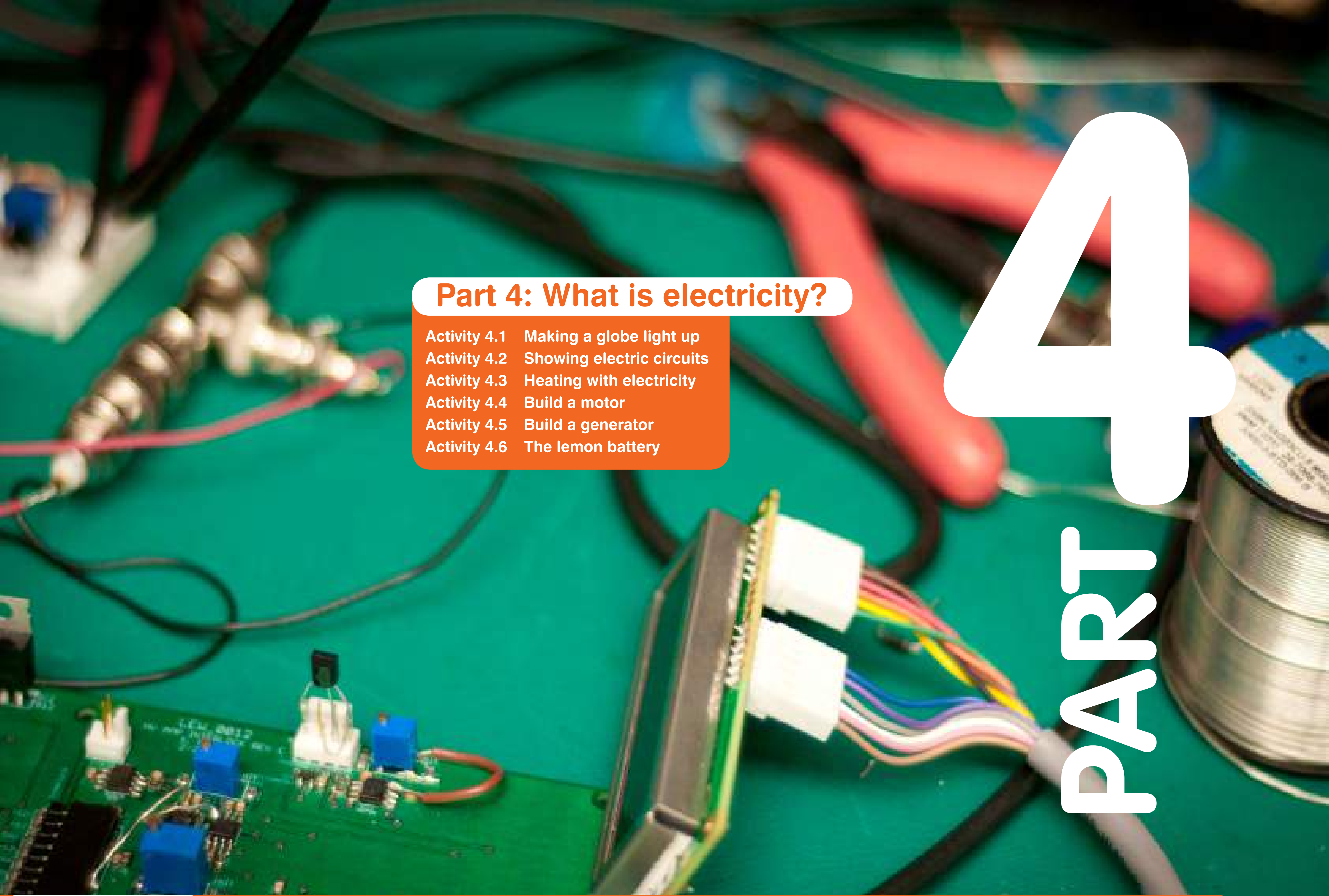


PART 4

Part 4: What is electricity?

Activity 4.1 Making a globe light up

Activity type

DOWNLOAD e-NOTEBOOK

Making a globe light up

What to use:

Each GROUP will require:

- two x 2 V light globes
- plastic-coated wires
- 1.5 V battery
- pair of wire strippers
- thick rubber band to hold the wires on the battery.

Each STUDENT will require:

- *Science by Doing* ***Notebook.***

What to do:

Step 1
Collect your equipment.

Step 2
Connect your devices so the globe lights up.

Challenge

Step 3
Set up your equipment so two globes light as brightly as one did.

Discussion:

- What was required to make your globe light up?
- Summarise your findings in your ***Notebook***. Include a diagram showing how your circuit was set up.
- If you did the challenge activity, then describe your circuit in your ***Notebook***.

