxygen dissolved in water. Much like solids and liquids can dissolve in water, gasses can also dissolve in water.

2) Explain the factors that contribute to the concentration of oxygen in water. These factors are the concentration of oxygen in the air above the water, temperature, biological activity, chemical activity, and agitation.

Action: Set up the transmitter with a DO probe and place the probe in tank with some tap water. The DO reading should be around 7mg/L.

3) Dissolved oxygen is important to aquatic animals and plant life. The concentration of dissolved oxygen will increase with a plant that exhibits photosynthesis. Aquatic plants like terrestrial plants convert carbon dioxide into oxygen during photosynthesis.

Action: Place an aquatic plant in the tank and monitor the dissolved oxygen content.

4) An important aspect of water is the biochemical oxygen demand. This is measured in lakes, streams and waste water plants to determine how quickly oxygen is removed from the liquid. If oxygen is removed to quickly it means that there is a high concentration of bacteria and/or organic material. This can be dangerous for aquatic animals.

Action: Place the DO probe in a separate tank filled with tap water. Let the DO reading stabilize. Once the DO reading has stabilized place a fish in the tank. Monitor the concentration of DO and discuss the results.

5) The concentration of DO will decrease when animals consume this oxygen and expel carbon dioxide. What could offset this decrease in dissolved oxygen? (agitation, addition of plants)

6) Place the aquatic plant in the tank with the fish and continue to monitor the dissolved oxygen concentration. The dissolved oxygen concentration will increase. Some fish can only live in swift moving rivers because they require high concentrations of oxygen.

Intermediate Lesson Plan:

Additional Materials required:
Boekel OSB Relay: Ward's Sci
Small Air Pump: Ward's Sci 212983

Consumables
Tap Water

Objectives:

- Basic understanding of how a DO probe works
- Basic understanding of why and how a DO probe is calibrated
- Understand how to control DO with a computer program

Lesson Plan

1) A DO probe works similarly to a pH probe in that it uses a chemical reaction and voltage measurement to determine the concentration of oxygen. At the tip of the probe there is an oxygen permeable membrane. Oxygen passes through this membrane and reacts with cathode. Oxidation occurs and a current is created in proportion to the amount of oxygen. In a solution with no oxygen the voltage will be close to 0mV. In 100% oxygen the probe will generate a voltage of 36 to 54mV.

2) Dissolved oxygen probes are calibrated by taking two measurements. A zero measurement and a saturation measurement. This allows the probe to convert the electrical reading to an oxygen concentration value.

Action: Walk the class through the calibration procedure. The transmitter has step by step instructions on how to calibrate. Electrochemical probes are used in all aspects of chemistry, biology and environmental sciences. It is important to understand how they work.

3) Dissolved oxygen of a solution can be controlled with the use of an air pump. This is very useful in the treatment of waste water and in industrial processes. In the treatment of waste water bacteria is used to break down organic material. Oxygen is injected in to waste water to facilitate this breakdown.

Action: Hook the transmitter to a small air pump via the relay. Connect the pump to a tube with a sintered stone or fish tank bubbler on the other end. Place the bubbler connected to the pump into a tank of water. Load the control dissolved oxygen sketch so that the transmitter controls the concentration of oxygen. Log the data and discuss the trend created by the transmitter

4) One of the factors that contribute to dissolved oxygen is the size of the bubble injected into the liquid. This has to do with the surface area exposed to the liquid to allow for diffusion.

Action: Remove the sintered stone on the end of the air pump hose and allow just the open end of the tube to inject air into the liquid. Log the data and view the trend graphs. Compare the two sets of data with the sintered stone and without the stone to draw a conclusion about dissolved oxygen diffusion into the liquid.

Additional Learning Examples: Review the code used to control the concentration of dissolved oxygen. Modify the code and review the examples. Try to regulate the concentration of oxygen with the fish in the tank.

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