NAME PERIOD DATE

WHAT IS ELECTRICITY?

Driving Question | Objective

How do voltage and current change as electricity flows through a circuit?

Electricity is a stream of electrons. Electrons can move through a circuit to deliver electricity when there is enough voltage and current.

Voltage is the force that pushes electrons through a circuit when there is a difference in the amount of electrons between two points. Electrons will move to the side with less electrons. There is no voltage to push electrons through the light on the right because there is an equal amount of electrons (shown as dots) on both sides of the battery.

Current is the number of electrons flowing across a point in a circuit. If the electrons (dots) in the diagram to the right are moving at the same speed through their wires, the current is higher in the wire on the right so the light shines more brightly.

Anything that gets in electrons' way or slows them down is called resistance. For example, a narrow wire slows down electron movement more than a wide wire so it has more resistance. Notice how wire width affects the number of electrons that reach the bulb.

Materials

- Voltage sensor with red and black banana plug leads
- Current sensor with red and black banana plug leads
- Alligator clip adapters (2), red and black
- Solar panel
- Buzzer
- Adjustable lamp with minimum 60-W (incandescent) or 23-W (CFL) bulb
- Ruler or meter stick
- LED and DC motor

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Caution: Lamp may become very hot.

Consider

1. Electricity is made of a flow of:

   a) Energy

   b) Atoms

   c) Matter

   d) Electrons

2. A scientist measures river flow rate to find out how much water is passing by. This is most like measuring:

   a) Current

   b) Resistance

   c) Voltage

3. Limited water flow in a twisted garden hose is most similar to ___ in a circuit.

   a) Current

   b) Resistance

   c) Voltage

4. Predict the relationship between voltage and current:

   a) As voltage increases, current increases

   b) As voltage increases, current decreases

   c) As voltage increases, current stays the same

5. Explain your prediction.

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Investigate Voltage

1. Connect current and voltage sensors. Use **Help (?)** if necessary.

2. Build a page with 2 digits displays. Choose Voltage for the first digits display and Current for the second digits display. Change the units for Current from amps (A) to milliamps (mA). Use **Help (?)** if necessary.

3. In the Sampling Options menu, change Sampling Mode to Manual, change Sampling Rate to 2, and change Sampling Rate Units to seconds. Use **Help (?)** if necessary.

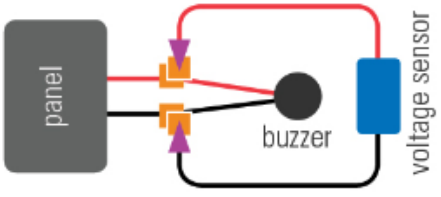
4. Start collecting data.

5. Add banana plug leads to the sensors if needed. Use red for (+) and black for (-).

6. Build a circuit with the solar panel, buzzer, alligator clips, and voltage sensor as shown.

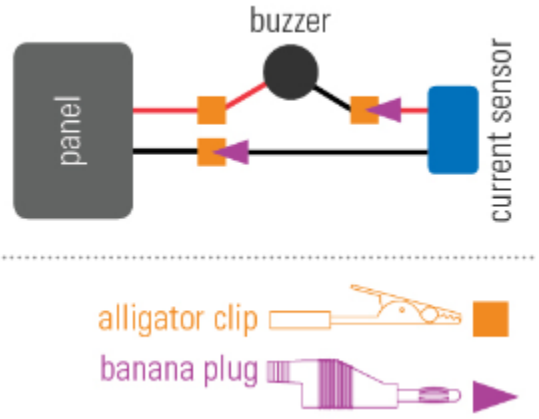
7. If you do not hear the buzzer, review the diagram.

8. Watch the voltage readings for at least 30 seconds to find the highest voltage.



9. Record the highest voltage in Table 1 below.

10. Take the circuit apart.



Investigate Current

1. Build a circuit with the current sensor as shown.

2. Find the highest current over 30 seconds. Record current in Table 1. The Resistance column will remain empty until you complete the Analysis.

3. Turn the lamp sideways. Set the bulb 15 cm away from the panel. Turn the lamp on.

4. Repeat the Step 2.

5. Enter the same voltage from the previous setup into the table. Voltage will stay the same because the circuit would be set up identically if you were to take a voltage reading.

6. Build the circuit as shown to investigate current on the opposite side of the buzzer.

7. Observe the highest current over 30 seconds. Record the current in Table 1.

8. Stop collecting data, turn off the lamp, and take the circuit apart.

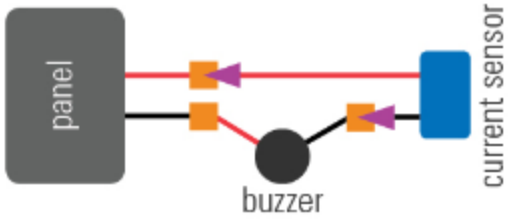


Table 1: Voltage, Current, and Resistance

Circuit Tested	Voltage (V)	Current (mA)	**Resistance (Ω)**
Panel and Buzzer			
Panel and Buzzer (with more light)			
Panel and Buzzer (with more light, new sensor location)			

Analyze

1. Use the following formula to calculate resistance for each circuit tested. Enter your answers in the table.

   Resistance (Ω) = [Voltage (V) ÷ Current (mA)] x 1000

2. Voltage is produced at the solar panel. How does light distance affect voltage? Support your answer with data.

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3. Did you correctly predict the relationship between voltage and current? Support your answer with data.

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4. What happens to current when resistance decreases? Support your answer with data.

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5. Does current change when measured at different points within this circuit? Support your answer with data.

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6. If current increases within a circuit, what will happen to the flow of electrons?

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_____

7. If resistance increases within a circuit, what will happen to the flow of electrons?

_____

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Extend

Write a testable question to investigate the effects of other devices on a circuit's voltage, current, and resistance. Other devices available include an LED and a DC motor. Get your instructor's approval before moving on with your experiment.