In this night image of Earth, most of the light comes from cities. Some night light, however, comes from bushfires in the Australian outback.

The black marble: Earth's night side viewed from space.

Activity 4.2 Showing electric circuits

Activity type

Designing symbols for a circuit diagram

What to use:

Each GROUP will require:

- A3 sheet of paper
- felt pens.

What to do:

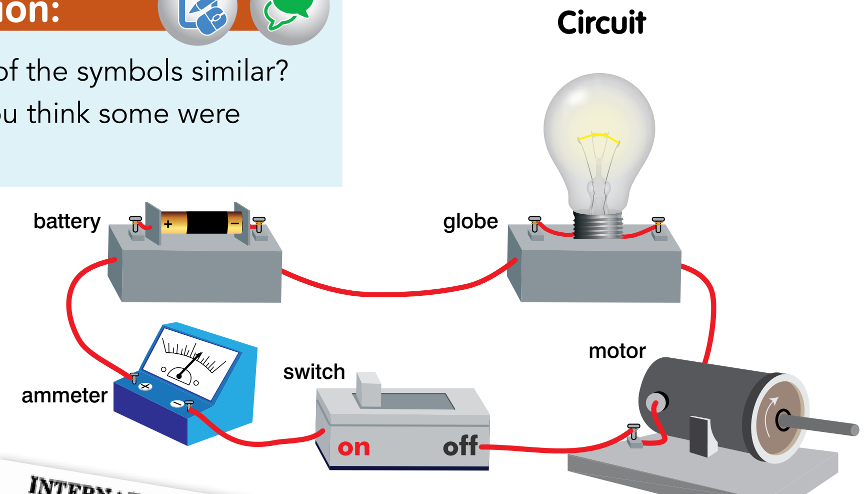
Step 1
In your group devise symbols to represent the items from your circuit-building activity.

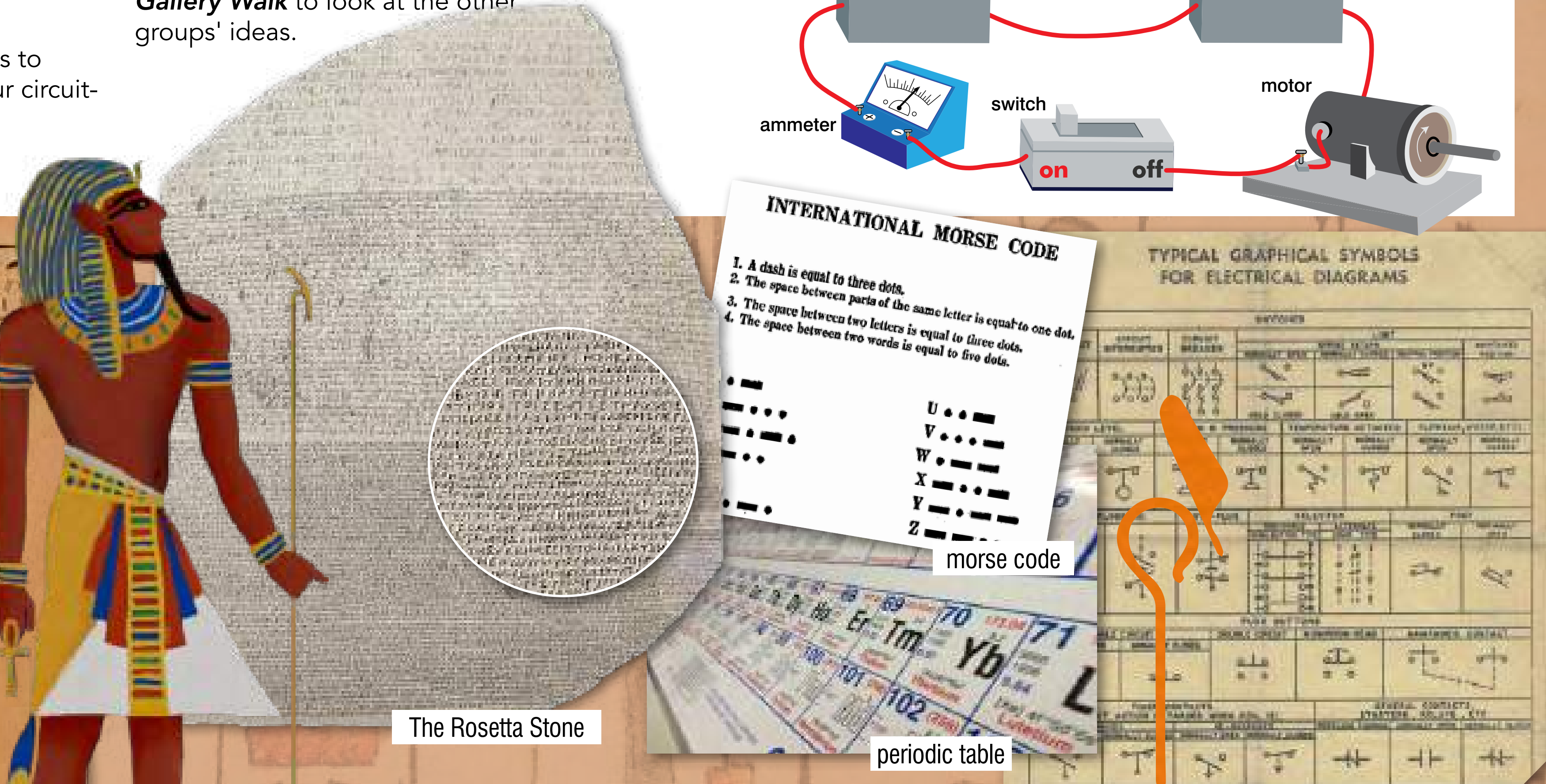
Step 2
Agree on your symbols, produce a poster explaining them and use it to represent the circuit shown on this page.

