4 What Can You Learn?

c - Energy takes many forms and can change forms

Purpose

To explore key concepts in greater depth and relate them to your school situation

Key concepts

Energy takes many forms and can change forms.

We use energy from many different sources and in many different forms. When we use energy, we often change it from one form to another, (e.g. electricity changes into light, fuel is transformed into movement in our cars and the energy in food becomes growth and movement when we eat it).

Different sources and forms of energy have different effects on the environment, so some are more environmentally friendly than others. Become more aware of what the impacts of energy use are.

Sources include: sun, geothermal, wind, water, fuels.

Forms include: electricity, heat, light, growth, movement, sound.

Consider

- Which sources of energy are renewable and which are non–renewable?
- How does energy change?
- What is energy useful for?
- How does our energy use affect the environment?

Evaluate/Reflect

- What are the problems with different sources of energy?
- How might this affect you in a school environment?
- How do you contribute to any problems?
- Which energy sources do you think are the best? Why?
- Which are the best sources of energy for making electricity?
- Where does most of our electricity come from?
- What forms of energy do we use for transport?
- What key insights can you add to your Pool of Knowledge that relate to energy use and its effects in your school environment?
- Have you any questions to add to your 'find out' sheet?

Activities:

Background text - Energy what is it?

Background text - The Electricity Industry

4c.1 Types of energy

4c.2 Exploring energy

4c.3 Balloon Rocket Experiments

4c.4 Energy Transfer

4c.5 Renewable and Non Renewable Energy Sources

4c.6 Let's Talk About It

4c.7 Where does it come from, How does it change?

4c.8 Electricity to our home

4c.9 Where do we get our power from?

4c.10 Switch on – Switch off

4c.11 Connect it

Teacher information - Scientific Inquiry

4c.12 Conductor or insulator

Background text

Energy - What Is It?

Almost all the energy on Earth has come from the sun; it comes from nuclear reactions taking place on the sun.

All life needs energy. We need energy to breathe, move and grow.

The sun radiates enormous amounts of energy in all directions. The Earth intercepts some of this energy. The sun's energy reaches the Earth as electro-magnetic energy, the only type of energy that can travel through space. Almost all the energy on Earth has come originally from the sun. All life needs energy. We need energy to breathe, move and grow, without the sun's energy the earth would be a frozen mass of ice with no living thing moving on it.

There are many different forms of energy, here are some examples:

- Chemical energy – a lot of energy is stored in things such as wood, coal and food. Plants and trees use energy from the sun through the process of photosynthesis while they are growing. This energy is stored in the plant and is only released when the chemical make-up of the plant changes e.g. when wood or coal is burnt to release energy as heat and light, or when food is digested to give us energy
- Heat energy – this includes radiant heat from the sun and heat released from energy stored in for example wood, coal, oil and gas
- Light energy – from the sun as well as from electrical lights and candles etc
- Sound energy – from sounds in nature and from electrical appliances such as radios. Sound moves in sound waves radiating through the air from the sound source likes waves when a pebble is dropped into a pool of water
- Electrical energy is a flow of electrons – lightning is natural static electricity – household appliances use electrical energy e.g. TVs and fridges
- Mechanical energy – is to do with movement. It describes different kinds of energy including kinetic energy (energy contained in any moving object) and gravitational potential energy (energy an object has as a result of its position in a gravitational or magnetic field)

Everything that changes or moves has some form of energy. All forms of energy can do work. Energy can make something happen. It may move something, heat something up or change something.

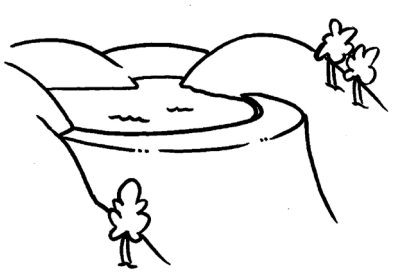
You can't see energy but you can see what it does. You can't see the wind but you can see what the energy of the wind does; especially how it moves things.

Energy changes

The total amount of energy in the universe stays the same. The Law of Energy Conservation states that energy cannot be created or destroyed. When we use one form of energy it changes to one or more other forms of energy e.g. burning wood changes the stored chemical energy in the wood into heat energy and light energy. The total amount of energy at the beginning is the same as the total amount at the end. Every form of energy can turn into heat.

There are many different forms of energy. One form of energy can change into one or more different forms of energy. Each time energy changes form some energy is "lost", as it is changed into energy that is not wanted. When electrical energy changes to light energy in an incandescent light bulb, the bulb also gets hot. The heat energy is not wanted, only the light energy so some energy is "lost".

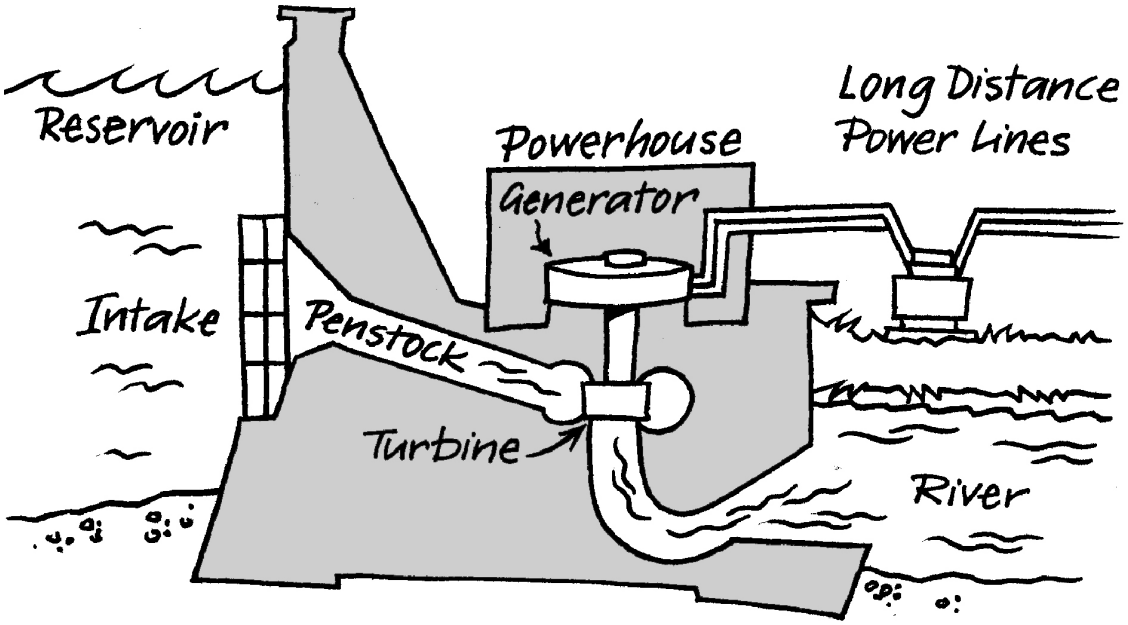
Potential and Kinetic Energy



There are two states of energy

- Kinetic energy (movement energy) is contained in a moving object e.g. a moving bicycle or moving water
- Potential energy (stored energy) is the energy an object has as a result of its position in some force field such as the gravitational field e.g. a ball lifted off the ground has potential energy. When the ball is dropped it falls back to the ground as a result of the gravitational force, the potential energy it had is changed into kinetic energy

For example inside the power station are turbines and generators which make electricity. When water from the lake is allowed to flow through the sluice gates in the dam, it falls and loses its stored



energy and at the same time gains kinetic energy. As it falls, getting faster and faster, it has more and more kinetic energy (movement energy).

