

## Should I Drink That? Worksheet **Example Answers**

### Pre-Lab Prediction

As you know, electrical conductivity is the ability of a material to conduct electricity.

In this lab, you have **4 liquid samples**: deionized water, purified water, tap water, and salt-water solution.

Question: Which water test sample do you think will have the highest conductivity? Explain your logic.

Answers will vary.

↓Note for **resistance** example answers: It depends on how long the multimeter probes are submerged in the sample.

### Part 1. Measuring Electrical Conductivity of Different Liquids

#### Data Collection

Test the electrical conductivity of the water samples using different pieces of equipment: LED-conductivity tester, electrical conductivity tester and digital multimeter.

Refer to the **Lab Equipment Testing Instructions** for the steps to follow to use this equipment.

**Table A.** Fill in the table with your conductivity measurements of the water test samples.

Water Sample	Relative LED Brightness (observation)	Electrical Conductivity (μS/cm)	Resistance (ohm, Ω)
deionized	no light observed	1-3	~1.4 x 10 <sup>6</sup>
purified	no light observed	5-10	~1.3 x 10 <sup>6</sup>
tap	dim light observed	400-700	~1.0 x 10 <sup>6</sup>
salt-water	bright light observed	9000 (for ~1.5g salt in 200 ml purified water)	0.1 x 10 <sup>6</sup>

#### Data Analysis

1. Compare the brightness of the LED that you observed using the LED-conductivity tester in each sample. Describe the relationship of the brightness of LED with the conductivity of a sample.

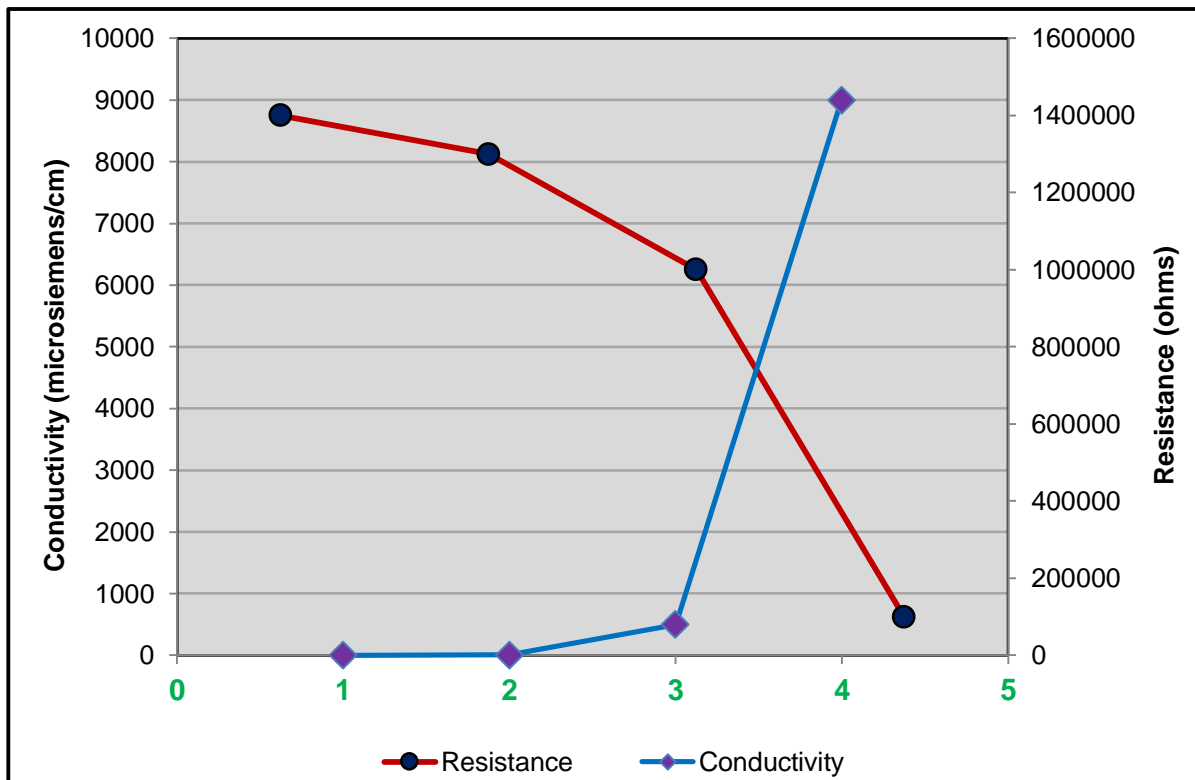
The deionized and purified water shows no light on LED; the tap water shows dim light and the salt-water solution show bright light.

