Stage 5 – Industrial Technology Electronics – Power hungry

## Summary

In this unit students will develop a fundamental understanding of electricity, electrical components and the underlying scientific principles and practices. Students will take on the role of an electrical engineer and use theoretical principles learned throughout this unit to create circuits. Students will investigate the function of batteries and the role that batteries could potentially play in a change from non-renewable to renewable power generation.

## Duration

10 weeks 2.5 hours/week

## Outcomes

* **IND5-1** identifies, assesses, applies and manages the risks and WHS issues associated with the use of a range of tools, equipment, materials, processes and technologies
* **IND5-3** identifies, selects and uses a range of hand and machine tools, equipment and processes to produce quality practical projects
* **IND5-4** selects, justifies and uses a range of relevant and associated materials for specific applications
* **IND5-8** evaluates products in terms of functional, economic, aesthetic and environmental qualities and quality of construction
* **IND5-10** describes, analyses and evaluates the impact of technology on society, the environment and cultural issues locally and globally

[Industrial Technology 7-10](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/technologies/industrial-technology-2019) Syllabus © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2019

## Unit overview

* Students will work individually on a range of electrical projects that will begin with a simple series circuit/continuity indicator and progressively evolve into a sophisticated battery level indicator.
* Students will begin by learning electrical safety and basic electrical theory including knowledge of common electronic components, basic circuit construction, Ohm’s Law and basic DC theory.
* Students' practical skills will be developed by constructing basic circuits using breadboards and electrical simulation software. Students will then complete permanent circuits using Vero board once their prototyped circuits have been tested and troubleshot.
* Students will be assessed on their ability to comprehend and apply fundamental electronics principles to practical and theoretical tasks as well as their ability to produce functioning circuits and describe their function.
* Students will investigate and prepare a report on power generation in Australia and its implications and provide an extended response on the effects of power generation in Australia and the part that batteries could potentially play in making renewable power generation more feasible for widespread use in the future.

## Resources overview

### Physical resources

* Power Hungry student and teacher resource package
* Occasional computer room access
* Workshop with electronics equipment (breadboards, soldering irons, multimeters and so on)
* Various electrical components including a range of common resistors, potentiometers, LEDs, capacitors (25V 100μF), Zener diodes (6.8V, 8.2V, 9.1V, 10V, 11V), transistors (BC547), integrated circuits (LM3914)

### Websites

* Equipment Safety in Schools (ESIS) [online.det.nsw.edu.au/esis/teacher](https://online.det.nsw.edu.au/esis/teacher/)
* SafeWork safety signs in the workplace (PDF poster) [safework.sa.gov.au/resources/free-resources](https://www.safework.sa.gov.au/resources/free-resources)
* Home-made battery [wikihow.com/Make-a-Homemade-Battery](http://wikihow.com/Make-a-Homemade-Battery)
* Australia's rising greenhouse gas emissions [climatecouncil.org.au/resources/australias-rising-greenhouse-gas-emissions](https://www.climatecouncil.org.au/resources/australias-rising-greenhouse-gas-emissions/)
* Circuit Construction Kit [phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc\_en](https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html)
* TinkerCAD [tinkercad.com](https://www.tinkercad.com/)
* Australian electricity statistics
	+ [opennem.org.au](https://opennem.org.au/#/all-regions)
	+ [energymatters.com.au/energy-efficiency/australian-electricity-statistics](https://www.energymatters.com.au/energy-efficiency/australian-electricity-statistics/)
	+ [reneweconomy.com.au/nem-watch](https://reneweconomy.com.au/nem-watch/)
* Snowy Hydro system [snowyhydro.com.au/our-energy/hydro/](http://snowyhydro.com.au/our-energy/hydro/)
* Monash university [Regulatory and Hazard Signage Guidelines](https://www.monash.edu/__data/assets/pdf_file/0019/147061/signage.pdf)

YouTube:

* [SparkFun Electronics - What is Voltage?](https://www.youtube.com/watch?v=z8qfhFXjsrw&t=2s) (duration 6:56)
* [SparkFun Electronics - What is Electric Current?](https://www.youtube.com/watch?v=kYwNj9uauJ4) (duration 5:12)
* [SparkFun Electronics - Ohm's Law](https://www.youtube.com/watch?v=8jB6hDUqN0Y) (duration 6:15)
* [SparkFun Electronics- What is a Battery?](https://www.youtube.com/watch?v=-EB7NVA7rI4) (duration 4:06)
* [Resistors in series and parallel - deriving the formula](https://www.youtube.com/watch?v=mZFae-g28Ik) (duration 5:09)
* [Soldering tutorial for beginners](https://www.youtube.com/watch?v=Qps9woUGkvI) (duration 3:56)
* [How batteries work - Adam Jacobson](https://www.youtube.com/watch?v=9OVtk6G2TnQ) (duration 4:19)
* [Yes, Batteries are our Future](https://www.youtube.com/watch?v=dOn-L6nUS54) (duration 13:25)
* [Batteries, recycling and the environment](https://www.youtube.com/watch?v=oKFOqMZmuA8&amp=&t=27s) (duration 13:28)

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| **Content** | **Teaching and learning** | **Evidence of learning** | **Adjustments and registration** |
| **Week one:*** Demonstrate safe workshop practices and procedures
 | **Teacher:*** Introduces the unit 'Power hungry' and provides an overview of unit and assessment.
* Identifies any prior knowledge that students may have of electronics to assist with adjustments/extensions.
* Inducts students into workshop and discuss workshop safety and how it is to be applied during the completion of practical projects.
* Explain electrical safety to students and the application of electrical safety in the workshop whilst using powered tools and machinery.
* Clarify the difference between electrical safety and with electronics, students only to use up to 24 Volts DC in electronics projects.

**Students:*** Complete a general workshop safety test and specific safety test for each piece of equipment used throughout the project. For example, soldering iron, drill press.

**Resources:*** Refer to [ESIS](https://online.det.nsw.edu.au/esis/teacher/)
 | * Students demonstrate safe work practices whilst in the workshop environment such as: wearing correct PPE, using equipment in the way demonstrated by the teacher, cleaning and maintaining equipment after use, being responsible and mature when using equipment and reporting any malfunctions, damage or hazards related to equipment to the teacher.
* Students demonstrate electrical safety such as: checking that power leads for powered equipment are in good condition and have been tested and tagged before plugging them into a wall socket.
* Students satisfactorily complete a general workshop safety test and safety tests for relevant equipment and machinery.
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| * Recognise and comply with WHS signage
 | **Students:*** Investigate the colour and shapes associated with safety signs and discuss the importance of safety signs in a workshop.

**Resources:*** [SafeWork safety signs in the workshop](https://www.safework.sa.gov.au/resources/free-resources)
* Monash university [Regulatory and Hazard Signage Guidelines](https://www.monash.edu/__data/assets/pdf_file/0019/147061/signage.pdf)
 | * Students demonstrate compliance with safety signs in the workshop.
* Students articulate the meaning of various types of safety signs and their colours and symbols.
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| * Select and use personal protective equipment (PPE) when working with tools, materials and machines
* Safely use and maintain hand, power and machine tools
 | **Teacher:*** Demonstrate the safe use and maintenance of all equipment related to the unit as required.

**Students:*** Identify and select appropriate PPE for tools, materials and equipment used in electronics projects.
* Must demonstrate safe use of equipment to teacher (on first use).

**Teacher and students:*** Discuss PPE and which PPE is appropriate for tools, materials and equipment that will be used during the construction of the project.

**Resources:*** Refer to [ESIS](https://online.det.nsw.edu.au/esis/teacher/)
 | * Students demonstrate safe work practices whilst using tools and equipment such as: wearing correct PPE, using equipment in the way demonstrated by the teacher, cleaning and maintaining equipment after use, being responsible and mature when using equipment and reporting any malfunctions, damage or hazards related to equipment to the teacher.
* Students demonstrate familiarity with the safe set-up, use and maintenance of tools and equipment.
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| * Apply the principles of risk management
* Describe elementary first aid procedures
 | **Teacher:*** Demonstrates basic first aid appropriate for the workshop.
* Identifies the location of first aid kits in the workshop and outlines what first aid supplies are available within kits and how to use supplies.
* Demonstrates first aid procedure to follow in the event of an accident.

**Students:*** Identify the risk and precautions that need to be taken when using tools, materials and equipment used in electronics projects.
* Demonstrate an understanding of how to manage risk and identify what procedure to follow in the event of an accident.
* Complete a safe work method statement related to the production of the project.
* Demonstrate workshop risk assessment and hazard identification.

**Teacher and students:*** Discuss risk management and hazard identification and its importance in the workshop environment.
* Discuss the purpose of safety documents in industry and in the workshop such as SOP, SWMS and JSA.

