Worksheet No. XX: Experiment - Salinity Sensor

How a Salinity Sensor Works

Salinity is the concentration of dissolved salts in water. When salts dissolve, they split into positive ions (such as sodium) and negative ions (such as chloride). These charged particles allow electricity to flow through the water.

Salinity is measured in microsiemens per centimeter (uS/cm at 25°C), or the amount of electricity flowing over a certain distance.

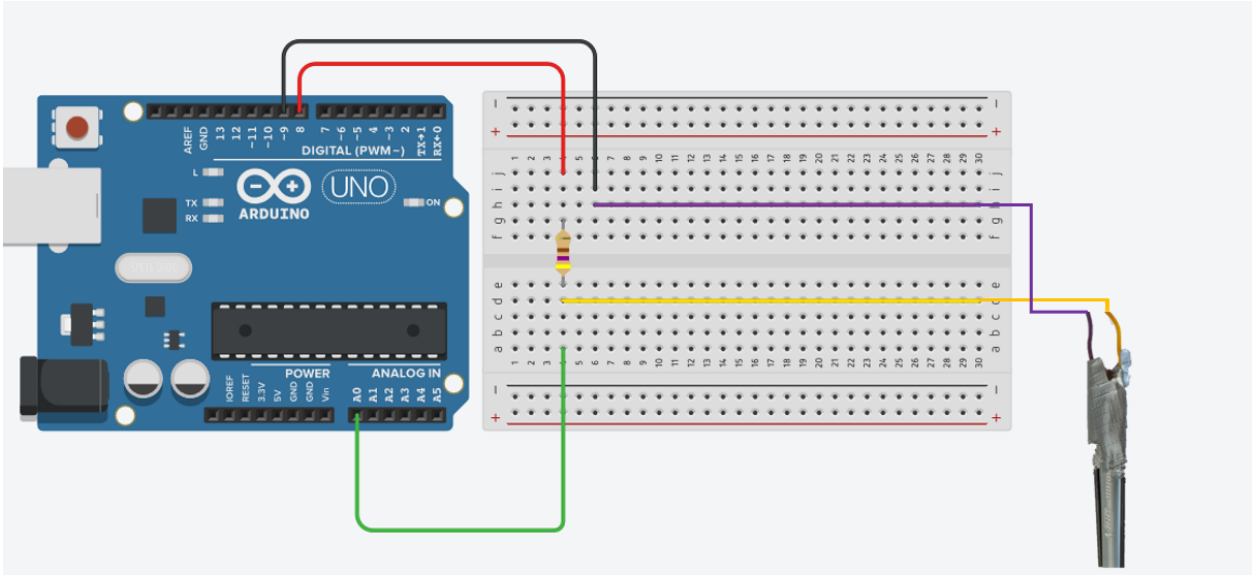
Water Type	Concentration (% salt)	Conductivity (uS/cm)
Distilled Water	0.00025 - 0.0015	0.5 - 3
Melted Snow	0.001 - 0.021	2 - 42
Tap Water	0.025 - 0.400	50 - 800
Freshwater	0.05 - 0.50	100 - 1000
Brackish Water	0.50 - 27.0	1000 - 54000
Industrial Wastewater	5.0	10000
Seawater	27.0 - 27.5	54000 - 55000

Bodies of water must stay in their salinity ranges to maintain healthy ecosystems. If a city uses too much road salt in the winter, it runs off into the soil, which is harmful to plants and water,

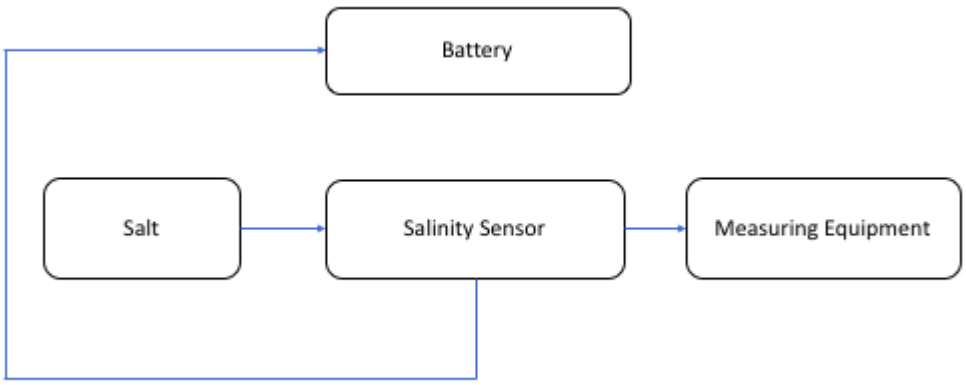
which raises the salinity of surrounding lakes and rivers. It can also contaminate drinking water sources, which makes water dehydrating and bad-tasting in high concentrations, as well as corroding pipes. Corrosion of pipes from an excess of chloride in water contributed to the lead contamination present in Flint, Michigan.

The salinity, or conductivity, sensor measures the ability of a solution to conduct an electric current between two electrodes. In solution, the current flows by ion transport; therefore, an increasing concentration of ions in the solution will result in higher conductivity values.

Below is the circuit that you will need to build to use your salinity sensor.



We can apply our **systems perspective** to this circuit to help us understand and design it. The system below represents the circuit above (*take a second to compare the two*).



Equipment Required

Making test solutions:

- Distilled water
- Salt
- 3 small cups
- Scale
- 2 liter bottle
- Funnel
- 500 mL measuring cup
- 3 mason jars

Circuit:

- Graphite
- Pen tube
- Hot glue gun
- Copper wire tape
- Soldering equipment (soldering iron, solder paste)
- Arduino and Laptop
- Breadboard

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Test Solutions

1. Fill the measuring cup with 500 mL distilled water, then use the funnel to pour into the 2 liter bottle. Repeat this 3 more times, ending with 2 liters of distilled water.
2. Turn on the scale, place the cup on it, and tare it. Add salt until it reaches 1 gram.
3. Transfer this salt to the 2 liter (use the funnel again if necessary). Shake thoroughly. Fill one of the smaller containers with some of this solution (a smaller cup makes it easier to insert the probe) and close the container. The rest of the solution can be used for other students. This sample is equivalent to freshwater, and should be labeled as such.
4. Fill the measuring cup with 500 mL distilled water again.
5. Tare a clean cup on the scale as in step 2. Add 7g of salt.
6. Add the water, then the salt, to a container, cap it, and shake. If necessary, distribute this into smaller containers. This is the brackish water solution, similar to the water of the Hudson in New York City.
7. Fill the measuring cup with 500 mL distilled water again.
8. Tare a clean cup on the scale as in step 2. Add 18g of salt.
9. Add the water, then the salt, to a container, cap it, and shake. If necessary, distribute this into smaller containers. This is the ocean water solution.

Calibration

Solution	Measurement (uS/cm)

Hypothesis Specific Design

Now that you understand more about the sensor and its operation, think about the sensor's limitations and any environmental conditions that affect your hypothesis or how you collect your data.

What do you want to do with the data you collect, and is there any other data that might be important to write down when you collect it?

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What limitations or conditions might affect your salinity sensor measurements?

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What other features do you want to implement in your circuit or code?

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Share your thoughts with your group and circuits mentor, and make design changes!

Salinity Sensor Data Sheet

Sample	Measurement (uS/cm)	?? should be something else probably