

Links to the Australian Curriculum: Senior Secondary Physics (Unit 1)

Science understanding concepts include:

Electrical circuits

- Electrical circuits enable electrical energy to be transferred efficiently over large distances and transformed into a range of other useful forms of energy including thermal and kinetic energy, and light (ACSPH037)
- Electric current is carried by discrete charge carriers; charge is conserved at all points in an electrical circuit (ACSPH038)
- Energy is conserved in the energy transfers and transformations that occur in an electrical circuit (ACSPH039)
- The energy available to charges moving in an electrical circuit is measured using electric potential difference, which is defined as the change in potential energy per unit charge between two defined points in the circuit (ACSPH040)
- Energy is required to separate positive and negative charge carriers; charge separation produces an electrical potential difference that can be used to drive current in circuits (ACSPH041)
- Power is the rate at which energy is transformed by a circuit component; power enables quantitative analysis of energy transformations in the circuit (ACSPH042)
- Resistance for ohmic and non-ohmic components is defined as the ratio of potential difference across the component to the current in the component (ACSPH043)
- Circuit analysis and design involve calculation of the potential difference across, the current in, and the power supplied to, components in series, parallel and series/parallel circuits (ACSPH044)

Science as a human endeavour concepts include:

- Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSPH011)
- The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSPH013)
- Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSPH014)

Science inquiry skills concepts include:

- Conduct investigations, including using temperature, current and potential difference measuring devices, safely, competently and methodically for the collection of valid and reliable data (ACSPH003)
- Select, construct and use appropriate representations, including text and graphic representations of empirical and theoretical relationships, flow diagrams, nuclear equations and circuit diagrams, to communicate conceptual understanding, solve problems and make predictions (ACSPH006)

Science understanding concepts include:

Electrical circuits

- There are two types of charge that exert forces on each other.
- Electric current is carried by discrete charge carriers; charge is conserved at all points in an electrical circuit. This includes applying the relationship $I=q / t$
- Energy is conserved in the energy transfers and transformations that occur in an electrical circuit.
- The energy available to charges moving in an electrical circuit is measured using electric potential difference, which is defined as the change in potential energy per unit charge between two defined points in the circuit. This includes applying the relationship $V=W / q$.
- Energy is required to separate positive and negative charge carriers; charge separation produces an electrical potential difference that drives current in circuits
- Power is the rate at which energy is transformed by a circuit component; power enables quantitative analysis of energy transformations in the circuit. This includes applying the relationship $P=W / t =VI$.
- Resistance depends upon the nature and dimensions of a conductor
- Resistance for ohmic and non-ohmic components is defined as the ratio of potential difference across the component to the current in the component. This includes applying the relationship $R=V / I$.
- Circuit analysis and design involve calculation of the potential difference across the current in, and the power supplied to, components in series, parallel, and series/parallel circuits.
- There is an inherent danger involved with the use of electricity that can be reduced by using various safety devices, including fuses, residual current devices (RCD), circuit breakers, earth wires and double insulation
- Electrical circuits enable electrical energy to be transferred and transformed into a range of other useful forms of energy, including thermal and kinetic energy, and light.

Science as a human endeavour concepts include:

- The supply of electricity to homes has had an enormous impact on society and the environment. An understanding of electrical circuits informs the design of effective safety devices for the safe operation of: lighting, power points, stoves other household electrical devices.

Science inquiry skills concepts include:

- Conduct investigations, including using temperature, current and potential difference measuring devices, safely, competently and methodically for the collection of valid and reliable data.
- Select, construct and use appropriate representations, including text and graphic representations of empirical and theoretical relationships, flow diagrams, nuclear equations and circuit diagrams, to communicate conceptual understanding, solve problems and make predictions.

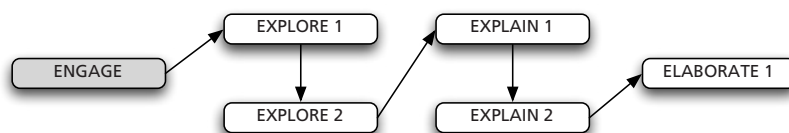
Background

These SPICE resources can be drawn together into a learning pathway for students to develop their understanding of electrical circuits. The pathway is structured around a constructivist model based on the 5-Es where teachers can:

- **Engage** students' interest and minds in the concept through consideration of a natural source of electricity: lightning.
- provide opportunities for students to **Explore** static and current electricity through hands-on investigations.
- develop **Explanations** for rules governing circuits through use of an interactive learning object and a set of fact sheets.
- **Elaborate** on the concepts. Here students can apply their knowledge in different contexts and extend their knowledge of and about science. Students look at the role of electricity in biological systems, including the human body.
- **Evaluate** students' progress through the pathway.

The pathway has been designed for teachers of Year 11 physics.

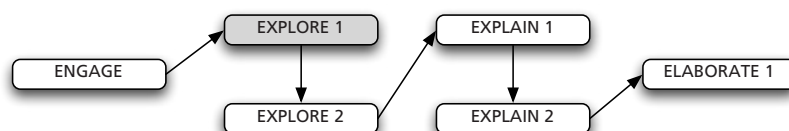
Learning pathway



Electrical circuits 1: Lightning

Lightning includes a teacher guide, video and fact sheet.

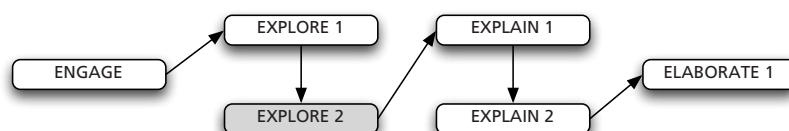
Dramatic slow-motion video footage and still photographs of lightning strikes leads to a discussion of properties of lightning. See the teachers guide for detailed information on the purpose and use of this resource.



Electrical circuits 2: Static electricity

Static electricity comprises a teacher guide, procedure sheet and student worksheet.

Students explore the nature of charge and effects caused by separation of charge through a series of practical exercises. A worksheet explores two aspects of charge separation: lightning and powder-coating. See the teachers guide for detailed information on the purpose and use of this resource.



Electrical circuits 3: Current electricity

Current electricity comprises a teacher guide, background sheet and student worksheet. Students construct circuits using simple electrical components. See the teachers guide for detailed information on the purpose and use of this resource.