Step 3
Pin up your poster and conduct a ***Gallery Walk*** to look at the other groups' ideas.

Discussion:

- Were any of the symbols similar?
- Why do you think some were different?





The Rosetta Stone

morse code

periodic table

What do chemical symbols, Egyptian hieroglyphs and Morse code have in common?

Activity 4.3 Heating with electricity

Activity type

DOWNLOAD e-NOTEBOOK

Electric water heater

What to use:

Each GROUP will require:

- 12 V power supply
- leads with alligator clips
- voltmeter
- ammeter
- 20 cm of high-resistance wire
- large test tube for winding the heating coil around
- tap water and measuring cylinder
- Styrofoam cups
- thermometer (0 - 100°C).

Each STUDENT will require:

- *Science by Doing* ***Notebook.***

Heating water is one of the biggest energy demands of the average home.

What to do:

Step 1
Examine the circuit diagram on this page.

Step 2
Your group will be assigned a power supply setting for running your heating experiment.

Step 3
Add 150 mL of cold tap water to a cup and carefully measure its starting temperature.

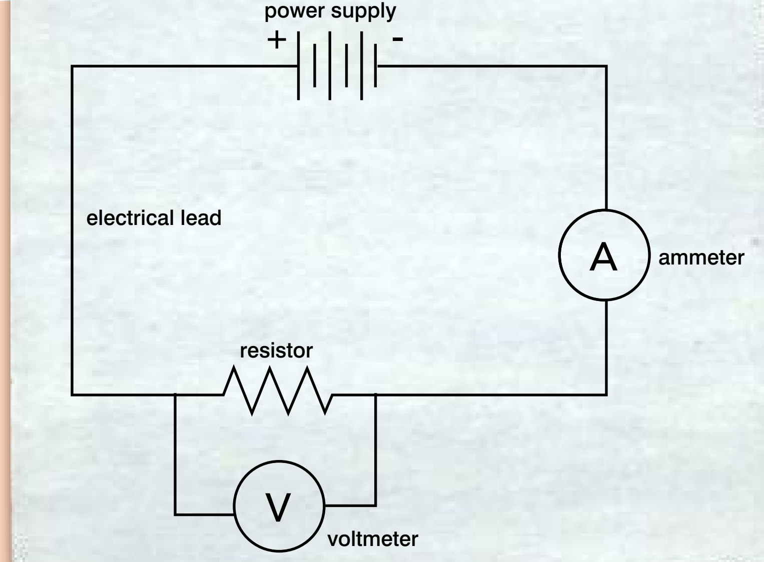
Step 4
Note the time and switch on the circuit. Measure the voltage and current. Ensure the coil of high-resistance wire does not touch the cup in case it melts.

Step 5
After 15 minutes turn off the power and measure the final temperature of the water.

Step 6
Place your results in the class table.

Step 7
Graph the energy used against the increase in temperature.