The moving water turns the turbines and generators that make electricity. This electricity is then carried by high voltage overhead cables from the power stations to sub stations and transformers which reduce the voltage.

Overhead or underground cables then bring the electricity to our industries, businesses and homes. The electrical energy generated in the power stations can be used to give us light, heat and sound.

A great deal of water is stored in the lake held back by the dam wall. This is an example of potential energy.

Background text

The Electricity Industry

(Information from the Electricity Commission)

Electricity industry markets and operational structure

The Commission oversees and regulates the electricity industry operations and its wholesale and retail markets.

New Zealand's electricity sector has four main components

- generation (electricity production stations)
- transmission (the high voltage network known as the national grid)
- distribution (local lines companies)
- retail (electricity retail companies compete to buy wholesale electricity and compete to retail it to consumers)

Electricity markets

The wholesale market is the market in which generators compete to sell their electricity to electricity retailers and other purchasers such as major commercial and large industrial users.

The retail market is a market where electricity retailers compete to sell the electricity they have purchased on the wholesale market, to consumers including small-scale industrial and commercial users and domestic consumers. Retailers can also purchase electricity directly from embedded generators (smaller generators connected directly to distribution networks such as biomass, landfill, and wind turbine generation).

The Commission is responsible for ensuring that the electricity industry and markets operate efficiently on a day-to-day and longer-term basis. To achieve this it has contractual service provider agreements with a number of organisations for managing the operations.

The spot market - the buying and selling of wholesale electricity is done via a 'pool', where electricity generators offer electricity to the market and retailers bid to buy the electricity. This market is called the spot or physical wholesale market.

Industry structure

Generation

Electricity in New Zealand is largely generated from hydro, gas, coal and geothermal resources with an increasing development of wind generation. Electricity is produced at generation stations and connected at high voltage to the national electricity transmission network, called the national grid, at grid injection points (GIPs).

There are some 40 major electricity generation stations connected to the grid. The stations are owned and operated by the following main generator companies which compete to supply electricity to retailers.

- Contact Energy Ltd
- Genesis Power Ltd
- Meridian Energy Ltd
- Mighty River Power Ltd
- Todd Energy Ltd
- TrustPower Ltd

Transmission

The electricity transmission system is, "the grid", owned by state-owned enterprise Transpower. The grid is the physical hub of the electricity system bringing electricity from remote generation sites to customers some distance away. High voltage electricity is transmitted across the grid from the GIPs to the points of distribution at the grid exit points (GXPs). At the GXPs electricity is reduced to lower voltage at transformer substations for distribution on local networks to consumers.

Transpower owns the high voltage national electricity grid. The Electricity Commission manages a contractual service provider agreement with Transpower to ensure the grid management in real time.

Distribution

There are around 28 lines companies that own the local distribution networks throughout New Zealand. The lines companies are connected to the national grid at the GXPs. Low voltage electricity is distributed via the local networks to end commercial and domestic consumers. Generally the lines companies sell their distribution or lines services to retailers who manage the electricity supply agreements with end consumers. Some commercial and industrial consumers contract directly with lines companies for electricity supply.

Retail

A retailer is a company that buys wholesale electricity at spot prices from the generator companies (which is transmitted across the grid and transformed to lower voltage for distribution via local networks to consumers). The retailer's charges to an end user include the cost of the electricity supplied to the consumer as well as charges for transmission and line services.

Some of the electricity retailers in New Zealand are:

- Contact Energy Ltd
- Empower Ltd
- Energy Online
- Genesis Power Ltd
- Meridian Energy Ltd
- Mercury Energy Ltd
- Nova Energy
- King Country Energy
- TrustPower Ltd

Consumption

Consumers are the end users of electricity. They can choose between retailers for electricity supply.

Source: http://www.electricitycommission.govt.nz/industry

4c.1 Types Of Energy

You will need

- A copy of this sheet for each student or group

Can you match the type of energy with the correct picture? Write the type of energy in the box under the picture.

Chemical energy

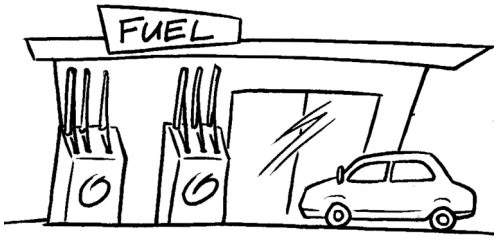
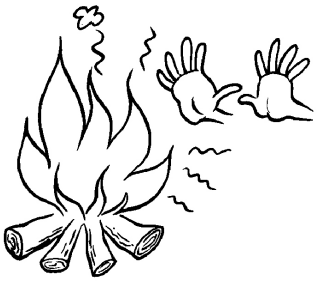
Mechanical energy

Light energy

Heat energy

Sound energy

Electrical energy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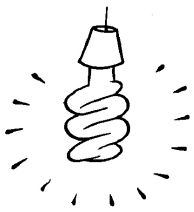	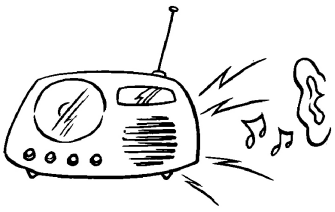
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	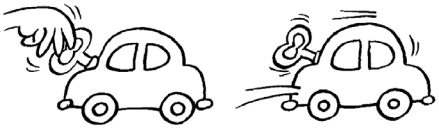
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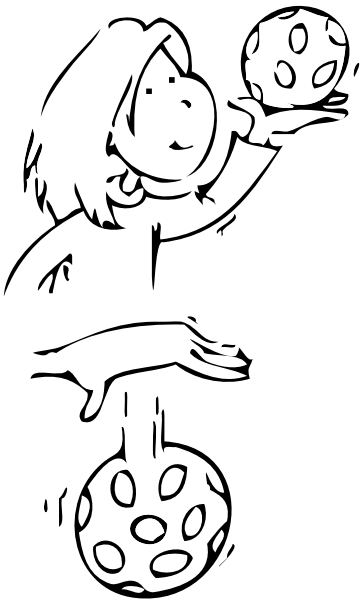
4c.2 Exploring Energy - Potential and Kinetic

You will need

- A small bouncy ball per group
- An elastic band per group
- Target per group

Ball activity:



1 Pick up a ball and hold it about 20 cms off the ground.
   - What type of energy has the ball got now?
     The ball has potential energy

2 Now drop the ball and watch what happens.
   - What type of energy did the ball have when it was moving?
     The potential energy changed to kinetic energy when it began to fall.
   - Did you notice any other type of energy when you dropped the ball?
     Some energy changed to sound energy – you could hear the sound as it hit the ground
   - What happens if you give the ball more potential energy by lifting it higher from the ground and letting it drop?
     By lifting the ball higher it has more potential energy thus is able to do more work and gives more kinetic energy as it falls (and more sound energy as it bounces).

Elastic band activity:

1 Take an elastic band and stretch it back to form a catapult. Now it has potential mechanical energy (stored strain energy). When you release the band it goes back to its original length and the potential energy is changed to kinetic energy (movement energy).

   This produces a force that will throw a pellet of paper forward at great speed.

2 Try stretching the band a little and then stretch it as much as you can.
   - Which time did the band have the most potential (strain) energy?
     It had most potential energy when it was pulled back furthest
   - What would that mean when that energy was released?
     The more potential energy, the more the kinetic energy. The pellet would fly further

Note: A great deal of energy is stored in the lake held back by the dam wall. Is this potential or kinetic energy? Potential energy.

4c.3 Balloon Rocket Experiments

You will need

- balloons
- straws
- sticky tape
- different types of line
- record sheet
- pencil
- tape measure

Hypotheses:

The distance that the balloon rocket will travel along the line depends on:

1 How smooth the line or string is

2 How much potential energy is stored in the balloon

Write your own hypothesis for example:

The smoother the line, the _____ the balloon rocket will travel.

