Current and voltage: measuring different quantities

Student activity • investigation and reasoning

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The question

How does current change when voltage or circuit resistance changes?

Measure a low-voltage resistor circuit and distinguish a series ammeter from a parallel voltmeter.

Equipment

- Current-limited 0–3 V source, switch, ammeter and voltmeter
- 100 Ω and 220 Ω resistors, each rated at least 0.5 W; leads

Disconnect before changing components or meter sockets. Never place an ammeter across the source. Keep voltage at or below 3.0 V and current limit at 0.05 A. Stop if a component warms unexpectedly; no mains connections are made by pupils.

Course coverage: Shared Physics / Double Award: 2.1, 2.8, 2.10. Current, voltage and resistance.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Work in ten groups of three. With the source disconnected, connect a 100 Ω resistor rated at least 0.5 W in series with a switch and ammeter. Connect a voltmeter across the resistor.

2. Ask staff to check the meter sockets, ranges and circuit. Use the current-limited low-voltage source, starting at zero and never exceeding 3.0 V.

3. Set approximately 1.0 V across the resistor, then record the actual voltage and current. Repeat at approximately 2.0 V and 3.0 V, opening the switch between readings.

4. Disconnect the source and replace the resistor with a 220 Ω resistor rated at least 0.5 W. Repeat the three voltage settings and record the actual values.

5. Compare current at similar measured voltages. Explain why greater resistance gives a lower current at the same voltage.

6. Draw both meter positions and explain what each measures. Use the measured values rather than the power-supply dial setting in your conclusions.

Cleanup

- Switch off, disconnect sources and return components and meters.

Record your evidence

Blank spaces are for your own work

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Reference and task data

At 3.0 V, an ideal 100 Ω resistor carries 0.030 A and dissipates 0.090 W. These are checking calculations, not class measurements. Voltage is measured between two points; current is measured through a branch.

Resistor / setting	Actual V / V	Current / A
100 Ω / 1 V		
100 Ω / 2 V		
100 Ω / 3 V		
220 Ω / 1 V		
220 Ω / 2 V		
220 Ω / 3 V		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Where does the ammeter go?

2. Where does the voltmeter go?

3. What happens to current as voltage rises for the same cool resistor?

4. Compare 100 Ω and 220 Ω at equal voltage.

5. Why record actual voltage?

6. What is the unit of resistance?