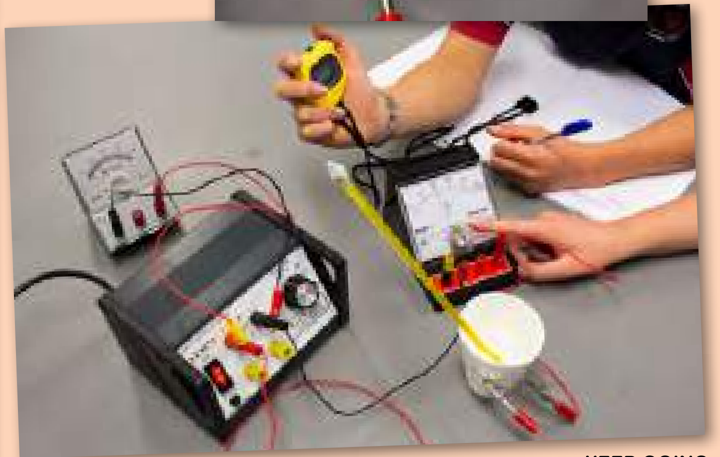
Circuit diagram



Discussion:

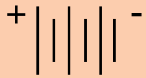
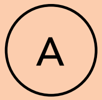
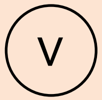
Answer these questions in your ***Notebook***.

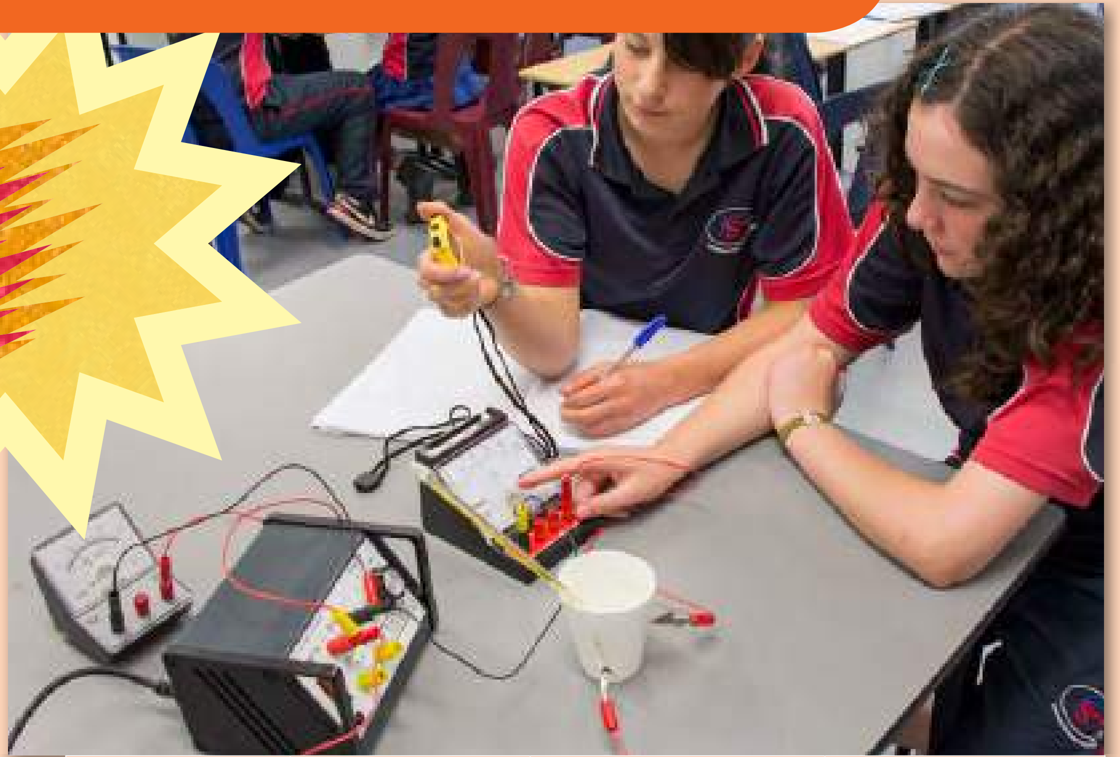
1. How did the temperature increase of the water compare with the power of each heater?
2. What do you think would have happened to the temperature increase in your heater if you had doubled the time of heating?



KEEP GOING

CIRCUIT DIAGRAM SYMBOLS

Symbol	Name	Description
	**Power Supply**	• provides electricity. • positive and negative terminals are shown
	**Resistor**	• resists the flow of electricity • gets hot as current flows through it
	**Ammeter**	• measures electric current in Amperes (amps)
	**Voltmeter**	• measures voltage; the electrical 'push' provided by your power supply
	Electrical lead	• carries the electric current with little resistance



Voltage (Volts)	Current (Amps)	Power (Watts) = Voltage x Current	Temp. increase (°C) in 150 mL of water in 15 minutes

WHAT IS POWER?

The power of your heating circuit tells you how quickly it delivers energy.