The _____ the balloon, the _____ it will travel.

Think about how you could do some experiments to test these hypotheses.

Remember you only want to test one thing at a time.

Do two separate experiments – one for the size of the balloon (potential energy) and another for the smoothness of the line.

Activity

Do you think this would be a good way to do an experiment to test either of your hypotheses?

Setting up and running the experiment	**good or not good**
Using different length strings for each test.	
Doing the experiment twice or three times to check that there were no mistakes.	
Measuring the distance and recording the results the balloon rocket travelled.	
Guessing the distance and trying to remember the results for the distance the rocket travelled.	
Using the same size balloon to test the effect of the string type.	

Remember you want your experiment to be a 'fair' test.

Fill in the missing words

To be a _____ test, we must keep everything the _____

except the one thing we are testing. (same / fair)

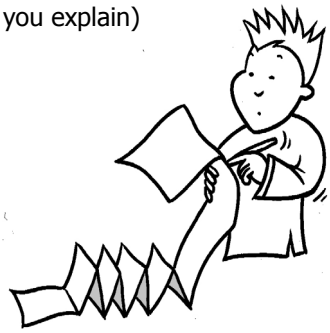
Activity - Do you think these things would be a 'fair' test or not?

Doing the experiment	fair or not fair?
Blow up the balloon large for the smooth line and small for the rough line.	
Blow up the balloon the same size to test the different types of string.	
Blow up the balloons with the same number of breaths each time you need a large balloon.	
Use lots of different length straws and don't worry which is which.	
Use the same length of straw for each experiment.	
Hold the string tight sometimes and slack other times.	

Writing about your experiment

Method: (What you did. You can draw pictures and diagrams, or take photos to help you explain)

- Describe what you did to set up and run your experiment.
- What equipment did you use?
- How did you set it up?
- What did you do to test your hypothesis?



Results: (Writing down what happened)

- How did you measure your results?
- How did you record your results?
- Where there any problems with your results?

Findings: (What you found out)

- What did your results show you?
- Why do you think you got those results?
- What did you find?

Reflection: (What do you think about what you found?)

- Does this help you understand more about energy?
- Could you make a better experiment or another experiment to learn more?

Result sheet example:

Balloon size	Distance travelled along line (cm)		
	Measurement round balloon (circumference cms)	Fishing line (smooth)	Wool (medium)
Small balloon First trial	cm	cm	cm
Small balloon Second trial	cm	cm	cm
Large balloon First trial	cm	cm	cm
Large balloon Second trial	cm	cm	cm

4c.4 Energy transfer

You will need

- a copy of these sheets

The first law of thermodynamics

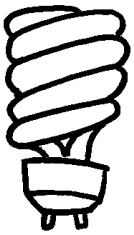
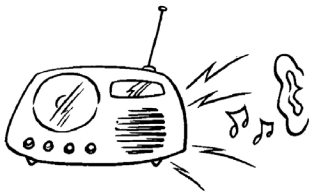
This law of physics states that there is a total amount of energy in the universe that always stays the same.

Energy cannot be created or destroyed, but it can change from one form of energy to another form of energy. It can change electrical energy to light energy or chemical energy to heat energy.

Choose the main form of energy for each of these inputs and outputs.

Electrical energy	Light energy	Sound energy	Heat energy	Chemical energy	Kinetic energy

Energy Input ⇒ **Process** ⇒ **Energy Output**

Energy input	Process	Energy Output
Electrical energy	 Light bulb	*Light energy*
	 Radio	
	 Oil lamp	

Middle Balloon rocket experiment © GreenGauge

Energy Input	Process	Output
		
		
		
		
		

4c.5 Renewable and Non Renewable Energy Sources

You will need

- A copy of these sheets per student or group

Electricity can be generated from different energy sources.

A **renewable** energy sources is a source that renews itself or is always available.

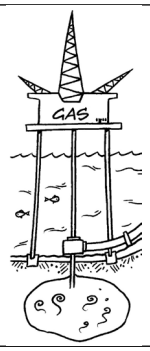
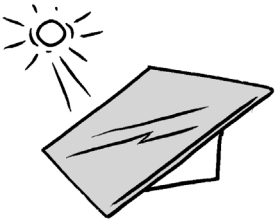
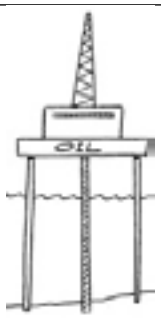
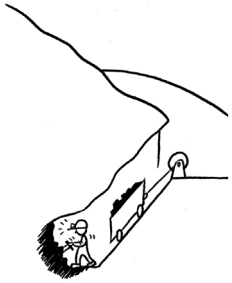
Once a **non-renewable** energy source is used, it is gone. Fossil fuels, such as oil, have taken millions of years to form and once oil is used it can not be replaced.

Look at the pictures in the table.

Some are renewable sources and some are non-renewable sources.

Cut out the labels and match them with the correct picture.

Geothermal
Renewable

Solar Energy	**Hydro Electric Power**	**Oil**
Gas	**Wind**	**Coal**
Renewable source	**Renewable source**	**Renewable source**
Non-renewable source	**Non-renewable source**	**Non-renewable source**

4c.6 Let's Talk About It

You will need

- A copy of the picture per group / person
- Scissors
- Glue

1 As a class or in groups, discuss the picture over the page – where is the energy in the picture.

2 Check student understanding of the following terms:

Wind turbine	Light switch
Electric socket	Hydro electric power station
Energy efficient light bulb	Solar panel
Overhead power lines	Electricity meter box
Electricity pylon	Electrical house wires

3 When students have an understanding of the terms, cut out the labels and stick them around the picture to show electricity generation transmission and use.

