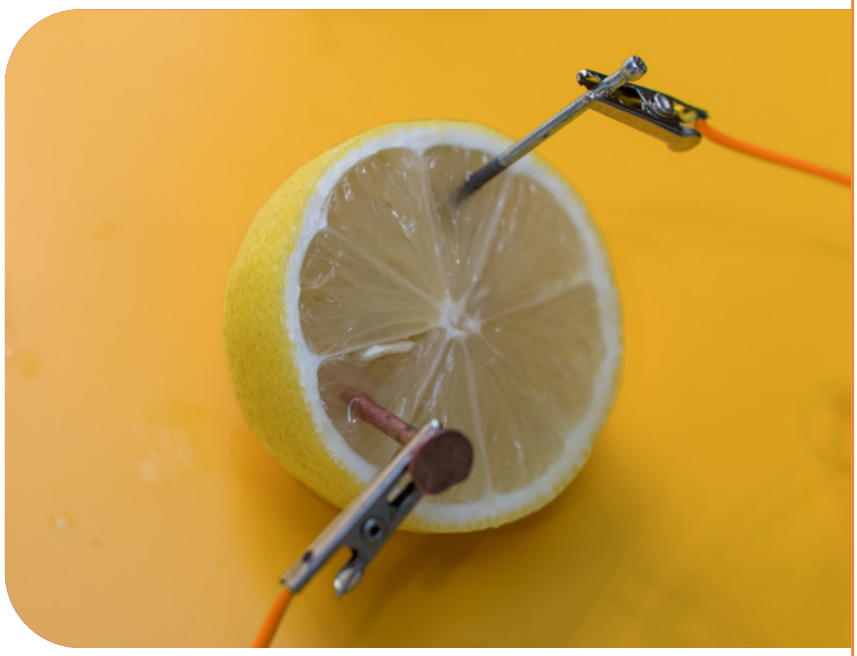
genesis school-gen

EMPOWERING KIWI KIDS

YEARS 5-8

Battery Power



OVERVIEW

How does a battery work and what can they be used for? Make a lemon battery cell to explore the science of batteries in this fun, hands-on lesson

Batteries change chemical energy into electrical energy – to provide a flow of electrons. Before the invention of batteries people couldn't operate devices that moved around, such torches, phones and EVs. Batteries are also important for storing the energy generated from solar and wind power.

NZ CURRICULUM LINKS

LEARNING AREAS:	ACHIEVEMENT OBJECTIVES:	LEVELS:	YEARS:
Science: Material world: Chemistry and society.	Relate the observed characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.	3-4	5-8
Nature of science: Investigating in science.	Develop and carry out more complex investigations, including using models.	3-4	5-8
English: Reading Comprehension: Information	Use visual information, textual elements, and text features (e.g., side bars, hyper-links, links to glossaries) to understand a text and locate additional relevant information.	Phase 2	4-6

TEACHER INFORMATION:

Learning sequence

INTRODUCING KNOWLEDGE

EXPLORE AND INVESTIGATE

CREATE AND SHARE

REFLECT AND EXTEND

MAKE A DIFFERENCE

Learning intentions

Students are learning to:

- Investigate the parts of a battery through modelling and experimenting
- Explore how a battery works
- Compare standard and rechargeable batteries

Success criteria

Students can:

- Make a working battery from a lemon
- Explain how a battery works
- List the similarities and differences of standard and rechargeable batteries

Resources needed

- Slideshow: Battery Power slideshow
- Materials for lemon battery (see page 7)
- Devices, internet access

Additional Support

Brittanica Kids: Battery article

Vocabulary

Battery, electrical, charge, chemical, electron, voltage, rechargeable, energy, ions, electrodes, electrolyte, copper, zinc, wire, standard, circuit.

Any text highlighted in orange represents a link to further material. If you have printed this resource, please return to schoolgen.co.nz/teachers/resources/ to access the linked material.

LEARNING EXPERIENCE

Battery Power

Note: These are suggestions only and teachers are encouraged to adjust the activity to suit the needs and interests of their students.

INTRODUCING KNOWLEDGE

Allow approximately 20 minutes

Electricity revision

- Revise what a circuit is, what electrons are and how electricity flows. Review what students have learnt about circuits and electricity already, with the Electrical circuits slideshow (from the School-gen electrical circuits activity).

Batteries and electricity

- Discuss what a battery is and show common examples of batteries. There are many types of batteries, but the most commonly used batteries, such as AA and AAA batteries, are known as primary or standard batteries. This lesson focuses on these batteries. Other batteries work slightly differently.
- View the Battery Power slideshow slides 1-9 to introduce the concepts of:
  - what a battery is
  - common examples of batteries
  - how batteries are used in everyday life.