1 Watt means it delivers 1 Joule of heat energy per second. What was the power of your heater?

Activity type

DOWNLOAD e-NOTEBOOK

Activity 4.4 Build a motor

What makes a motor move?

Electric motor

What to use:

Each GROUP will require:

- 2 jumbo-sized paper clips
- 1.5 V battery
- rubber bands
- sticky tape
- 2 m of fine insulated electrical wire
- super magnet (neodymium)
- sandpaper
- Plasticine or Blu Tack.

What to do:

Step 1
Neatly coil the wire around the battery about 15 times. It should be as round as possible. Bend the two ends out from each side as shown. It should be nicely balanced so it turns easily and isn't lopsided.

Step 2
Use sandpaper to carefully shave the coating off the same side of each side wire.

Step 3
Shape each paper clip into a 'cradle' to hold the wire, as in the picture.

Step 4
Attach the paper clips to the battery terminals using the rubber band.

Step 5
Attach the magnet to the battery. It should be attracted to the steel jacket.

Step 6
Arrange the apparatus on the table and secure with Plasticine.

Step 7
Place the coil in the cradle and nudge to start.

Discussion:

- Did your motor need a complete circuit?
- What energy transformation did your motor achieve?

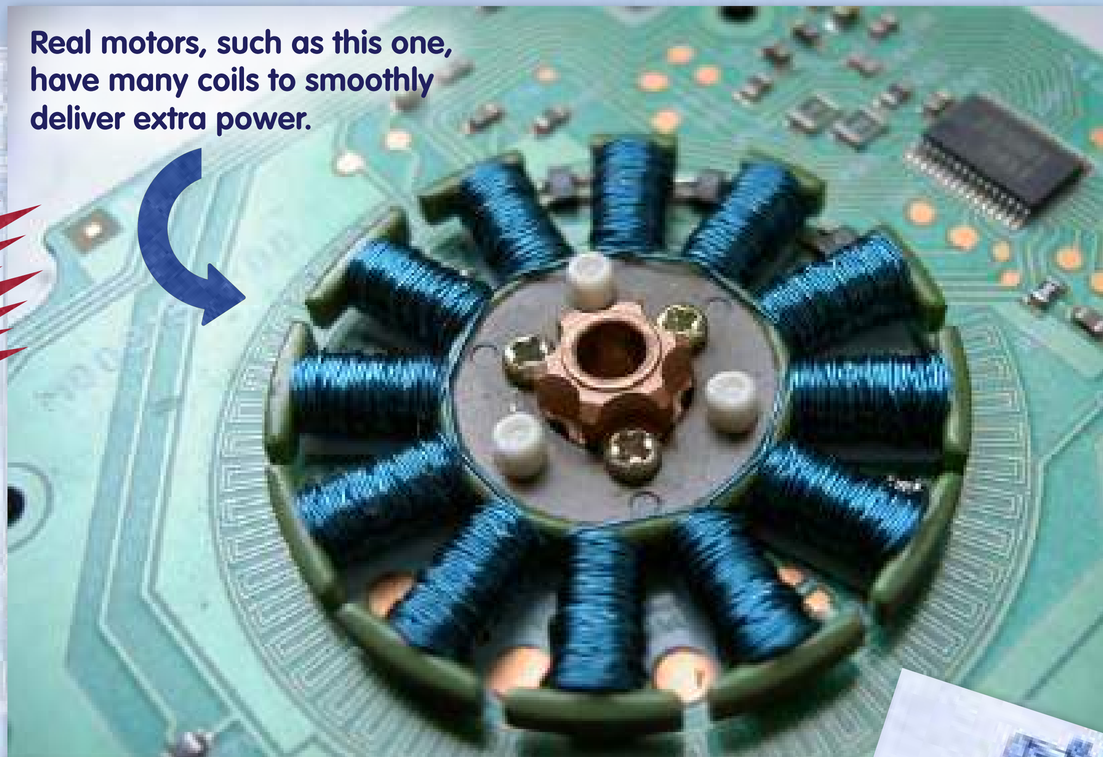
Click here to watch the electric motor video.

KEEP GOING

YOUR BATTERY MOTOR MIGHT SEEM A TOY, BUT IT HAS ALL THE MAJOR COMPONENTS OF OTHER MOTORS.