4 Students then draw a line from the term to the relevant part of the picture.

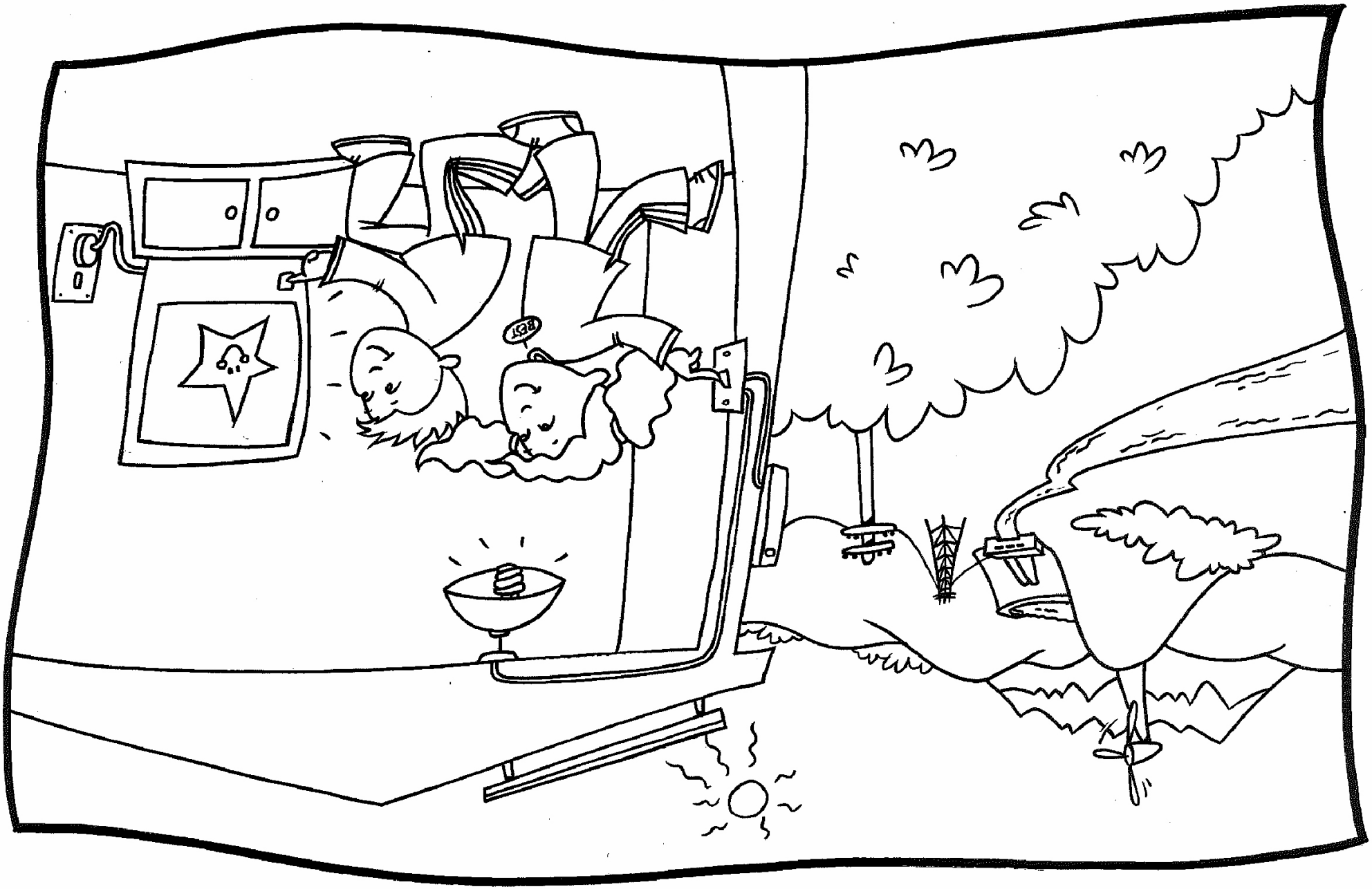
5 Discuss

Your home or your school

- Are there any electricity power stations in your area? If so, what type of power station are they? (e.g. hydro, wind, geothermal…)
- Are there any power poles or pylons nearby?
- Do you know where the meter box is at your house?
- Do you have any energy efficient light bulbs?

Evaluate/Reflect

- What source of energy do you use to
  - Heat your home
  - Heat your water
- How many different energy sources are people using? What are they? Which of these are renewable energy sources?
  (e.g. cooking – electric cooker, gas cooker, wood stove, solar cooker)



4c.7 Where Does It Come From - How Does It Change?

This small group activity traces some different energy paths, from source to use. The energy is changed and transported in between. The activity involves people co-operating to put together pieces of an energy jigsaw. Some pieces will illustrate a source, some a product and others a process.

You will need

- Energy Cards cut up and shaded different colours to identify: e.g. source (red), product (green) and process (white)

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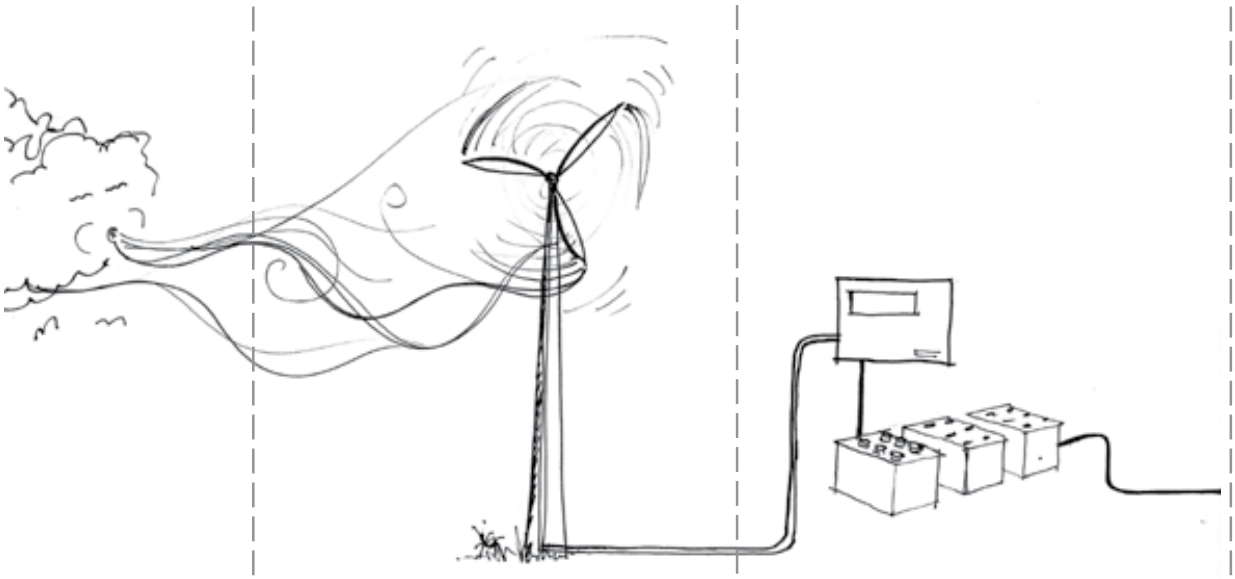
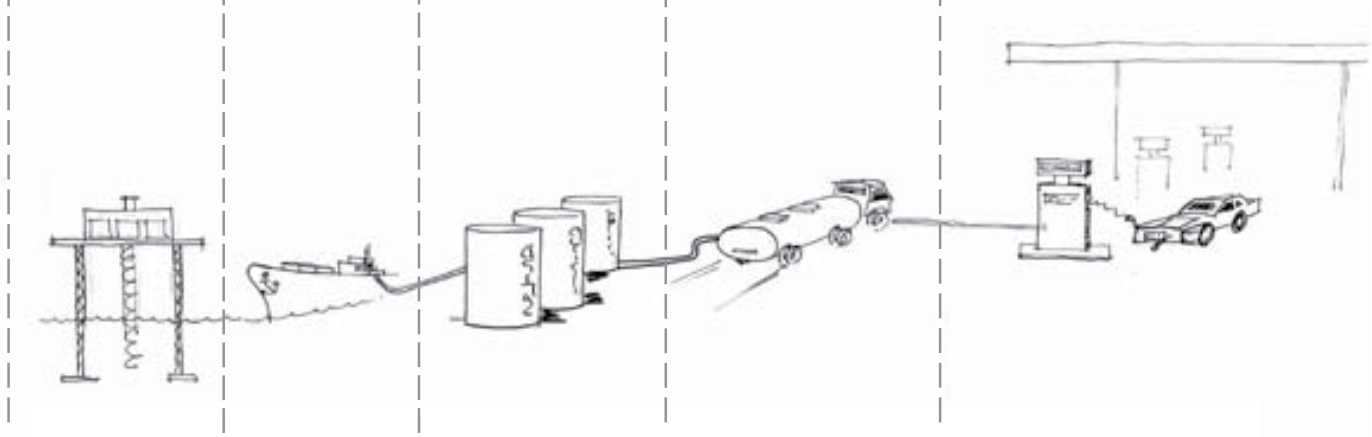
1 Share out the energy cards and then find others who have cards which link to yours. The 'jigsaw' will show the process of some energy being generated and how it gets to you. Some pieces fit more than one jigsaw, so compare notes!

