Activity Template

Subject Area(s)   Measurement, physical science, science and technology

Associated Unit   Desalination Engineering

Associated Lesson Distillation

Activity Title   Measuring the Resistance of Water

Grade Level 11 (10-12)

Activity Dependency N/A

Time Required 1 hour

Group Size   3

Expendable Cost per Group $0

Summary
In this activity students learn one technique to measure the amount of salt dissolved in a water sample. Students first receive a brief background on the physics regarding solutions and conductivity. Then students measure the resistance of multiple water samples with a known salt concentration. The students analyze their data and plot the results. The activity ends with a discussion on the accuracy of the measurements and the feasibility of using resistance measurements to determine salinity.

Engineering Connection
One of the largest problems facing the world is clean drinking water. Engineers from multiple fields are working on designing new tools and machines to purify dirty water. However, these engineers must have a method in which they are able to measure how well their machines are working. This activity introduces one method of measuring the purity of water.

Keywords
desalination, multimeter, resistance, salinity, salt, water

Educational Standards

- Science: 3.1, 3.2, 3.4, 3.7
- Math: 2.3, 2.5, 2.6

Learning Objectives
After this lesson, students should be able to:
- Measure the electrical resistance of a material using a multimeter

- Collect multiple data points and display them on a graph

- Explain the relationship between resistance of water and its salt content

Materials List
Each group needs:
- 1 multimeter
- 1 glass cup
- Deionized water
- Salt
- 1 graduated cylinder
- 1 balance scale

To share with the entire class:

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Introduction / Motivation
In this unit we have been discussing different methods of desalinizing water. There are many places on Earth where clean fresh water is difficult to find but there is salt water in abundance. Inexpensive methods of desalinization are in great demand at the present time. However, once we think we have desalinized the water, we need to be able to test if the method we used worked. What are some ways we could test the salt content of water? (Possible answers: taste, density, spectra, electrical properties, etc.) Today we are going to use the electrical properties of solutions to determine the salt content of a water sample.

Vocabulary / Definitions

Word	Definition
Multimeter	A device that measures multiple electric signals, including resistance
Resistance	A measure of how difficult it is for a material to pass electrical current

Procedure

Before the Activity
- Gather the materials for each group.

With the Students
1. Introduce the topic of desalinization and ask the students how they would measure the salt content of a water sample.
2. Tell the students that today they will use the electrical properties of water to measure salt content, specifically resistance.
3. Give a general overview of resistance, and ask the students to make a hypothesis of how the resistance of water will change when the salt content is changed.

4. Have the students first measure the resistance of the deionized water. [The multimeter may not be able to measure the resistance of deionized water because it is too high. If this is the case tell the students to write "greater than (maximum resistance multimeter is capable of reading)".]
5. Tell the students to add salt to the water sample in increments and stir until the salt is dissolved. The students should measure the resistance after each change. [For 100mL of water the students can add salt in 1g increments].
6. After the students have collected their data, have them graph the data and describe the trend.

Attachments
Measuring_Salinity_Presentation.ppt

Troubleshooting Tips
Although the listed saturation point of salt in water is ~35g/100ml, in practice this is difficult to achieve. The student's solutions may saturate well below the true saturation point.
When measuring the resistance, the value given on the multimeter will not be constant. The resistance value will change before finally stabilizing at a value. If the water is disturbed while the resistance is being measure, it will take longer for the resistance to stabilize.

Investigating Questions
1. Why did the multimeter not read a constant value for resistance over the course of a single measurement?
2. If you were given the resistance of a water sample, would you be able to determine the salt content of the sample? Why or why not?

Assessment

Pre-Activity Assessment
Class discussion: Use the class discussion to determine how the students would test the salinity of water.

Activity Embedded Assessment
Data chart and graph

Post-Activity Assessment
Lab Report: The students can write a full lab report detailing the experiment and explaining all of the steps they used in the scientific method.

Activity Extensions
The activity can be repeated with a conductance meter to see if the results are consistent with a separate measurement device.

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