EVERY MOTOR:

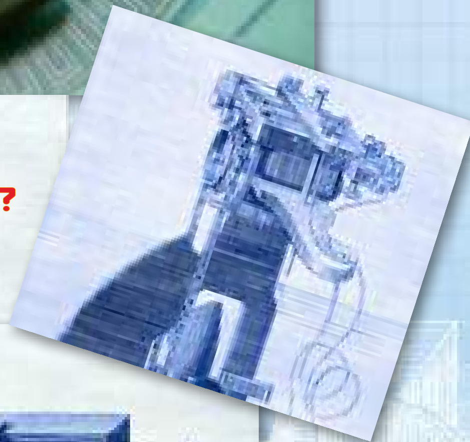
- has a coil. These are often called the windings. They are often very fine wire thinly coated with an insulator.
- has magnets (often electromagnets)
- has sliding electrical connections. On your motor this connection is where you shaved the coating off the wire so that it could connect with the paper clip. In real motors this sliding switch is called a **COMMUTATOR.** Sliding contacts in motors and generators are called **BRUSHES.**
- has a supply of electricity.



Real motors, such as this one, have many coils to smoothly deliver extra power.

DID YOU KNOW THAT THE ELECTRIC MOTOR IS ONE OF THE MOST IMPORTANT INVENTIONS OF ALL TIME?

They are found everywhere.
How many electric motors does your family own? This includes every device (large or small) where electricity is used to make something move. You should find quite a few.



Activity 4.5 Build a generator

Activity type

DOWNLOAD e-NOTEBOOK

Make an electric generator

How do we produce electricity?

We couldn't run our cities or most of our machinery without making electricity.

What to use:

Each GROUP will require:

- a coil of wire with at least 50 turns
- strong bar magnet
- electric leads
- galvanometer or micro ammeter.

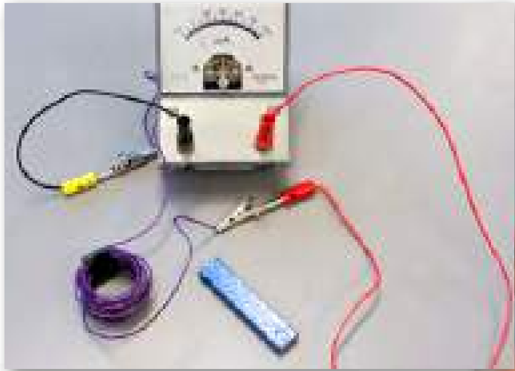
What to do:

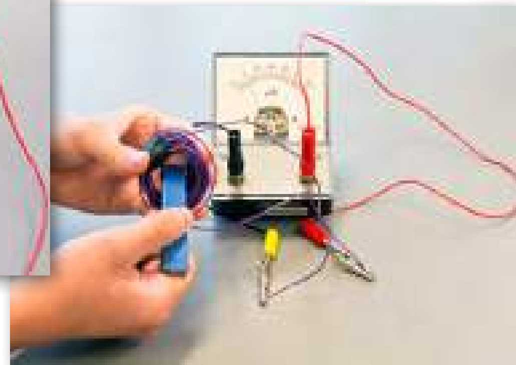
Step 1
Connect the coil and the meter in a complete circuit.

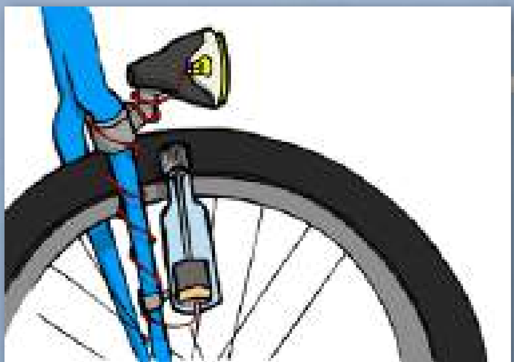
Step 2
Quickly pass the magnet in and out the coil, watching the meter as you do.

Discussion:

- Did the meter needle move?
- Was it a large effect?
- What sort of energy is being transformed to electrical energy?







Many different generators can power bicycle lights. They are often called dynamos.

Generating electricity with a magnet.

Water pipes carrying water down the mountain to run the turbines in the Snowy Mountain Scheme.

Activity type

DOWNLOAD e-NOTEBOOK

Activity 4.6 The lemon battery

Lemon battery

What to use:

Each GROUP will require:

- 4-6 lemons
- 4-6 strips of copper and zinc
- LED (light-emitting diode)
- electrical leads with alligator clips
- empty matchbox
- tray for lemons.

Each STUDENT will require:

- *Science by Doing* ***Notebook***.

What to do:

Step 1
Roll each lemon firmly on the table to release the juice. You may have seen Jamie Oliver do this on his cooking shows.

Step 2
Cut two parallel slits in each lemon.

Step 3
Push one piece of copper and one piece of zinc into each lemon. Make sure they don't touch each other inside the lemon.

Step 4
Use the electric leads to connect the lemons in a circuit. You should connect the lemons one after the other, so copper connects to zinc on the next lemon, and so on.