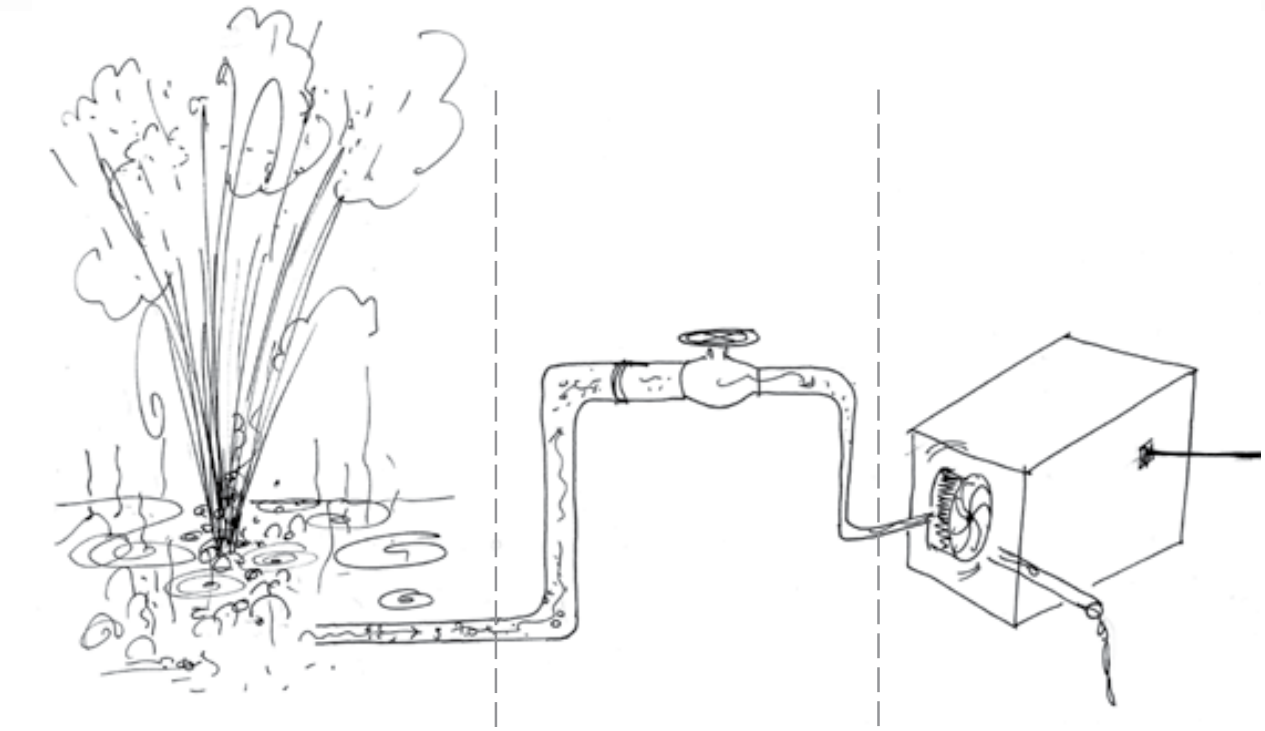
2 Leave your jigsaws made up to do the next activity.

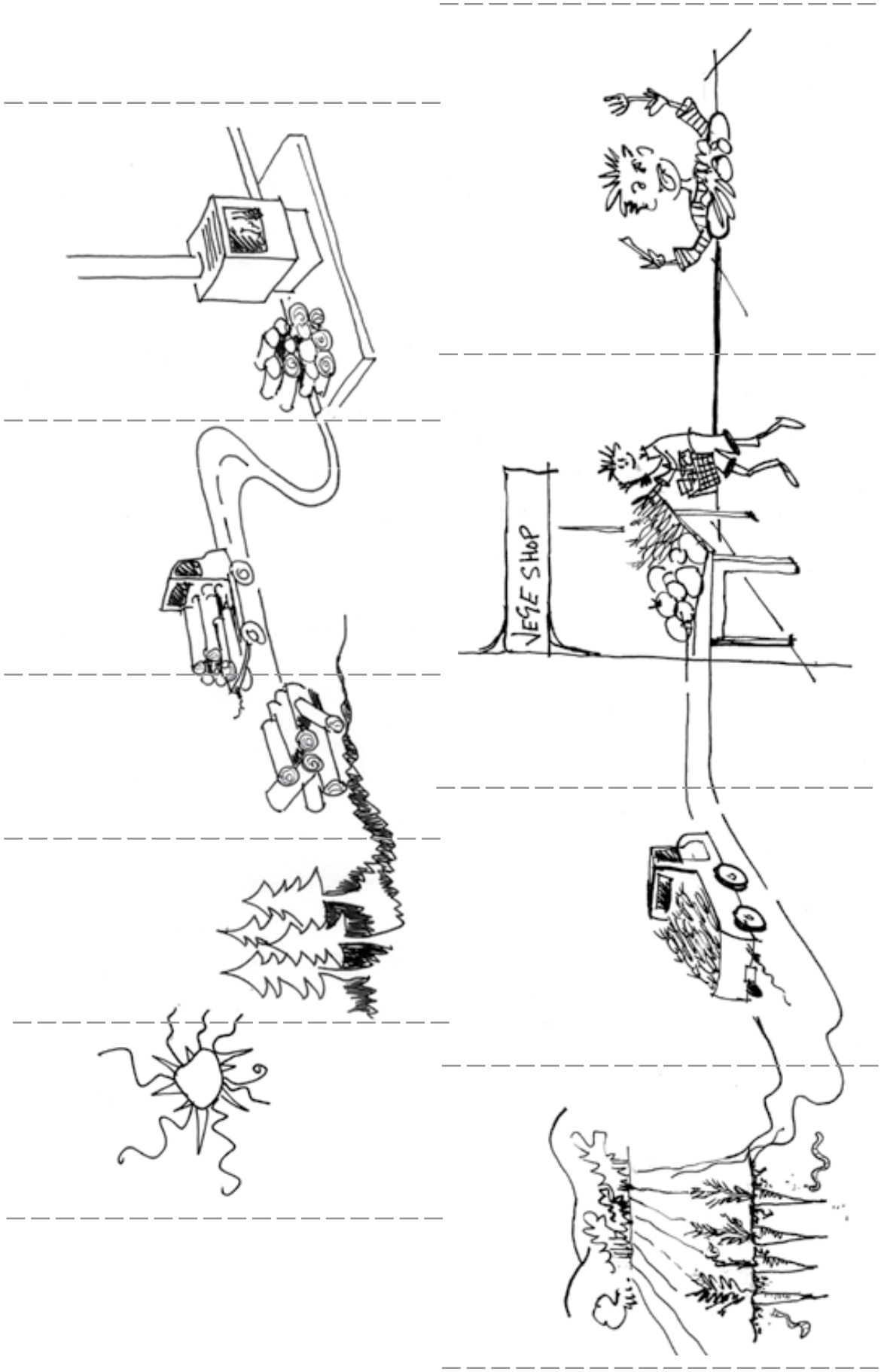
Evaluate / Reflect

- Where does the energy come from in each jigsaw?
- How does it change?
- What things might it be useful for?
- Why are some of the jigsaws longer than others?
- Which sources of energy are used in your school?








