Finding a Relationship Between Current and Potential Difference

1. Observe, find a pattern, and explain You connect a resistor in series with an ammeter and a variable voltage source (a power supply whose voltage can be varied). In the table, the electric current \( I \) through the resistor is shown as you vary the potential difference \( \Delta V \) across the resistor.

<table>
<thead>
<tr>
<th>Potential Difference ( \Delta V ) (V)</th>
<th>0.0</th>
<th>2.0</th>
<th>4.0</th>
<th>6.0</th>
<th>8.0</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current ( I ) (A)</td>
<td>0.000</td>
<td>0.020</td>
<td>0.038</td>
<td>0.061</td>
<td>0.079</td>
<td>0.105</td>
</tr>
</tbody>
</table>

Construct a circuit diagram

Represent the data graphically (Current vs Potential Difference)

Describe the pattern mathematically

Use words to explain the relationship between the current through the resistor and the potential difference across it
The mathematical pattern you found in activity one is the basis of the relationship for **Ohm’s Law**. As current is proportional to potential difference, a proportionality constant must be included in the equation. The relationship between current and voltage can be written as follows:

\[ I = \frac{\Delta V}{R} \]

Where the current, \( I \), is the dependent variable, \( 1/R \) is the slope of the line on the graph (where \( R \) is the resistance), and \( \Delta V \) is the potential difference (energy per charge).

This linear relationship between current and voltage does not hold for a lightbulb as the resistance of a lightbulb increases with temperature. A lightbulb is not an ohmic resistor.

### Some simple Ohm’s Law problem solving

\[ I = \frac{\Delta V}{R} \]

Units: \( R \) is \( \Omega \) (ohms), \( \Delta V \) is \( V \) (volts), \( I \) is \( A \) (amperes)

#### 2. Find the unknown quantity:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>a)</td>
<td>I = 10 A, R = 1500 ( \Omega ), ( \Delta V ) = ?</td>
<td>b) I = ?, R = 200 ( \Omega ), ( \Delta V ) = 240 V</td>
</tr>
</tbody>
</table>

#### 3. Find the unknown quantity

<p>| | | |</p>
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<tbody>
<tr>
<td>a)</td>
<td>I = ?, R = 2000 ( \Omega ), ( \Delta V ) = 0.02 V</td>
<td>b) I = 0.025 A, R = ?, ( \Delta V ) = 110 V</td>
</tr>
</tbody>
</table>

#### 4. How much resistance does a lightbulb create if it has a current of 0.025 A around it in a 9 V circuit?

#### 5. A heating coil offers a resistance of 2500 \( \Omega \). What potential difference is required so that 1.5 A of current pass through it?
6. **Evaluate the reasoning** Your friend says that when two identical light bulbs are connected in series to each other and then to a battery, the light bulb connected closest to the negative pole of the battery will be brighter. He explains this by claiming that the second bulb will get fewer electrons because the first bulb will use up some of the electrons. Do you agree or disagree? How can you convince your friend of your opinion? Use the analogies that you discussed in the previous activity or perform an experiment to test his suggestion.

7. **Represent and reason** Imagine that you have a 9.0-V battery connected by wires to a light bulb. Fill in the table that follows. Consider that the negative terminal of the battery is at 0 potential.

<table>
<thead>
<tr>
<th>Draw the circuit.</th>
<th>Draw a qualitative electric potential versus position graph.</th>
</tr>
</thead>
</table>
|                   | ![Graph](image)

Use household voltage = 120 V for all problems.

8. A 60 watt light bulb uses 0.5 A. $R = \underline{\quad} \text{Ohms (}\Omega\text{)}$
9. A blender uses 2 A $R = \underline{\quad} \Omega$
10. A microwave oven uses 8.3 A $R = \underline{\quad} \Omega$
11. A TV has 36 Ohms (\Omega) of resistance $I = \underline{\quad} \text{A}$
12. A toaster has 40 \Omega of resistance $I = \underline{\quad} \text{A}$
13. A Refrigerator has 13.8 \Omega of resistance $I = \underline{\quad} \text{A}$