EXPLORE AND INVESTIGATE

Allow approximately 15 minutes

Exploring how batteries work

Discuss ideas about how a battery works.

Explain that batteries create energy through chemical reactions that produce a flow of electrons, when connected in a circuit.

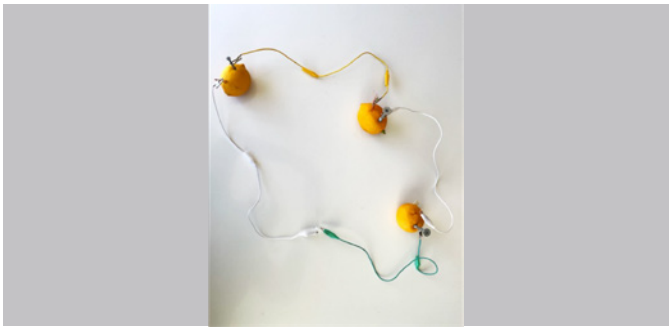
View the Battery Power slideshow slides 10-11 to see how batteries work.

To demonstrate these ideas, a simple cell or battery can be made using a lemon and some basic electrical equipment.

See page 7 for instructions about how to make a lemon battery.

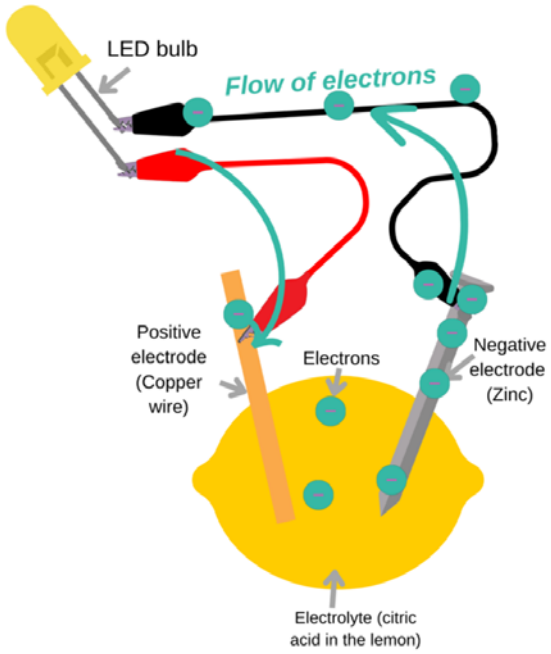
THINKING LIKE A SCIENTIST:

- How does a battery work?
- How does the energy in a battery change from a chemical form to a flow of charge?



How a lemon battery/cell works

THINKING LIKE A SCIENTIST:
- Is the electricity coming from the lemon?



The electricity is not from the lemon! Electrons move from the zinc in the nail, through the circuit to the copper wire.

The copper wire is hungry for electrons, while the zinc in the nail is happy to give away its electrons. When a wire is connected between the two, electrons that have built up on the zinc will flow through to the copper.

How energy is stored in a real battery

A battery gives us the ability to store charge for use later. The experiment with the lemon works in a similar way to how a primary battery such as an AA battery works, with a negative electrode, positive electrode and solution (electrolyte).

Batteries have positive and negative ends or terminals. Electrons in a battery move from the negative end to the positive end, until the chemical reaction is all used up.

CREATE AND SHARE

Allow approximately 20 minutes

Make a model of a battery

Making a model of a standard battery can help students to understand more about how batteries work. Your model could be made from dough, clay, plasticene or air-dry clay.

In the model on left, the blue clay is the positive electrode (often zinc-based). The red clay is the negative electrode.

The yellow layer is the electrolyte that allows the current to flow through the circuit and acts as a separator, keeping the red and blue layers from reacting. The wire is the brass pin found in many household batteries. This collects the electrons and is where they leave the battery from.

You can also wrap your model in tin foil which can represent the steel container of the outside of the battery.

REFLECT AND EXTEND

Allow approximately 15 minutes

Review how batteries work and how we use them in our lives.