VEGE SHOP

4c.8 Electricity To Our Home

You will need

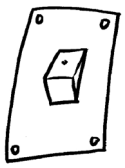
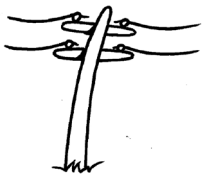
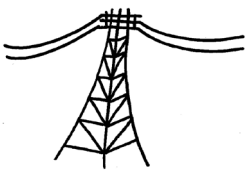
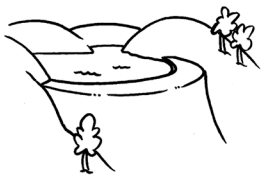
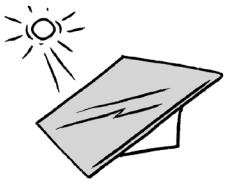
- A copy per student or group of the matching activities

Use the drawing on page 112 and the photographs on page 118 to discuss how electricity is generated and how it reaches our home.

Vocabulary

Switch	Dam
Power pole	Hydro electric power
High voltage overhead cables	Wind turbine
Pylon	Solar panel

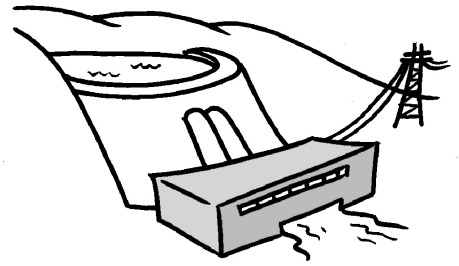
Cut up the cards and use as a matching activity

Switch		Overhead cable	
Power pole		Pylon	
Dam		Hydro electric power station	
Wind turbine		Solar panel	

Electricity generation, transmission, distribution and retail sale

Look at the photographs on the next page. There are photographs showing

- Electricity generation at a hydroelectric power station and the electricity generator's control room
- Electricity transmission through high voltage power lines on the national grid
- Electricity distribution through the local power lines
- Retail – where electricity is sold to consumers in their businesses or homes



Match the words on the diagram to the relevant photo.

Remember – Always stay well away from power lines, power boxes and overhead cables. Always take care around electricity.

Evaluate/Reflect

- Before this activity what did you think was involved in getting electricity to your house?
- Is there another other way to get electricity to your house from a closer source?
- What would be involved in this?

Electricity to our home

Write these in the appropriate box

- Transmission
- Retail
- Generation
- Distribution

4c.9 Where Do We Get Our Power From?

Investigate where power is generated in New Zealand and how it is transmitted across the country to our homes, businesses and schools. See www.transpower.co.nz website.

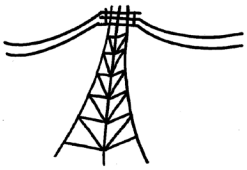
Look at the Transpower Transmission Maps which show the location of power stations and the high voltage transmission network in New Zealand.

1 Find out where you live on the map.

2 Find the nearest power station to your home.

3 What type of power station is it?

4 Count the number of hydro-electric power stations in the South Island.



5 What do you notice about the power stations on the North Island compared with those on the South Island?

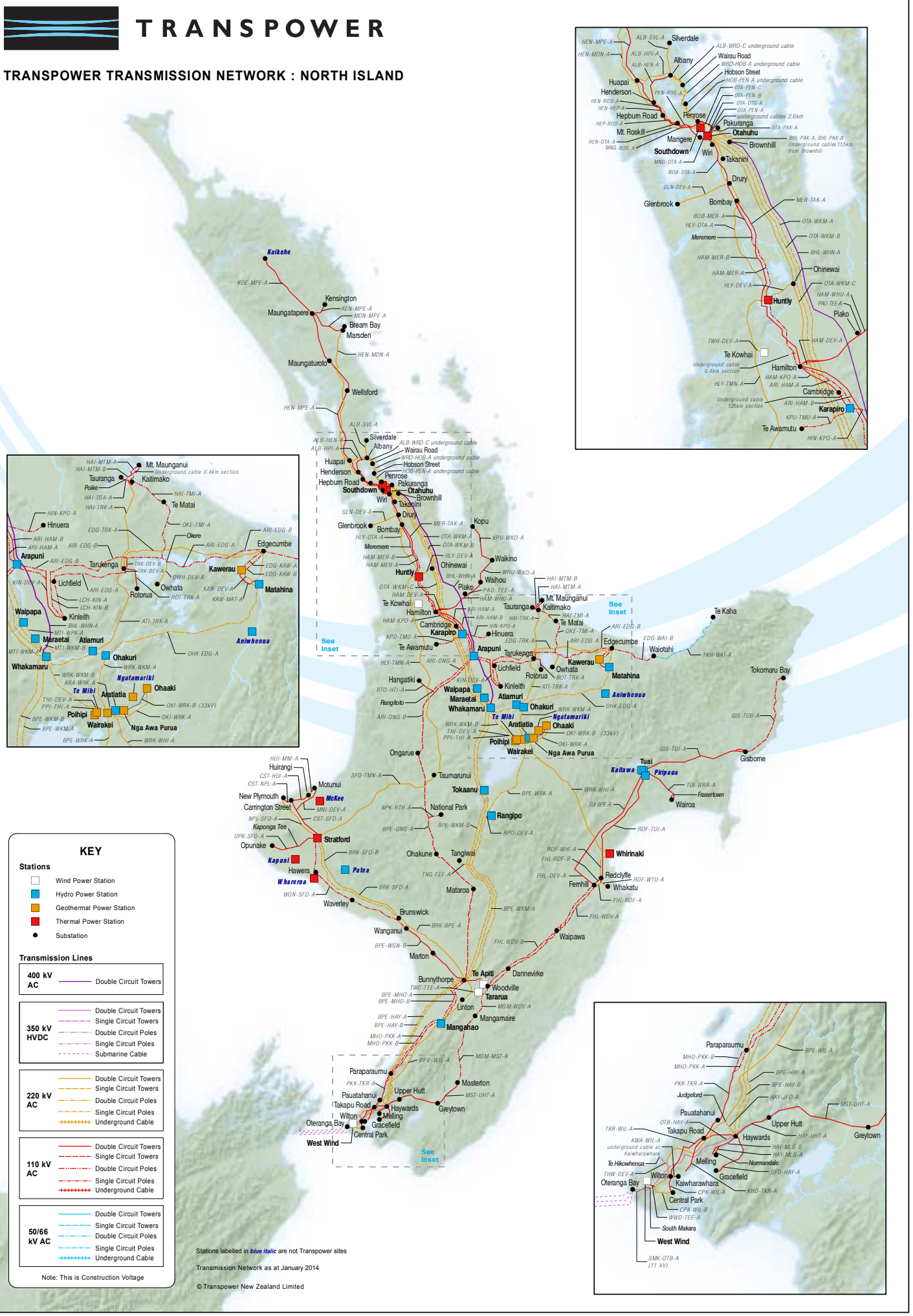
6 The lines you see on the map are called transmission lines, they carry high voltage electricity from the power stations around New Zealand. Most people live in the North Island yet most electricity is generated in the South Island.

7 Follow the transmission lines on the map from the power station at Benmore on the South Island to Auckland on the North Island.

