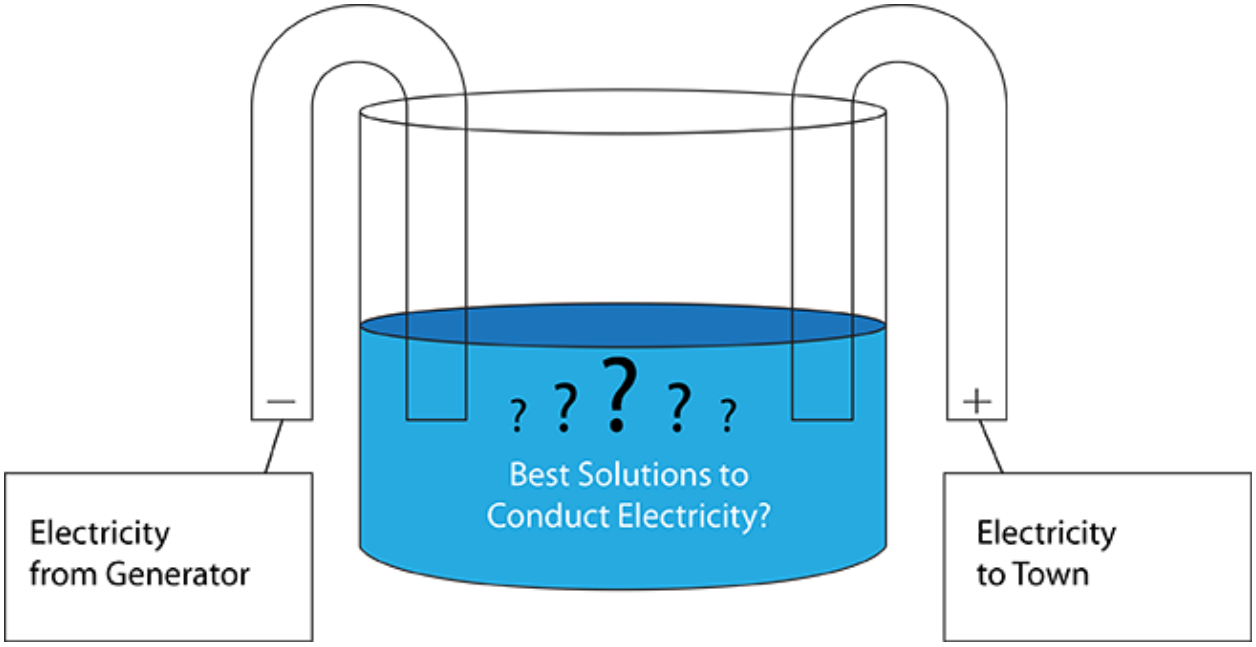
Electricity Lesson 2: *The Make*

Student Handout

The town of Waterville is low on wires but has an abundance of water. They have asked you to design an electricity solution that uses local water sources to light up the town. Waterville has a prime location with access to a river of pure water to the east, an ocean of saltwater to the west, and an interesting mix of the two where these two bodies of water meet.



What is the best type of water to use that will best conduct electricity?

Today you will:

Design an electricity solution that uses local water sources. You will:

- Investigate the flow of electricity by constructing a model that successfully powers a light bulb.
- Compare the electric current in saltwater vs. pure water solutions.
- Explain your recommendation for the best liquid solution to conduct electricity.

Oftentimes, when scientists can't conduct tests on the specific things they're investigating, they use models to help them draw conclusions. For example, to test how a piece of equipment works in Antarctica, a scientist might test it in the freezer first. Today, since we can't go to the river or ocean near Waterville, we're going to use representative samples of these solutions.

Directions:

1. Assemble an electric circuit and use it to test the electric current in:
    a. saltwater
    b. fresh water.
2. Collect data and draw conclusions.
3. Design a solution with the best water to conduct electricity.

Planning Organizer

Part A: Build an electric circuit, which will be your water solution testing equipment.

<u>Build Your Electric Circuit</u> Use **Part A: Student Procedure Card** to build your electric circuit. This will be your water solution testing equipment.
<u>Test Your Electric Circuit</u> **Directions**: Test your circuit by touching the two electrodes together. 1. If the light bulb lights up, your circuit is working. 2. If it does not light up, check your wire connections to make sure they are all secure. Try again. **Check one:** ❑ Circuit worked on first try. ❑ Circuit didn't work at first. We fixed it, tested it again, and it worked.
<u>Set up your circuit for solution testing</u> **Directions:** Insert the electrodes into an empty cup to see how you will test your solutions. Your electrodes must not touch during testing.
Equipment Set-Up Drawing
Check your drawing using the **Self-Check Card** provided by your teacher. Correct your set-up as needed.
In one or two sentences, explain how electricity is flowing through your circuit.

