# ELECTRIFYING BEVERAGES
Written by Amy Rowley and Jeremy Peacock

## Annotation
In this demonstration, students investigate the relationship between the electrolyte content of common beverages and their conductivity.

## Primary Learning Outcome:
Students will be able to define the terms *conductivity, ion, and electrolyte*.

Students will be able to describe how conductance is measured.

Students will be able to calculate the average conductance of each beverage.

Students will be able to describe how beverage ingredients affect conductance values.

## Georgia Performance Standards:
*Characteristics of Science*
SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

*Physical Science Content*
SPS6. Students will investigate the properties of solutions.

*Chemistry Content*
SC7. Students will characterize the properties that describe solutions and the nature of acids and bases.

## Duration:
Preparation: 30 minutes
Introduction: 20 minutes
Conductivity Demonstration: 30 minutes
Conclusion: 15 minutes
**Total Class Time: 65 minutes**

## Materials and Equipment:
Per Class:
1. Gatorade®
2. PowerAde®
3. Propel Sports Water®
4. Orange Juice
5. Apple Juice
6. Tap Water
7. Distilled Water
8. 8 Clean, dry 250 mL beakers

9. Conductivity Meter (YSI 30 Salinity/Conductivity/Temperature Instrument or similar)
10. Light bulb conductivity tester

**Safety:**
Ensure that students do not drink beverages in the laboratory. Use caution when using the light bulb conductivity tester to prevent electric shock.

**Technology Connection:**
Not applicable.

**Procedures:**
Teacher Preparation:
Calibrate the conductivity meter according to manufacturer's recommendations. Label one beaker for each of the seven test solutions and one beaker for a distilled water rinse for the conductivity probe. Add approximately 50 mL of each solution to the appropriate beaker. Set up solutions, conductivity meter, and conductivity tester at demonstration table.

Introduction:
Conductivity can be measured using a conductivity meter and tester. In each case, two electrodes are placed in a solution. If that solution is conductive, electric current is able to pass from one electrode to the other, completing the circuit and registering a response on the tester or meter. The tester is a qualitative instrument that responds only above a minimum current determined by the specific setup. The meter is a quantitative instrument that will give an accurate conductivity measurement over a wide range of values.

This demonstration will explore the conductivity of seven common beverages: Gatorade®, PowerAde®, Propel Sports Drink®, orange juice, apple juice, tap water, and distilled water. Ask students to define conductivity, ion, and electrolyte as they relate to solutions and to record this definition in their laboratory notebooks. Next, ask students to categorize the seven beverages as either conductive or non-conductive and record these lists. Next ask students to rank the "conductive" beverages in order from least conductive to most conductive. For each "conductive" beverage, students should list a brief, hypothesized explanation for the conductivity. Briefly discuss student predictions.

Conductivity Demonstration:
In order to establish the credibility of the conductivity meter readings, perform an initial demonstration in which the conductivity of orange juice is evaluated using both the tester and meter. Students will see that the bulb lights when the tester electrodes are immersed in orange juice. When the probe of the conductivity meter is immersed in orange juice, students will see that a relatively high conductivity value (approximately 2000 µS) is reported. This can be compared to tap water which will exhibit weak or no lighting of the bulb and a low conductivity reading (approximately 50 µS).

Ask students to draw a table in which to record conductivity readings for each of the beverage samples. The table should contain a row for each beverage and a column for each of the triplicate readings, as well as a column for the average value. Measure and record triplicate conductivity readings for each beverage. For each reading, ask a student to assist in immersing the probe into the beverage and reading the conductivity value. For each beverage, ask students to calculate the average conductivity reading. As readings are collected, briefly discuss student predictions regarding each beverage. Upon completion of the demonstration, review the final results, highlighting which beverages are conductive and the relative conductivities of the beverages.

Conclusion:
Review with students the definitions of conductivity, ion, and electrolyte and what factors contribute to the conductivity of a solution. Present to students the nutritional labels of each of the beverages. Using the collected data, in addition to the information found on the nutritional labels, students should write a paragraph in their laboratory notebook explaining the results of the demonstration.

Students should find that there is a correlation between the concentration of electrolytes (ions) in a particular beverage and its relative conductivity.

**Assessment:**
Assessment should be based on completion of the laboratory write up. Emphasis should be placed on the concluding paragraph. Conclusions and explanations of results should accurately reflect the data collected, be based on sound scientific reasoning, and accurately incorporate the concept of conductivity in solution.