8 What is different about the line which connects the two islands (use the key to help you).

TRANSPOWER

TRANSPOWER TRANSMISSION NETWORK : NORTH ISLAND



KEY

Stations

- Wind Power Station
- Hydro Power Station
- Geothermal Power Station
- Thermal Power Station
- Substation

Transmission Lines

400 kV AC	Double Circuit Towers
350 kV HVDC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Submarine Cable
220 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable
110 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable
50/66 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable

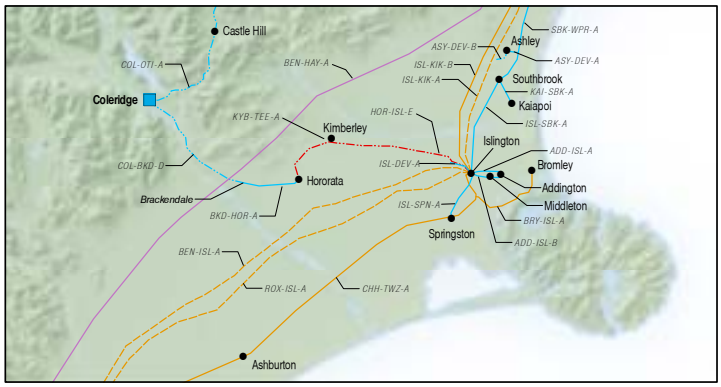
Note: This is Construction Voltage

Stations labelled in *blue italic* are not Transpower sites

Transmission Network as at January 2014

TRANSPOWER

TRANSPOWER TRANSMISSION NETWORK : SOUTH ISLAND



KEY

Stations

- Wind Power Station
- Hydro Power Station
- Geothermal Power Station
- Thermal Power Station
- Substation

Transmission Lines

350 kV HVDC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Submarine Cable
220 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable
110 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable
50/66 kV AC	Double Circuit Towers Single Circuit Towers Double Circuit Poles Single Circuit Poles Underground Cable

Note: This is Construction Voltage

Stations labelled in *blue italic* are not Transpower sites

Transmission Network as at January 2014

4c.10 Switch On – Switch Off

Making a basic electrical circuit

You will need for each group

- A Brain Box kit from the Energy kit or the circuit equipment shown
- Two AA batteries

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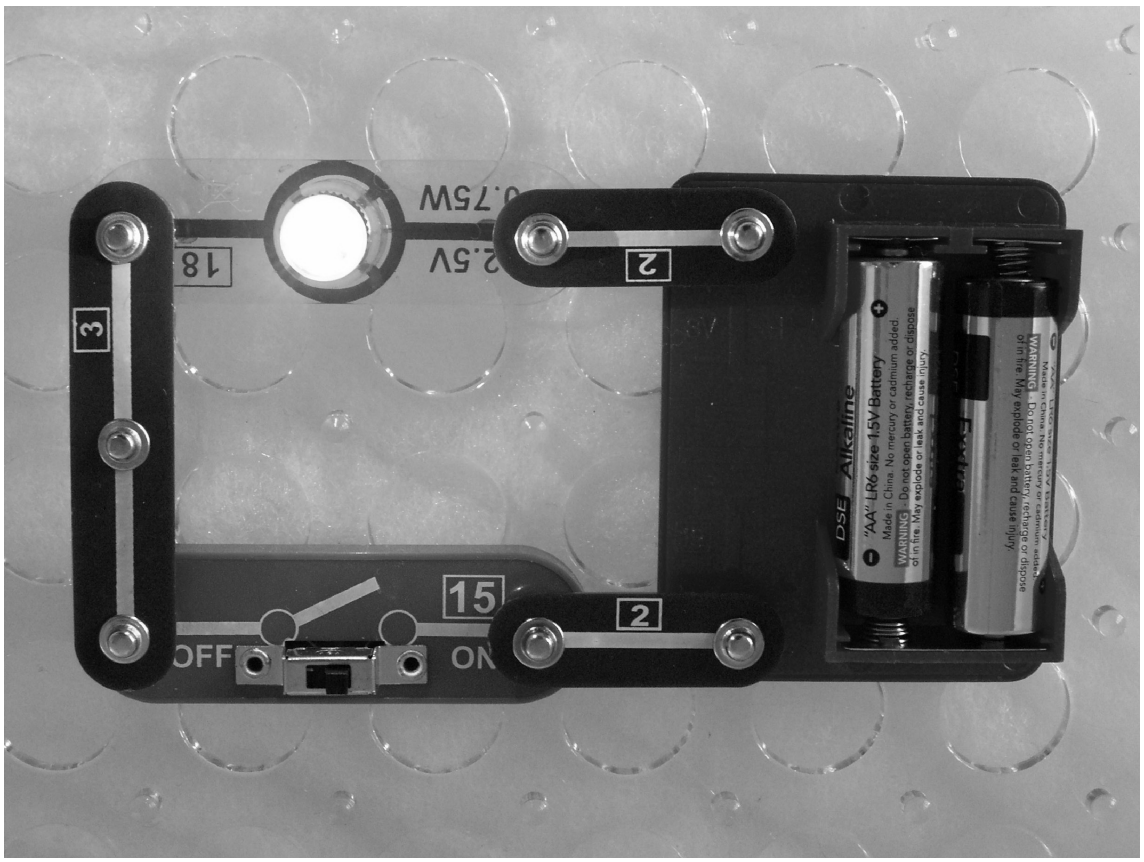
1 Place the plastic board on a table with the flat side down.

2 Look in the box to find the following parts
   - 1x battery unit
   - 2x two-snap connectors
   - 1x three snap connector
   - 1x 2.5 volt lamp unit
   - 1x bulb
   - 1x slide switch



3 Carefully press the parts onto the board as shown on the diagram.

4 Screw the bulb into the lamp base (18).

5 Put 2 AA batteries into the battery unit (19).

6 Turn the slide switch (15) on.

Evaluate/Reflect

- What happens to the lamp when you complete the circuit by turning the switch on?
- What is making the lamp do this? What is powering the lamp?
- What happens to the lamp if you break the circuit by turning the switch (15) off?
- What do you think would happen if you left the light on and didn't switch it off?
- The classroom lights use electricity too. These lights use mains electricity not stored electricity from a battery
- What could we do to save electricity used to light this classroom?
- Could you do the same thing at home?
- Can you think of other ways you could save electricity on lighting?

Extension

Use the Brainbox electricity kit to make other fun things happen and learn more about electrical circuits.

Go online and look at this website on using electricity and online circuit making.

http://www.bbc.co.uk/learningzone/clips/topics/primary/science/electricity.shtml

4c.11 Connect It

You will need

- A copy of this sheet per student or group

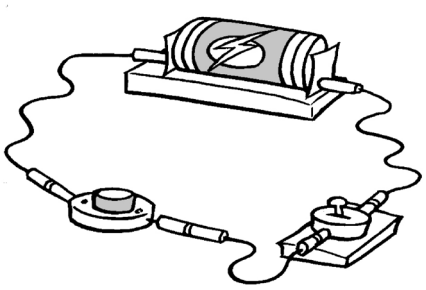
Here are three circuits. None of them work.

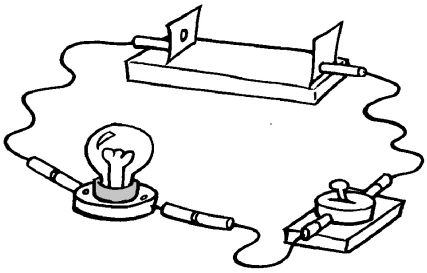
1 Can you see why they don't work?

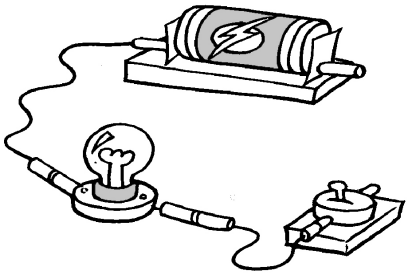
2 Draw in the parts that are missing.

3 Label the different items in one of the circuits with the following labels:

Battery, switch, wire, light – check the Glossary for definitions if you are unsure of these words







4 Complete the sentence: The light bulb will only light up if ….

If lights are left on all the time a lot of electricity is wasted. Remember to switch lights off if they are not needed.

Be safe around electricity

Electricity kits like this use low voltage batteries which store electrical energy. This circuit uses a small amount of electricity from the battery so it is safe to do these experiments.

NEVER experiment with mains electricity

Teacher Information

The Scientific Inquiry Process

Follow these steps during any scientific inquiry you do.