Step 5
Now complete the circuit by connecting the LED. Position the LED in an empty matchbox to create a dark background.

Note: **The pin under the flat side of the LED should connect to a zinc electrode.**

Step 6
Experiment with different numbers of lemons in your circuit to find the optimum number.

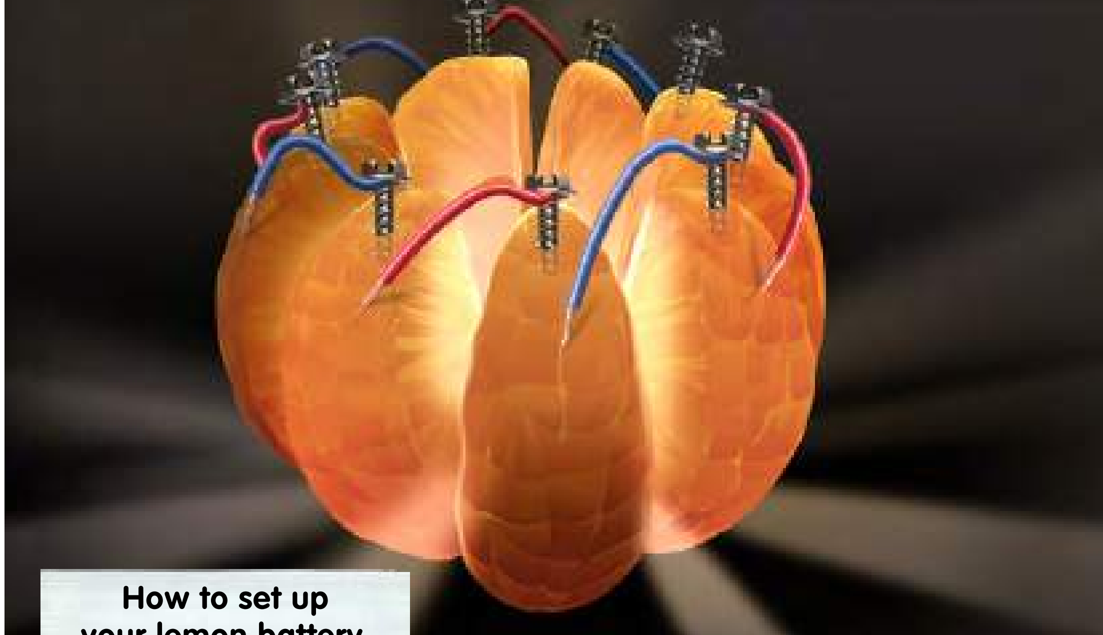
Further experiments

- You could try this experiment with other fruit or vegetables, or even salty water.
- You could also try different combinations of metals.
- You could also use a voltmeter to check how much voltage you got from your battery.

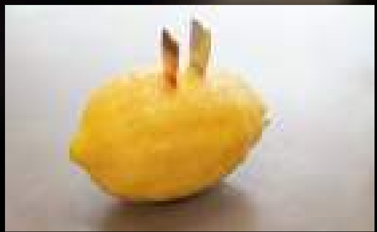
Discussion:

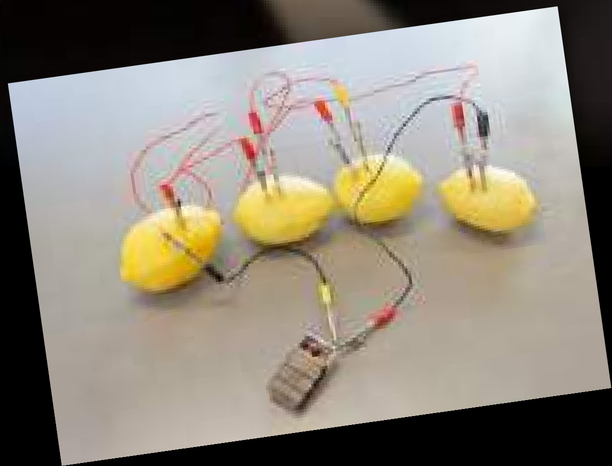
- What energy conversion was happening in your lemon battery?
- Sketch your lemon battery in your ***Notebook***.

A well lit orange, but where does the energy really come from?



How to set up your lemon battery.