**Optional adjustment:*** If students are unable to complete a comprehensive SWMS, instead list tools and equipment that will be used throughout the unit and identify the risks of using each.
 | * Students articulate how to apply basic first aid in a variety of circumstances.
* Students appropriately apply basic first aid if the need arises.
* Students apply principles of risk management and hazard identification by not taking risks whilst in the workshop environment and reporting any potential hazards to the teacher.
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| **Week two:*** Explore fundamental electricity principles
* Explain the operation of simple circuits
 | **Teacher:*** Explains what voltage and current is, how it is measured, how it is created in electrical circuits and how energy from electrical current is useful.
* Explains the difference between conventional current and electron flow.
* Shows videos on voltage, current and Ohm's Law.
	+ [SparkFun Electronics - What is Voltage?](https://www.youtube.com/watch?v=z8qfhFXjsrw&t=2s) (duration 6:56)
	+ [SparkFun Electronics - What is Electric Current?](https://www.youtube.com/watch?v=kYwNj9uauJ4) (duration 5:12)
	+ [SparkFun Electronics - Ohm's Law](https://www.youtube.com/watch?v=8jB6hDUqN0Y) (duration 6:15)

**Students:*** Investigate the underlying scientific principles of current, voltage and resistance in electrical circuits.
* Create a ‘simple continuity indicator’ (pages 18, 19 & 21).
* Complete pages 8-11 in student workbook.

**Optional adjustment:*** If students display difficulty comprehending the scientific principles of voltage, current and resistance use a visual analogy. For example, an image of water moving through a hose where the pressure of the water is the voltage, the water itself moving is current and anything that impedes the flow of water such as a kink in the hose is resistance. Have students label and compare the function of voltage, current and resistance in the analogical context.
 | * Students explain voltage, current and resistance scientifically or analogically.
* Students articulate the difference between electron flow and conventional current.
* Students articulate the relationship between voltage, current and resistance using Ohm’s Law.
* Students successfully create a ‘simple continuity indicator’ and describe how the circuit functions.
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| * Identify and describe a range of sources of power
 | **Teacher:*** Shows [SparkFun Electronics - What is a Battery?](https://www.youtube.com/watch?v=-EB7NVA7rI4) (Duration 4:06).

**Students:*** Investigate the basic operation of a battery.
* Experiment with the basic principles of a battery by making a [Home-made battery](https://www.wikihow.com/Make-a-Homemade-Battery).
* Create a basic ‘voltage reference’ circuit using a Zener diode.
* Read [Australia's rising greenhouse gas emissions](https://www.climatecouncil.org.au/resources/australias-rising-greenhouse-gas-emissions/) by the Climate Council of Australia Limited (document will need to be downloaded by teacher).

**Teacher and students:*** Discuss the implications of different methods of power generation.

 **Optional extension:*** Place dissimilar metals such as zinc and copper in lemon juice and test the electrical potential difference using a multimeter.
 | * Students articulate the basic function of a battery.
* Students contribute to discussion about renewable and non-renewable sources of power generation and the implications of different methods.
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| * Select and use specialist terminology in context
 | **Students:*** Develop a glossary as they progress through 'Power Hungry' unit in student workbook).
* Utilise appropriate terminology when referring to materials, tools, equipment and processes throughout the unit.
 | * Students use electrical jargon appropriately.
* Students complete glossary in student workbook and refer to it when unsure of a term.
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| * Prepare design and production folios to describe the management and processes undertaken in the production of practical projects
 | **Students:*** As students complete each circuit in this unit of work they should make note of skills and knowledge gained in the production journal on pages 38-39.
 | * Students successfully complete accompanying workbook.
* Students identify skills and knowledge gained, successes and challenges, and describe production processes of circuits in the production journal in the student workbook.
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| **Week three:*** Investigate components used in elementary electronics
 | **Students:*** Investigate various components to be used throughout 'Power Hungry' unit and describe their functions.

**Teacher and students:*** Discuss common components, their functions, how their values are measured and the variations and types of each component for example, potentiometer, LDR, thermistor and so on. Activities for different components are spread throughout the workbook as circuits increase in complexity.