Comparing rechargeable and primary (single use) AA batteries

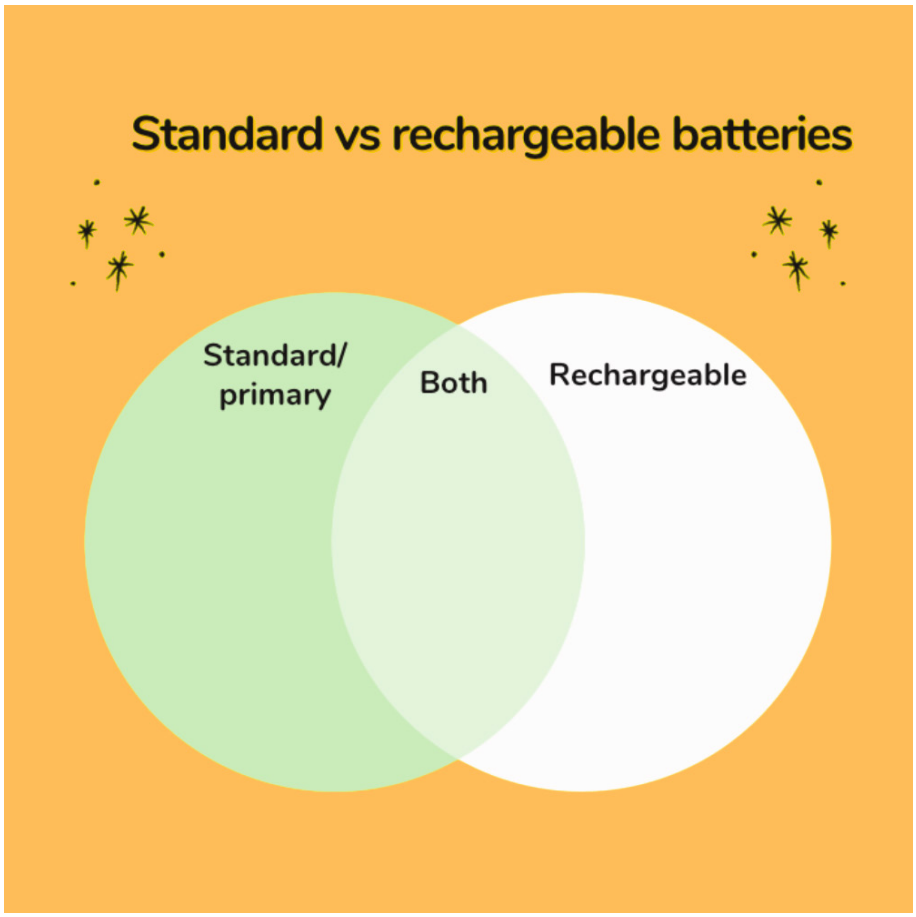
Discuss the difference between common primary batteries and rechargeable batteries.

Watch the video How batteries work by Adam Jacobsen.

In a primary battery all electrons go from one electrode to other and never return. Once all the material in the negative electrode has reacted, it disintegrates and can't be recharged.

Rechargeable batteries can reverse the process of charging – taking electrons from the power supply and returning them back to the negative electrode when they are recharged. Over time the metals become irregular and the process of recharging won't work anymore, usually after hundreds of uses.

Complete a venn diagram with the similarities and differences of primary/ standard batteries and recyclable batteries. See slide 13-14 for possible answers.



MAKE A DIFFERENCE

Allow approximately 10 minutes

Recycling batteries

Most batteries can be recycled. Recycling batteries makes the most of precious resources, is safer and helps protect natural environments.

Find out where batteries can be recycled in your area at the Wasteminz website. Many waste transfer stations, environment centres and some stores have battery recycling collections. Most recycling facilities take a variety of batteries, but it pays to check before dropping them off. Putting batteries in the rubbish bin can release harmful chemicals and even cause fires.

Switching to rechargeable batteries

Did you know that rechargeable batteries can be recharged and reused about 1000 times?

Maths Activity

How much money could you save if you bought rechargeable batteries instead of primary/ standard batteries, if they last 1000 times longer?

Type of battery	Standard alkaline batteries	Rechargeable batteries
Cost per battery	$2 each	$8 each
Number of times it can be used	Once	About 750 x
Cost per use		

Answer

The cost per battery use can be worked out by dividing the cost of the battery by the number of times the battery can be used in total. For the standard alkaline battery this works out as $2 per use ($2 divided by 1), and for the rechargeable battery it works out as about 1 cent per use ($8 divided by 750).

