PART 4 – MAKING AND USING A SALINOMETER

Part 4 of Water Quality (10% of the score)

- Actual testing will be limited to salinity
- Teams must build, calibrate, bring and demonstrate a salinometer/hydrometer capable of measuring saltwater (most likely NaCl) concentrations between 1-10% (mass/volume)
- There are no restrictions except that the device must be built by the team and if it is electronic it cannot contain programmable parts or communicate over wifi
- Teams should be able to estimate percent to the nearest tenth
- The solution to be tested will fit in a 400-600 ml beaker
- Full credit will most likely be given ±1 at Regionals and ±0.5 at State/Nationals
- Points for bring a salinometer to be used for testing will be 5% of the total score.
- Points for salinity testing should be approximately 5% of the total score
- The presence of calibration solutions is up to the event supervisor

Background

Salinity is a property of water, which describes its salt concentration. Salinity is measured by dissolved salts in parts per thousand (ppt) or grams of salt per kilogram of water.

A **salinometer** is a device designed to measure the salinity, or dissolved salt content, of a solution. Since the salinity affects both the electrical conductivity and the specific gravity of a solution, a salinometer often consist of hydrometer or an electrical conductivity meter (ec meter) and some means of converting those readings to a salinity reading.

The vast majority of salinometers are based on the principles of density and buoyancy. Since saline solutions contain dissolved NaCl, their densities are higher than that of distilled water. Due to the elevated density, the solution exerts a higher buoyant force, causing the hydrometer to float higher than in distilled water. There is a direct relationship between salinity and buoyant force - the more saline the water, the higher your hydrometer will float.

Types of Salinometers

The hydrometer measures the density of the water: more salt means higher density.

The electrical type tries to pass an electric current through a sample of the water; the more salt, the better it will conduct electricity.

Sample Directions for Making Salinometers/Hydrometers

To make a rudimentary salinometer, get a drinking straw and some clay. Place a ball of clay on one end of the salinometer, completely covering the opening of the straw. Then make some solutions of water and salt, with the salt concentration being between 0% and 10%, and mark the meniscus of the water solution on the straw with a permanent marker, Sharpie, etc. Repeat for any number of solutions for a more accurate calibration. The amount of clay and the length and diameter of the straw affect the distance between marks on the salinometer.

Making a Salinometer

- Measuring the salt in a water sample by using a hydrometer/salinometer (water with more salt is denser and has greater buoyancy so the hydrometer/salinometer will float at higher levels in the cylinder depending upon the concentration of salt)



freshwater



saltwater



calibrating the salinometer

- The narrow the diameter of the salinometer, the higher the water will rise – this make calibration easier.
- Small plastic pipettes instead of the straw and clay work well. Hold the pipette upside down, cut the opening to make it wider and weight it putting sand into the bulb. Cover the opening with tape or clay so the sand won't get wet when you calibrate it.
- Measuring electronic conduction (the more salt the more electricity is conducted) is another possibility – just be sure that the device is made by the team

Making A Simple Salinometer



Materials



Water



Saltwater Solution

Several types of salinometers can be made. The simplest is a hydrometer calibrated to read in % of salt concentration instead of specific gravity. Follow the instructions below to make and calibrate a simple salinometer. You will need to research how to make a known saltwater solution to use as a calibration standard.

Materials:

- soda straw
- modeling clay
- a fine-tipped permanent marker
- a tall clear container to hold the solution for calibrating your device
- salt for mixing one or more standard solutions
- water (tap water will work-distilled is better)

1. Mold a ball of modeling clay around one end of the straw. Make sure that the clay prevents water from leaking into the straw. Try to avoid forming pits or voids in the clay that can trap air.
2. Fill the container with water. Carefully insert the straw (clay covered end down) and add/remove clay until the straw floats at the maximum depth you wish.
3. Use the permanent marker to mark the depth where the salinometer floats in the water (0% salt solution).
4. Mix a saltwater solution of known concentration to use as a calibration standard. (10% is a good choice!)
5. Place the salinometer in the calibration standard and mark the level where it floats.
6. Interpolate/extrapolate from the two marks you have made to add additional lines on the scale. You can calibrate your device using additional standards at other concentrations to improve its accuracy.

You are not limited to this simple salinometer. Use your library, the internet, or other resources to research how to make a device with better accuracy and sensitivity.