**Optional adjustments:*** If students display difficulty in describing the function of components scientifically, extend upon the analogy used for comprehension of voltage, current and resistance and have students describe component function in that context.
 | * Students articulate the function of basic components scientifically or analogically.
* Students identify components and how to connect them correctly in electrical circuits.
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| * Interpret codes and units of measurement for electronic components
 | **Teacher:*** Demonstrates how to safely/correctly use a digital multimeter.

**Students:*** Use a resistor colour code chart to determine the value of the resistors.
* Measure a range of resistors using a digital multimeter and compare expected values with actual values.
* Complete pages 15-17 in student workbook.
 | * Students correctly read resistor values and tolerance using colour code.
* Students articulate reasons for discrepancy in reading between colour code and multimeter.
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| * Read and measure values for circuit components
 | **Teacher:** * Demonstrate how to correctly set the multimeter for reading values of various components as well as voltage and current within a circuit.

**Students:*** Read values of basic components without a multimeter for example resistor colour codes, identifying codes printed on capacitors, transistors and so on.
* Complete pages 15-17 in student workbook.
 | * Students correctly set the unit and range of multimeter for components they are measuring the value of.
* Students correctly use SI prefixes when reading and measuring values of components.
* Students access specification sheets online for any components that they are unfamiliar with.
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| **Week four:*** Calculate voltage, current and resistance using Ohm's law
 | **Teacher:*** Explains Ohm's law and the relationships between voltage, current and resistance.
* Demonstrates how to use Ohm's law triangle to manipulate the formula.

**Students:*** Use Ohm's law to calculate voltage, current and resistance in basic series and parallel circuits.
* Predict what happens in a circuit that has 0 resistance (short circuit).
* Simulate Ohm's law using [Circuit Construction Kit](https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html).
* Complete pages 12 & 13 in student workbook.

**Optional extension:*** Investigate how the series and parallel resistance formulae are derived from Ohm's law - [Resistors in series and parallel - deriving the formula](https://www.youtube.com/watch?v=mZFae-g28Ik) (duration 5:09).
 | * Students articulate the mathematical relationship between voltage, current and resistance.
* Students manipulate Ohm's law formula to solve for one unknown.
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| * Calculate values for resistors in series and in parallel
* Calculate elementary circuit values
 | **Students:*** Calculate voltage, current and resistance between nodes/through components in simple and complex circuits.
* Construct simple series and parallel resistor circuits, attempt to calculate voltage, current and resistance in the circuit and then use a multimeter to check and suggest reasons for discrepancies (page 28 & 29).
* Complete pages 25-29 in student workbook.

**Optional adjustments:*** If students display difficulty in calculating values in complex circuits allow them to create the circuit using an online circuit simulator such as [Circuit Construction Kit](https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html) or [TinkerCAD](http://www.tinkercad.com) and simulate the circuit to get circuit values (there will still be discrepancies between the simulated values and the values from creating the circuit in a breadboard and reading with a multimeter).
 | * Students identify if components are connected in series and parallel and select appropriate formula to calculate equivalent resistance.
* Students calculate equivalent resistance of resistors in series and parallel in simple circuits.
* Students calculate voltage and current between nodes in a circuit.
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| **Week five:*** Identify, understand and use a range of electrical components in the production of practical projects
 | **Students:*** Build a simple LED circuit that uses a Zener diode as a voltage reference (page 23 in student workbook).
* Utilise their knowledge of basic components and describe the function of the circuit.

**Optional adjustments:*** If students display difficulty in describing the function of circuits scientifically, extend upon the analogy used for comprehension of voltage, current and resistance and have students describe circuit function in that context.
 | * Students identify electrical components and their schematic symbols.
* Students distinguish between polarized and non-polarized components.
* Students articulate the function of components scientifically or analogically.
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| * Follow a planned sequence through to project completion
* Read and interpret plans and/or materials lists to prepare materials for the completion of projects
* Test circuits when producing practical projects
* Diagnose and rectify faults in circuits using fault-finding practices
 | **Teacher**:* Demonstrate how to read a complex electronic schematic and identify components and their values.
* Demonstrate how to troubleshoot circuits that are faulty using deductive reasoning, for example, use a multimeter as a continuity tester, and visually inspect soldered joints to make sure that there are no “dry” joints.