1 Purpose

- Why are you doing this experiment?
- What do you hope to find out?

Ask a question about something you observe.

How do..., What if..., When I..., Who knows..., Which..., Why does..., or Where can...?

2 Background research

Learn from the experience of others. Find out about the topic and gather information so you can design an experiment to find out the answer to your question. Research what techniques and equipment would be best to use in your investigation.

3 Hypothesis

Make an educated guess about how things work.

"If ....(I do this), then.....(this) will happen". You must state your hypothesis in a way that is easy to measure and helps you answer your original question.

4 Experimentation

Test whether your hypothesis is true or false by doing an experiment. It is important that your experiment is a fair test. Make sure you only change one factor at a time while keeping all the other factors the same. You should repeat your experiment several times to make sure that the results from the first experiment were not just an accident. It is good to have a 'control' situation to show what will happen if nothing is changed. When you describe your experimental procedure, it is like a step by step recipe for the experiment you are doing.

5 Analyse data

Once you have finished your experiment, collect all the results e.g. measurements or other data. Draw a table or graph to show your results. Analyse the results to see what happened.

6 Conclusion

The results and analysis will tell you if your hypothesis was true or false. Often scientists find their hypothesis was false so they will think of a new one to test. Write a conclusion to your experiment. You may want to display your results on a poster or display so others can look at your experiment. Having tested this hypothesis, is there anything else you would like to know? Can you think of a new hypothesis and experiment to test, and find out the answer to your question?

4c.12 Conductor Or Insulator

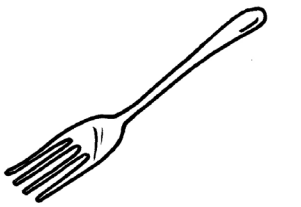
You will need

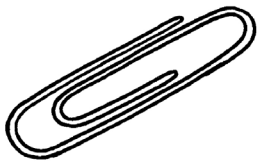
- A copy of the sheets per student or group
- The Brain Box or the circuit equipment shown
- Materials for testing

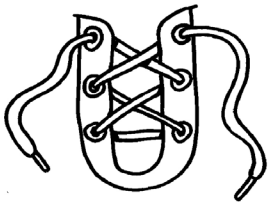
Look at the pictures. What materials do you think they are made from?

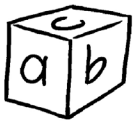
1 Tick if you think the materials will conduct electricity (will easily let electricity through). ✔

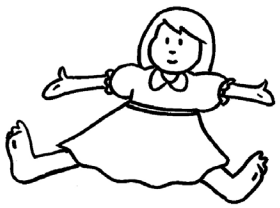
2 Cross if you think the material will insulate (will not easily let electricity through). ✗











Experiment to test the conductivity of different materials

Purpose

To find out which types of materials are good conductors of electricity.

To find out which types of material are good insulators and do not easily conduct electricity.

Background research

Find out about

- How to make an electric circuit
- Why electricity needs a complete circuit to flow around
- What being a good conductor or a good insulator means

3 Decide which materials you are going to test for their conductivity and cut a short strip of each material. Choose a good range of different materials or use the list in the table below.

Hypothesis

4 Make an educated guess about which materials you think will be good conductors of electricity and which you think will be good insulators.

"If I put a strip of material that is a good conductor across a gap in an electric circuit, electricity will flow around the circuit and the light will go on. If I put a strip of material that is a good insulator, electricity will not flow around the circuit and the light will not go on."

5 List the materials you are going to test in the table below.

For example...

Material	**I think this will be a good conductor**	**I think this will be a good insulator**
Wood		
Brass wire		
Card		
Plastic		
Steel		
Aluminium foil		
Copper		
Glass		
Rubber		

6 Write your own hypothesis or choose one of the following hypotheses.

- All materials are good conducts of electricity
- Some materials conduct electricity more easily than others
- All materials are good insulators
- Metals are good conductors of electricity

Write your hypothesis here

Hypothesis _____

Experimentation

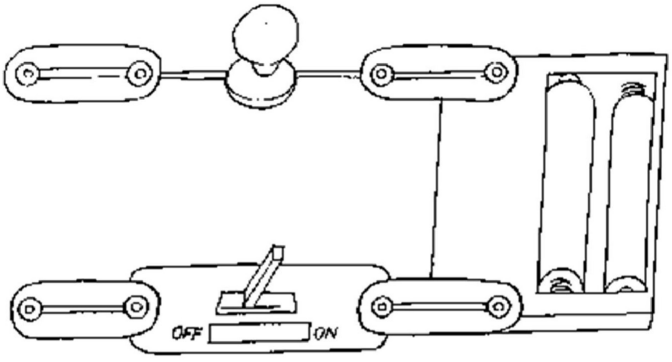
Test whether your hypothesis is true or false by conducting an experiment. It is important to make your test a fair test so you will only try one piece of material at a time. You should also repeat your experiment two or three times to make sure the results from your first test were not an accident.

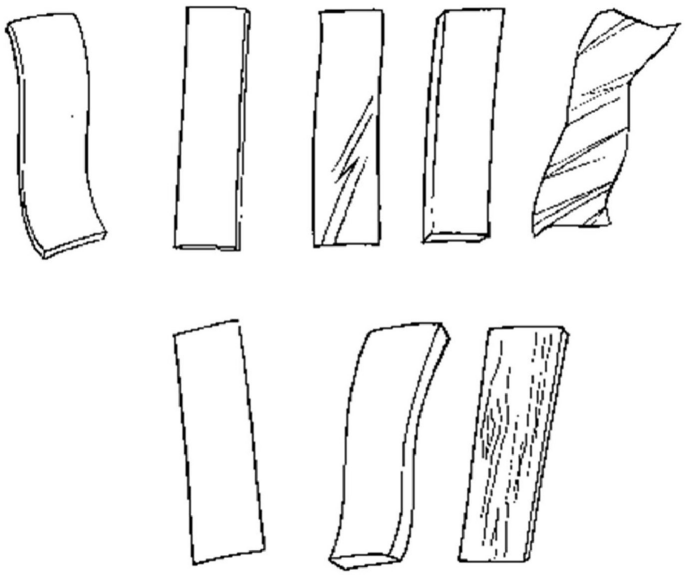
Equipment

- An incomplete electrical circuit (use the Brain box kit make the circuit from Switch on – Switch off then remove the piece number 3)
- Strips of material

Method

7 Write the name of the material next to each of the strips on the diagram below.





8 Describe what you did to test the materials for conductivity

- How you made the incomplete circuit
- How you chose what materials to test
- How you tested each material

Results

9 Record your results in the table like the one below. Write "Yes" or "No" in the boxes.

Material	Good conductor	Good insulator
Wood		
Brass wire		
Card		
Plastic		
Steel		
Aluminium foil		
Copper		
Glass		
Rubber		

Analyse data

10 You can now analyse the results (data) you have collected from your experiment. Look at the table of results. Think about them and work out what they mean. What happened? Is there any pattern you can see?

Conclusions

11 Describe what you found and what you conclude from that.

Was your hypothesis true or false?

Is there anything else you would like to know about how well materials conduct electricity?

Could you set up another experiment to find this out?

I tested my hypothesis and found it was _____

because _____

_____

_____

I would like to find out if _____

_____

Reflection

12 How are good insulators used to keep us safe around electricity?

_____

Be safe around electricity

Electric wires are covered with a protective plastic or rubber insulator.

If you see that the insulating material on the cable is frayed, tell an adult who can get it fixed. If an old, unsafe appliance is being thrown away, the plug should be cut off so that no one can use it again by mistake.