Electrolytes

Overview: Electricity. Chemistry. Nothing in common, have nothing to do with each other…right? Wrong! Electrochemistry has been a fact since 1774. Once electricity was applied to particular solutions, changes occurred that scientists of the time did not expect… and you get to play detective again and figure out what's going on.

What to Learn: An electrolyte is any substance (like salt) that becomes a conductor of electricity when dissolved in a solvent (like water). This type of conductor is called an "ionic conductor" because once the salt is in the water, it helps along the flow of electrons from one clip lead terminal to the other so that there is a continuous flow of electricity.

Materials

- 2 AA batteries
- AA battery case
- 3 alligator clip wires
- LED
- Water
- Sugar
- Salt
- Vinegar
- Baking soda
- Lemon juice
- Oil
- Soap
- 10 disposable cups
- 10 popsicle sticks for stirring
- Optional: DMM

Lab Time

1. Connect the alligator clip leads to the wires from the battery case, one on each.
2. Connect the other ends to the LED to make a simple circuit. This makes sure everything is working before trying something new.
3. Disconnect one of the wires from the LED and insert a third alligator wire.
4. Touch the two free ends of the alligator clip leads together. The LED should light up.
5. Fill the jar with water.
6. Insert the free ends of the alligator clip leads into the jar. What happened? Write it here:

   _____

7. Add a couple tablespoons of salt and stir.

8. Insert the free ends of the alligator clip leads into the jar. What happened? Write it here:

   _____

9. Optional: Turn on the DMM to "20" volts DC and insert the probes into the jar.

   How much voltage do you read? _____

10. Fill out the data table.
11. When you've got a couple of minutes of lab time left, ask yourself this question: What happens if you mix an electrolyte and non-electrolyte together? Test it and record your results in the last box on the data table.
12. Cleanup: Clean everything thoroughly after you are finished with the lab. After cleaning with soap and water, rinse thoroughly. Chemists use the rule of "three" in cleaning glassware and tools. After washing, chemists rinse out all visible soap and then rinse three times more.
13. Storage: Place all chemicals, cleaned tools, and glassware in their respective storage places.
14. Disposal: Dispose of all solid waste in the garbage. Liquids can be washed down the drain with running water. Let the water run awhile to ensure that they have been diluted and sent downstream.

Electrolyte Data Table

Substance Tested	Did it conduct electricity?	How much voltage is present?
Plain Water		
Water + Salt		
Electrolyte: *Non-electrolyte:*		

15. When you've got a couple of minutes of lab time left, run one more test, and you'll record your result in the last box on the data table.

Reading

Our first part of the experiment uses a saturated solution of table salt that is just sitting in a container minding its own business.

The batteries push voltage through the saltwater. That electric current tears the sodium from the chlorine. These positively and negatively charged ions rush about, looking for something they are attracted to. Opposites attract, so positively charged sodium ions find spending time with the negative electrode a treat. They are very happy together. Negatively charged chlorine ions are attracted to the positive electrode.

Sodium chloride decomposes into sodium and chlorine ions: $NaCl \rightarrow Na^{+} + Cl^{-}$

When the salt sodium chloride (NaCl) mixes with water, it separates into its positively (Na+) and negatively (Cl-) charged particles (ions). When a substance mixes with water and separates into its positive and negative parts, it's called a "salt."

Salts can be any color of the rainbow, from the deep orange of potassium dichromate to the vivid purple of potassium permanganate to the inky black of manganese dioxide. Did you know that MSG (monosodium glutamate) is a salt? Most salts are not consumable, as in the lead poisoning you'd get if you ingested lead diacetate.

If you pass a current through the solution of salt and water, opposites attract: the positive ions are attracted to the negative pole and the negative ions go toward the positive pole. These migrations ions allow electricity to flow, which is why "salt" solutions conduct electricity.

Exercises

1. Why does electricity flow through some solutions but not all of them?
2. What is a salt?
3. How are electrolytes used today in real life?
4. Which substance was your top conductor?
5. Which substance didn't conduct anything at all?
6. What happens if you mix an electrolyte and non-electrolyte together?

Answers to Exercises: Electrolytes

1. Why does electricity flow through some solutions but not all of them? (Salt mixes with water and separate into positively (Na+) and negatively (Cl ‑) charged particles (ions). If you pass a current through the solution of salt and water, opposites attract: the positive ions are attracted to the negative pole and the negative ions go toward the positive pole. These migrations ions allow electricity to flow, which is why salt solutions conduct electricity.)
2. What is a salt? (When a substance mixes with water and separates into its positive and negative parts, it's called a "salt.")
3. How are electrolytes used today in real life? (One example: the body uses electrolytes such as sodium, calcium, potassium, chloride, magnesium, and more to regulate the nerve and muscle function, keep your body hydrated, and maintain the right pH in the blood.)
4. Which substance was your top conductor? (Check data for result.)
5. Which substance didn't conduct anything at all? (Check data for result.)
6. What happens if you mix an electrolyte and non-electrolyte together? (Check data for result.)