**Students**: * Investigate the symbols of various components commonly used in electronic schematics and how to connect each component correctly according to the schematic.
* Use a range of hand tools and equipment in the production of their circuits within this unit of work, for example, pliers, third hand, wire strippers and multimeter.
* Troubleshoot circuits that are faulty.
 | * Students select and use appropriate equipment when producing practical projects.
* Students use deductive reasoning to find faults and troubleshoot circuits.
* Students read and interpret schematics to produce working electrical circuits.
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| **Week six:*** Use a range of hand tools and equipment in the construction of electronic circuits and circuit housings
* Identify and use a variety of semiconductors and components
 | **Students:*** Build a basic four LED battery indicator that uses Zener diodes as voltage references (page 30 in student workbook).
 | * Students identify which components are semiconductors and apply them in the production of electronics projects.
* Students select and use appropriate electronics tools and equipment to produce LED battery indicator circuit.
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| * Identify and investigate factors influencing design in electronics
 | **Students:*** Analyse component functions in basic circuits, and how the value of a component affects what will happen in the circuit.
* Utilise their knowledge of basic components and describe the function of the four LED Zener diode battery indicator circuit and hypothesize the change in function by changing values of the diodes or resistors.

**Optional adjustments:*** If students display difficulty in describing the function of circuits scientifically, extend upon the analogy used for comprehension of voltage, current and resistance and have students describe circuit function in that context.
 | * Students articulate the function of the LED voltmeter scientifically or analogically.
* Students hypothesise difference in function by changing the value of different components in the circuit such as the Zener diodes.
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| * Follow a planned sequence through to project completion
* Read and interpret plans and/or materials lists to prepare materials for the completion of projects
* Test circuits when producing practical projects
* Diagnose and rectify faults in circuits using fault-finding practices
 | **Teacher:*** Demonstrate how to read an electronic schematic and identify components and their values.
* Demonstrate how to troubleshoot circuits that are faulty using deductive reasoning, for example, use a multimeter as a continuity tester, and visually inspect soldered joints to make sure that there are no “dry” joints.

**Students:** * Investigate the symbols of various components commonly used in electronic schematics and how to connect each component correctly according to the schematic.
* Use a range of hand tools and equipment in the production of their circuits within this unit of work, for example, pliers, third hand, wire strippers and multimeters.
* Troubleshoot circuits that are faulty.
 | * Students successfully complete LED voltmeter circuit and test its function appropriately.
* If the circuit does not function as intended students apply troubleshooting techniques and apply deductive reasoning.
* Students identify issues with the circuit and take steps to rectify issues by replacing components, improving solder connections or placing components in the correct orientation.
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| **Week seven:*** Identify methods of prototyping designs before manufacture
 | **Teacher:*** Discuss why prototyping is important before creating circuits in Vero board or PCB for example, allows the circuit functionality to be tested and troubleshot before final production.
* Demonstrate the use of relevant software to design circuits.
* Demonstrate computer simulation software such as TinkerCAD.

**Students:*** Explore methods of prototyping circuits such as the use of breadboards, draw links between using a breadboard to test a circuit and then creating a permanent circuit using Vero board.
* Use computer simulation /prototyping software as a means of prototyping circuits for example, TinkerCAD can be used to create the circuit and simulate what the circuit will do when connected to power.
* Build battery indicator V1 in a breadboard (page 32 in student workbook).
 | * Students identify and apply various methods of prototyping a circuit prior to creating a PCB or other permanent solution such as Vero board.
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| **Week eight:*** Identify and use different types of wires
 | **Teacher:*** Discuss different types of wire and their applications, for example, solid core wire for soldering to boards and use in breadboards, stranded core wire for applications where flexibility is needed such as power cords, aluminium wire where weight is an issue such as aircraft and overhead power cables.

**Students:*** Build battery indicator V2 in breadboard (page 34 in students workbook).

**Optional adjustments:*** If students display difficulty in prototyping battery indicator V2 using the schematic provide a breadboard diagram.
 | * Students select and use different types of wire appropriate to the task at hand.
* Students can articulate the advantages and disadvantages of using different types of wires in various applications.
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| * Investigate solder applications
 | **Teacher:*** Discuss common alloys used as solder, for example, Sn-Pb and Sn-Ag-Cu.
* Investigate the use of flux or resin in soldering.
* Demonstrate how to safely solder components to boards, tin wires and use solder wick.

**Students:*** Discuss the advantages and disadvantages of common solder and lead-free solder.
* Investigate the motivation behind lead free solder, for example, remove lead from e-waste.
* Practice soldering and removing solid core wire and salvaged components such as resistors into scrap Vero board to gain competency in soldering.
 | * Students use solder and soldering processes such as tinning, soldering through-hole components and desoldering.
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| * Construct circuits using a soldering iron
* Develop skills in the use of soldering equipment
 | **Teacher:*** Shows [Soldering tutorial for beginners](https://www.youtube.com/watch?v=Qps9woUGkvI) (duration 3:56).