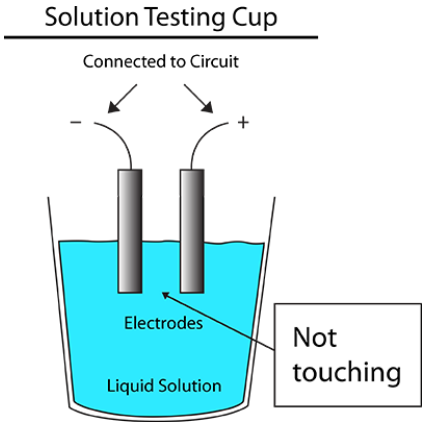
Part B: Test solutions using your electric circuit testing equipment

Choose your Test Solutions

Follow your teacher's directions to choose water and salt solutions for testing.

Test Your Solutions to See Which Best Conducts Electricity

1. Insert both electrodes in one test solution at a time.
    a. Make sure the electrodes do not touch each other.
    b. Wipe off electrodes with a paper towel after each trial.
2. Observe the brightness of the light bulb.
3. Record observations below.



Test #1

Solution: _____ ml Water_____grams salt

Observations:

Light Brightness:

▢ No Light ▢ Very Dim ▢ Dim ▢ Bright ▢ Very Bright

Test #2

Solution: _____grams salt

Observations:

Light Brightness:

▢ No Light ▢ Very Dim ▢ Dim ▢ Bright ▢ Very Bright

Test #3

Solution: _____grams salt

Observations:

Light Brightness:

▢ No Light ▢ Very Dim ▢ Dim ▢ Bright ▢ Very Bright

Test #4

Solution: _____grams salt

Observations:

Light Brightness:

▢ No Light ▢ Very Dim ▢ Dim ▢ Bright ▢ Very Bright

Rank the Solutions from Dimmest to Brightest by Visual Observation

Brightness Rank	Grams of Salt
1 Highest	_____ g
2 High	_____ g
3 Medium	_____ g
4 Lowest	_____ g

Fill Out Four Post-Its

Fill out FOUR Post-Its showing your results like this (fill in the blanks):

Rank #1

_____ g
salt

Rank #2

_____ g
salt

Rank #3

_____ g
salt

Rank #4

_____ g
salt

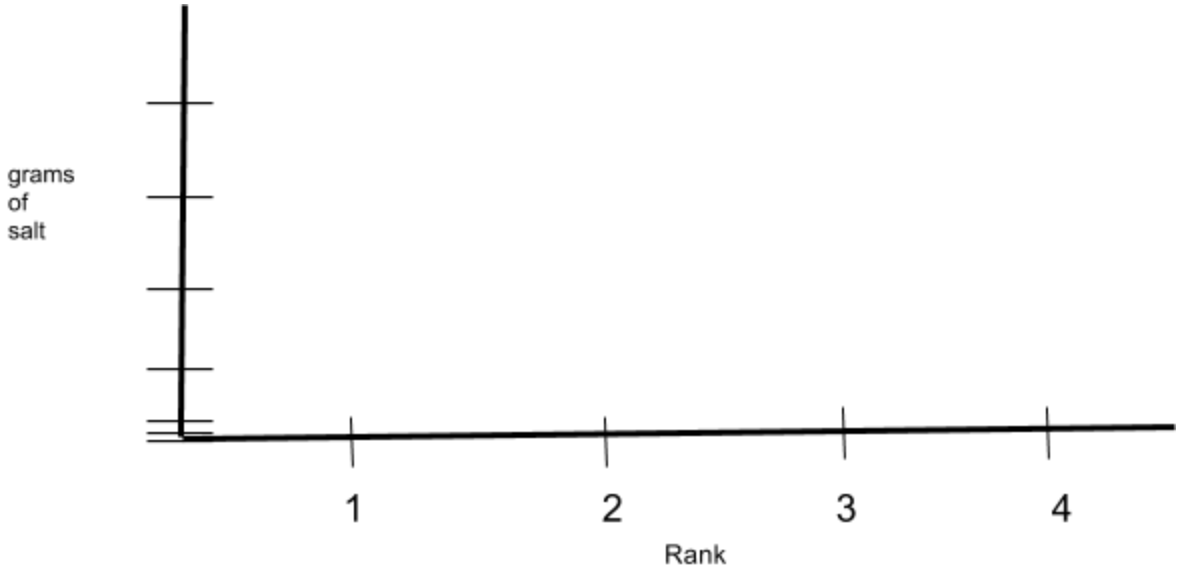
Add Data to Histogram

Follow your teacher's directions to put your team's Post-Its on the class data histogram.