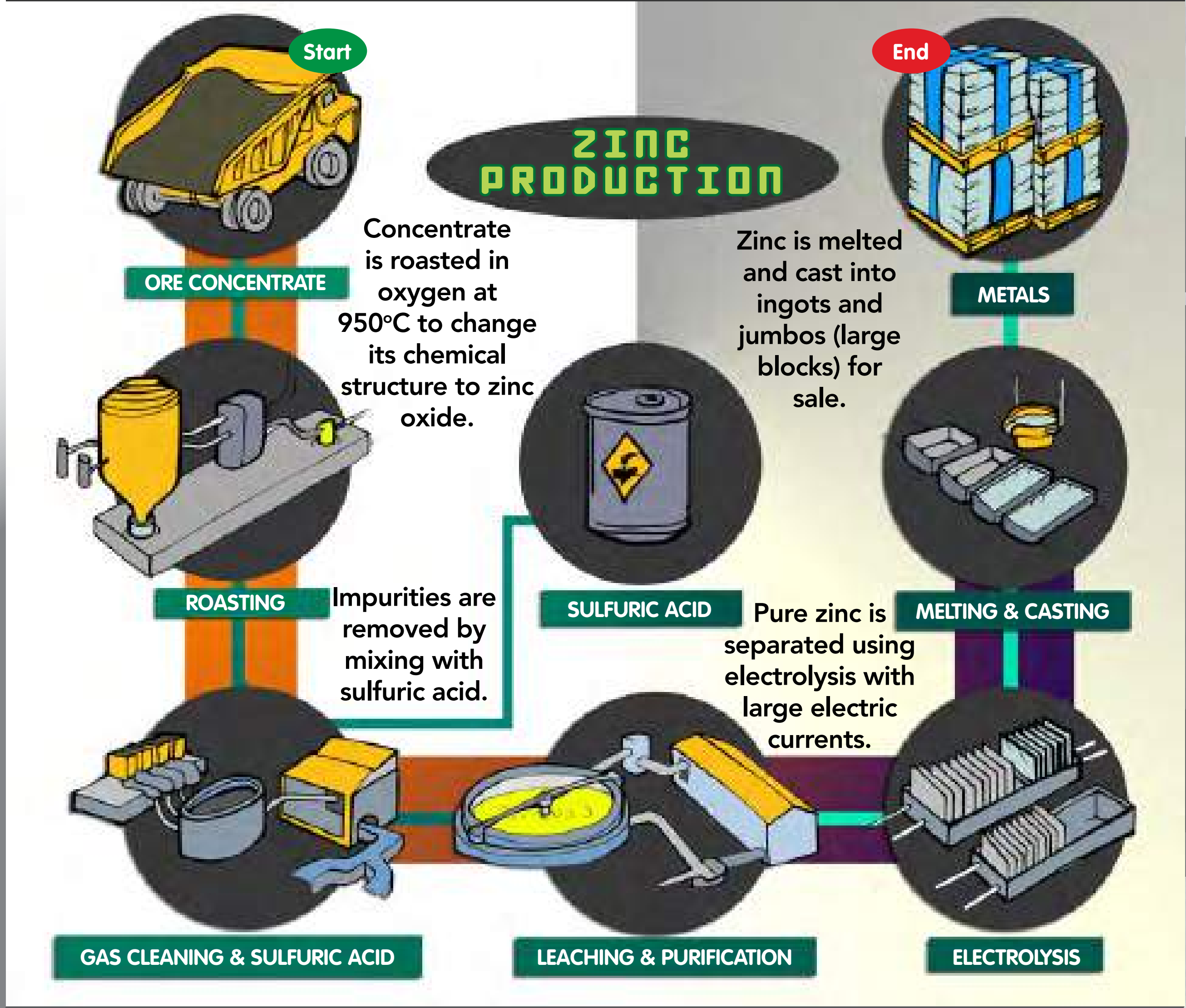
KEEP GOING

Where did the energy to run your battery come from? You may be surprised to learn that it was not from the lemons.

A ZINC REFINERY

Much chemical and electrical energy is used at this large plant to refine zinc from ore. Ore is the raw material mined from the ground. Chemical energy is stored in pure zinc. Your battery released some of this. Did you notice the zinc electrode in the battery began to corrode? It was gradually returning to a low-energy, impure form, similar to when the ore was first mined.

The Sun Metals Corporation zinc refinery in Townsville, Queensland.



Summary

PART 4

Electrical energy is very important for modern, high technology societies such as ours. Electrical energy can be transferred around **electric circuits** and transformed into other energy forms. In an electrical circuit the **voltage** describes the electrical 'push' of the circuit and current measures the quantity of electricity flowing around the circuit.

Electrical energy can be transformed into heat energy using a **resistor**. The **power** of an electrical circuit equals the **voltage** multiplied by the **current**.

An **electric motor** uses magnets to transform electrical energy into kinetic energy. An **electric generator** uses magnets to transform kinetic energy into electrical energy.

A **battery** transforms chemical energy into electrical energy.

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