**Students:*** Develop skills in using a soldering iron to attach components to circuit boards, attach probes to components that need to be able to be located away from the circuit board in housings such as LEDs, and learn to tin stranded wires so that they can be used as probes or inserted and soldered to circuit boards.
 | * Students use a soldering iron and associated equipment safely in the production of practical projects.
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| **Week nine:*** Investigate issues relating to the sustainability of resources in the electronics industry
 | **Teacher:*** Shows [How batteries work - Adam Jacobson](https://www.youtube.com/watch?v=9OVtk6G2TnQ) (duration 4:19).
* [Yes, Batteries are our Future](https://www.youtube.com/watch?v=dOn-L6nUS54) (duration 13:25).
* [Batteries, recycling and the environment](https://www.youtube.com/watch?v=oKFOqMZmuA8&amp=&t=27s) (duration 13:28).

**Students:*** Explore the life cycle of batteries and the implications of reusable and disposable batteries on the environment.
* Investigate what happens to different battery types when they are no longer useable.
* Complete pages 35-37 in student workbook.
 | * Students articulate issues with sustainability of resources used in battery technology.
* Students identify issues with sustainability of non-renewable power generation.
* Students contribute to discussion about and articulate how batteries could be instrumental in the shift to renewable energy.
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| * Identify and investigate factors influencing design in electronics
 | **Students:*** Arrange LEDs in battery indicator V2 to correspond with voltage into the circuit.
 | * Students design an LED arrangement to be user friendly so that it is obvious when the battery is charged.
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| * Use and/or modify existing designs when completing projects
* Apply a range of techniques and skills to enhance the appearance and/or function of electronics projects
 | **Teacher:*** Demonstrates how to transfer a prototyped circuit from breadboard to Vero board.

**Students:*** Transfer their battery indicator V2 from breadboard to Vero board to create a permanently joined circuit.

**Optional adjustments:*** If students display difficulty in transferring their circuit from breadboard to Vero board they may need step-by-step guidance.
 | * Students successfully prototype battery indicator V2 in breadboard.
* Students arrange LEDs in a manner that logically shows the level of the battery.
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| **Week ten:*** Design and produce project housings
* Apply a range of techniques and skills to enhance the appearance and/or function of electronics projects
 | **Teacher:*** Demonstration on how to design and produce appropriate housings for projects, for example, have a prepared laser cutter template that students can modify.

**Students:*** Design and produce a housing for their battery indicator V2 within teacher constraints.
 | * Students successfully design and produce a housing for battery indicator V2 circuit using appropriate hardware and processes to mount components and circuit boards and so on.
* Students mount LEDs in a manner that logically shows the level of the battery.
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| * Investigate power generation
* Describe a range of power-generation techniques and their relative impacts on the environment
 | **Teacher:*** Discussion about methods of power generation, how they work and their environmental implications.

**Students:*** Investigate how the majority of power is generated in Australia, visit the websites provided to view the Australian electricity generation statistics in real-time.
* Investigate the Snowy Hydro system.

**Resources:*** Australian electricity statistics.
	+ [opennem.org.au/#/all-regions](https://opennem.org.au/#/all-regions)
	+ [energymatters.com.au/energy-efficiency/australian-electricity-statistics/](https://www.energymatters.com.au/energy-efficiency/australian-electricity-statistics/)
	+ [reneweconomy.com.au/nem-watch/](https://reneweconomy.com.au/nem-watch/)
	+ [Snowy Hydro system](http://www.snowyhydro.com.au/our-energy/hydro/)

**Optional adjustments:*** If students display difficulty in designing and producing a housing, use a jiffy box and create appropriate holes/ use appropriate bezels and so on, for LEDs and the potentiometer.
 | * Students actively participate in and contribute to the discussion about power generation and related environmental issues.
* Students articulate issues with power generation in Australia.
* Students suggest methods to improve the sustainability of power generation in Australia.
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## Evaluation

Evaluation of learning activities should be an ongoing process that happens throughout the delivery of this unit. Teachers should document their evaluation of learning activities throughout the program. The space provided below is to evaluate the overall unit of work.

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