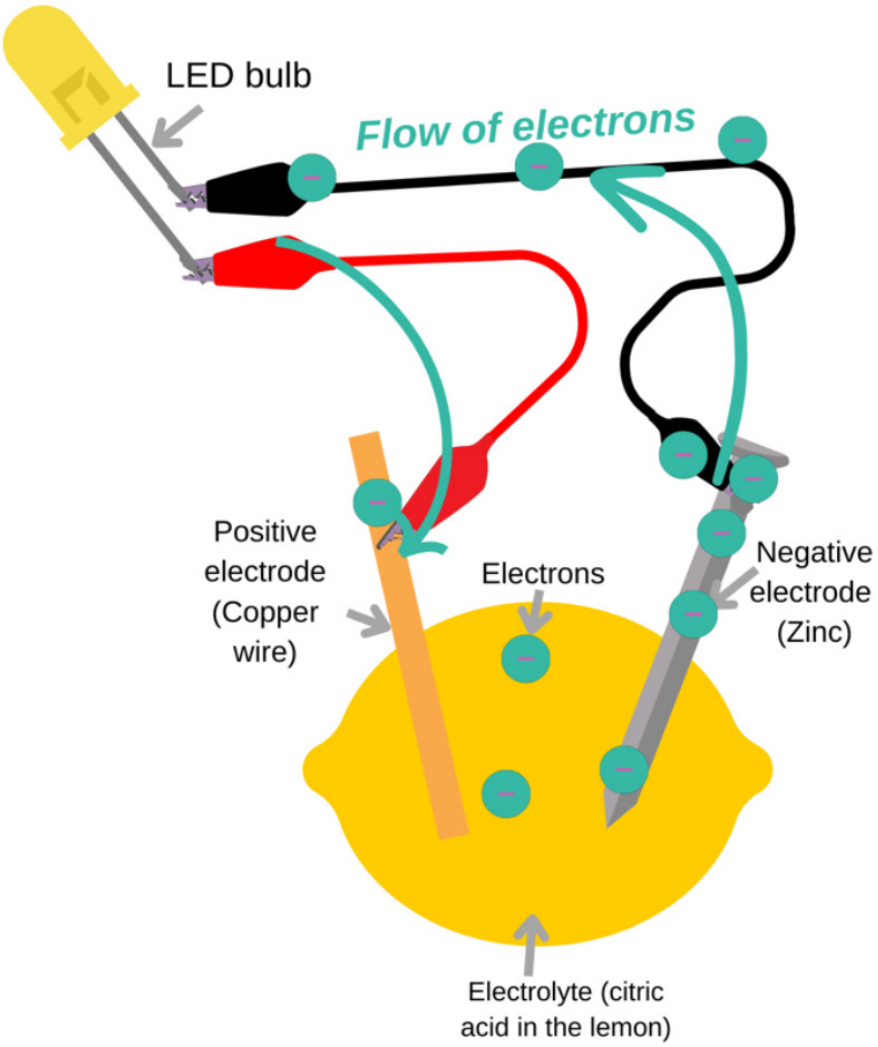
Conclusion

If possible, make the switch to rechargeable batteries- they're cheaper in the long-term and better for the environment.

How to make a lemon cell battery

What you'll need:

- 2-3 lemons
- 3 x large, galvanised nails (zinc coated) or pieces of zinc
- 3 - 9 lengths of at least 1.5mm thick copper wires or pieces of copper
- LED mini lamp/bulb (maximum 1.5 volts)
- Alligator clips



Instructions

Steps	Method
1	Roll lemons on a firm surface to break the segments and release the juice- the acidic electrolyte. Don't break the skin of the lemon.
2	Place a galvanised nail and a couple of copper wires at either end of each lemon. Make sure they are not touching and are well beneath the surface.
3	Connect the alligator clips from the nails to the copper to make a circuit. Leave a gap in the circuit for the LED mini lamp/bulb.
4	Place the lamp in the circuit with the long end touching the alligator clip which connects to the copper wire, and the short end touching the alligator clip connecting to the zinc nail. Make sure all the clips have good contact with the nails and wires and don't cross over.
5	You have made lemon battery cells, and your bulb should glow! If not, add another lemon to your circuit to add more power to light up your bulb.

Tips and troubleshooting

Can't see your bulb light up?

- Make sure your nail and copper are not touching at any point and that your wires are not crossed
- Try the experiment in a darker place or cup your hands around the lamp as it might be hard to see, especially if it's a red lamp
- Your bulb might be too high voltage, or you may need more power- i.e., even more lemons in your circuit! Try more lemon cells, repeating connecting in series: copper to zinc etc...
- Sand your copper wire and nail to make sure you have exposed the metals
- Try thicker copper wires and/or bigger nails
- Try a different bulb- yours may be damaged or may have blown
- Try different lemons: juicy and fresh, not old or dry.

Explanation

Lemons act like a battery when they have two different metals (the zinc and copper act as electrodes) separated by a liquid electrolyte (the lemon juice). The zinc in the nail wants to give its electrons to the copper, forming a flow of electrons through the wire, which lights the bulb.