2. Do each of the samples have the same EC reading? Explain your observations.

The higher the conductivity, the brighter the light; close to zero conductivity reading does not make the LED light up.

3. In graph form, show the relationship between resistance and electrical conductivity. Label all graph components and provide a graph title.

**Relationship of Water Conductivity and Resistance**



4. What is the relationship between the electrical conductivity and the resistance of water? Explain your answer.

Electrical conductivity is inversely proportional to the resistance. Conductivity is the material's ability to make electricity flow, while resistance is the opposition of the material to make electricity flow.

5. Was your pre-lab prediction correct? Explain your answer.

Answers will vary.

## Part 2. Electrical Conductivity of Community Tap Water Samples

- Looking at the school district map, group yourselves according to the area where your home is located. **My home is located in group** Answers will vary.
- Prediction:** Do you think the water in your area will have the same electrical conductivity as the other group areas? Explain your logic.  
Answers will vary.
- Pour your home tap water sample in a clean lab container (such as a paper cup).
- Measure the electrical conductivity of your sample using the electrical conductivity tester, as you did in Part 1. **The electrical conductivity of my home tap water sample is** Answers will vary. ( $\mu\text{S}/\text{cm}$ ).
- Record your home tap water measurement in the class table.
- Describe your area. *Does it have schools, hospitals, restaurants, grocery stores, offices, shops, factories, rivers, ponds, parks, hills, farms, highways, roads, train tracks, bridges, etc.?*  
Answers will vary.
- As a group, agree on a summary area description and have one person write that on the class data table for your group area.
- When everyone is finished, calculate the average conductance per group. Write this in Table A and in the class table for your group area.
- Fill in Table B with the group area information and data from the class table.
- Rank the groups in order of increasing conductance.

**Table B. Average electrical conductivity at different areas in the school district.**

Area Group #	Area Description	Average Conductivity ( $\mu\text{S}/\text{cm}$ )	Ranking (lowest = 1)
1			
2	<u>Answers will vary.</u>		
3			
4			
5			

### Data Analysis & Reflection

Analyze the class table results by writing a paragraph that includes the answers to these questions:

- What reasons might explain a high electrical conductivity for tap water?
- What are any differences in the conductivity readings among groups?
- Based on the results, what relationship exists between the type of area and the electrical conductivity of tap water?
- Thinking as an environmental engineer, what are ways to reduce the conductivity of tap water? Propose any design (or design improvement).

↓ See paragraph answers on the next page

The answers for the analysis paragraph will vary because it depends on the type of area and how your map is divided. As an example, the average conductivity in a class in Texas was measured to be between 450-600  $\mu\text{S}/\text{cm}$ , which is in the acceptable range according to the EPA.

Below are some example answers and good discussion points to make with students.

1. Reasons to explain high electrical conductivity for tap water might include increases in the dissolved solids such as salts and minerals caused by corroded metal pipes where rust breaks free and dissolves in the water. Pollutants added to the water can also increase the conductivity. Households near mining areas may have increases in conductivity due to the minerals leaking to the water sources. If a city's wastewater treatment is not done correctly, it may result in higher conductivity and health problems for the people drinking the water.
2. In addition, our results (the Texas data) did not indicate much difference among the groups' areas, although areas with hospitals were relatively higher than other areas. Other reasons to explain differences in the conductivity readings among groups might include the water source, how the water was treated to be safe for drinking and the metal pipes in which the water flows.
3. The relationships students might find between area types and the electrical conductivity of the measured home tap water samples include the type of area (the presence of a lot of factories, hospitals, restaurants) and the number of people residing in the area (more people tend to produce more pollutants, which can increase water conductivity).
4. Ways to treat (tap) water to reduce its conductivity so it is in the acceptable range include filtration, reverse osmosis, evaporation and distillation approaches; it depends on how and where you want to use the water. For example, at home, many people use a kitchen- or household-sized Brita or Pur device to filter water. The following resources provide additional information:
  - *How to Treat High Conductivity in Water* at [http://www.ehow.com/how\\_8717444\\_treat-high-conductivity-water.html](http://www.ehow.com/how_8717444_treat-high-conductivity-water.html)
  - *High Conductivity Water Treatment Using Water Surface Discharge with Nonmetallic Electrodes* at [http://iopscience.iop.org/1009-0630/15/6/08/pdf/1009-0630\\_15\\_6\\_08.pdf](http://iopscience.iop.org/1009-0630/15/6/08/pdf/1009-0630_15_6_08.pdf) (the key information is sufficiently provided in the abstract)