Part C: Draw Conclusions

Analyze Class Data

Copy class Post-It histogram data below:



Results

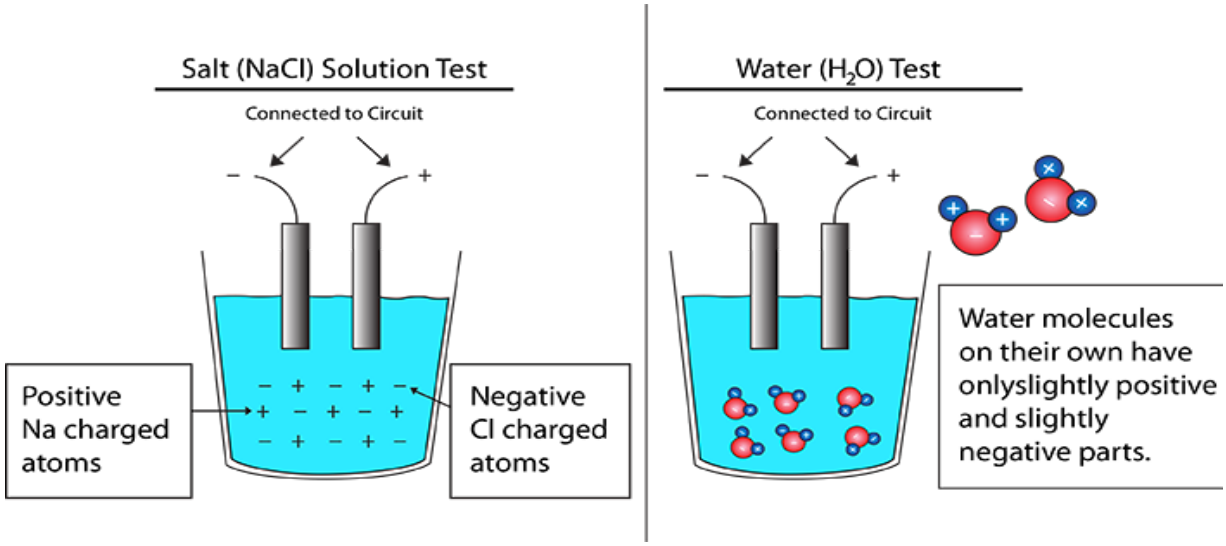
As a group, answer these questions.

Which solution is the MOST effective to conduct electricity for the brightest light?

Which solution is the LEAST effective to conduct electricity for the brightest light?

Salt vs. Water to Conduct Electricity

When salt goes into water, it breaks down into positively-charged atoms and negatively-charged atoms.



As a group, explain which diagram shows the best liquid solution to conduct electricity. Why is it the best?

Sketch your idea for the design of an electricity station with an electricity flow tank filled with your the best liquid solution to conduct electricity.

Work with your team to construct a full-color annotated diagram of an electricity station that has the best electricity flow tank.

Include in your diagram how the electricity flows out of the electricity station to the town so that it can be used in homes and businesses.

Name: _____ **Date:** _____

Exit Ticket: Connection to the Design

1. How is the flow of electricity different in saltwater than in pure water?

2. How did the strength of the electric force change when you changed the salt concentration of the water? Use data to back up your claim.

3. Why is saltwater a better conductor of electricity than pure water?

4. What materials are good conductors of electricity, and therefore probably contain charged atoms?

5. Electricity is an incredible resource for our society. Are there any dangerous aspects of electricity that you have heard of?

***The Make* Assessment**

Use the Checklist and Science & Engineering Practices Rubric to ensure you have addressed all aspects of *The Make* with quality work.

Electricity *Make* Checklist: Content Concepts and Practices

- ❏ Includes drawing of electricity flow for saltwater and pure water
  - ❏ Describes what an electric current is
  - ❏ Explains how electric current moves differently in saltwater and pure water
- ❏ Includes a description label of both an open circuit and a closed circuit
  - ❏ Describes how one solution creates an open circuit
  - ❏ Describes how one solution creates a closed circuit
- ❏ Explains which solution (salt or pure water) is better for efficient electric current and why
- ❏ Extra credit: Depicts circuits as a 3-D or dynamic model
- ❏ Diagram design is well-organized, neat, and in color with relevant annotations

Science & Engineering Practices Rubric

	Emerging (1)	**Developing (2)**	**Proficient (3)**	**Advanced (4)**
Developing and Using Models	Drawings, diagrams, or visual models include major misconceptions or have missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or have missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
Constructing Explanations or Arguments From Evidence	Constructs an explanation with no clear sources of evidence.	Uses scientific principles and/or data from at least one source to construct or evaluate an explanation, but explanation contains minor misconceptions.	Uses accurate but incomplete scientific principles and/or data from multiple sources to construct or evaluate an explanation.	Uses accurate and complete scientific principles and/or data from multiple sources to construct or evaluate an explanation.