teacher guide

Electrical circuits 3: Current electricity

Components

	NAME	DESCRIPTION	AUDIENCE
	*Current electricity* teacher guide	This guide suggests alternative ways that students can experiment with simple circuits.	teachers
	*Models and misconceptions* background sheet	Eight models that teachers may use to help explain concepts in electricity are described. A list of common misconceptions about electricity, held by students, is included.	teachers
	*Simple circuits* worksheet	Students explore simple circuits by completing open-ended and structured experiments to explore current, resistance and potential difference.	students

Purpose

To **Explore** concepts of current, resistance and potential difference.

Outcomes

Students:

- construct simple circuits from components following circuit diagrams or verbal instructions;
- draw circuit diagrams to represent simple electrical setups;
- explore relationships between current size and position current is measured in a circuit;
- use ammeters and multimeters to measure current and resistance; and
- investigate the total resistance when resistors are connected in series and in parallel.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students explore simple circuits either using procedures described in this guide, or in the worksheet, *Simple circuits*. Simple circuits can be connected using standard laboratory components: power pack, lamps, meters, switches, cells and wires. Resistances can be measured using multimeters.	small groups or individuals

Teacher notes

Procedures may be open-ended with students experimenting with different combinations of components to develop confidence in using equipment. If a more structured approach is required then teachers may direct groups to connect components so a specific outcome is achieved. For example an instruction may be: 'Produce a circuit in which two lamps can be switched on and off independently.'

These experiments are written up in many different laboratory manuals in a more structured way. Teachers may prefer to use these sources instead of the more open-ended approach.

Circuit diagrams may be drawn to represent circuits students construct.

A structured worksheet is included for teachers who prefer to approach the concepts more traditionally.

A large quantity of components is required if students work in small groups to construct a wide variety of circuits. If power packs are used as power sources, 12 V lamps will eliminate accidental 'blowing' of bulbs.

Commercially designed kits of components, which may be available in some schools, assist distribution of equipment to students.

Procedure 1: Resistors in series

Purpose

This is an open-ended experiment in which students explore resistance effects of connecting lamps in series in electrical circuits.

Background

Most devices, when connected in an electrical circuit, provide some resistance to drift of electrons in the circuit. Depending on the size of resistance, one effect is to produce heat. In the case of lamps, resistance in the filament is such that it becomes white-hot and so produces light.

Resistance that lamps produce can be measured by connecting a multimeter (set to measure resistance) across resistors in the circuit.

Materials required

- five 12 V lamps with approximately equal resistances
- power supply
- electrical leads
- multimeter

Students' task

- Use equipment to connect various numbers of lamps in series. Measure resistance across the lamps using a multimeter.
- Record findings in a table and analyse data collected.
- Identify any relationship between number of lamps connected in series and total resistance.

Procedure 2: Resistors in parallel

Purpose

This is an open-ended experiment in which students explore resistance effects of connecting lamps in parallel in electrical circuits.

Background

Most devices, when connected in an electrical circuit, provide some resistance to drift of electrons in the circuit. Depending on the size of resistance, one of the effects is to produce heat. In the case of lamps, resistance in the filament is such that it becomes white-hot and so produces light.

Resistance that lamps produce can be measured by connecting a multimeter (set to measure resistance) across resistors in the circuit.

Materials required

- five 12 V lamps with approximately equal resistances
- power supply
- electrical leads
- multimeter

Students' task

- Use equipment to connect various numbers of lamps in parallel. Measure resistance across the lamps using a multimeter.
- Record your findings in a table and analyse data collected.
- Describe the relationship between number of lamps connected in parallel and total resistance.

Procedure 3: Measuring current

Purpose

The purpose of this activity is to explore the relationship between size of an electrical current and position in a circuit where it is measured.

Background

Current is a measure of rate of drift of charge as it travels in a circuit. It can be measured by an ammeter that provides a reading in amperes (amps). The ammeter must be connected, in series, with the positive terminal connected closest to the positive terminal of the power pack, and the negative terminal closest to the negative terminal of the power pack.

Materials required

- ammeter
- 12 V power supply
- four 12 V lamps with equal resistances, or four 50 Ω resistors.

Students' task

- Connect lamps and power pack into a series circuit and measure current at various points in the circuit.
- Record findings in a table.
- Rearrange lamps so at least two lamps are in parallel with each other, then measure current at various points in the circuit.
- Record findings and analyse data collected.

Technical requirements

The guide, background sheet and worksheet require Adobe Reader (version 5 or later). This is a free download from www.adobe.com. The worksheet is also available in Microsoft Word format.

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Associated SPICE resources

Electrical circuits 3: Current electricity may be used with related SPICE resources to address the broader topic of electricity.

DESCRIPTION	LEARNING PURPOSE
Electrical circuits (sequence overview) This learning pathway shows how a number of SPICE resources can be combined to teach the topic of electricity.	
Electrical circuits 1: Lightning Students are engaged in the topic of electricity through observing and exploring lightning.	**Engage**
Electrical circuits 2: Static electricity Students explore the effects of charge through a series of laboratory experiments.	**Explore 1**
Electrical circuits 3: Current electricity Students construct circuits using simple electrical components.	**Explore 2**
Electrical circuits 4: Circuit rules Students use an interactive learning object to record observations and derive rules for circuits.	**Explain 1**
Electrical circuits 5: Measuring electricity Six measurements that relate to electricity are explained and related to electrical safety: charge, current, electric potential, resistance, power and energy.	**Explain 2**
Electrical circuits 6: Bioelectricity Four fact sheets and a video provide examples of how electricity is used in living organisms, including humans.	**Elaborate**