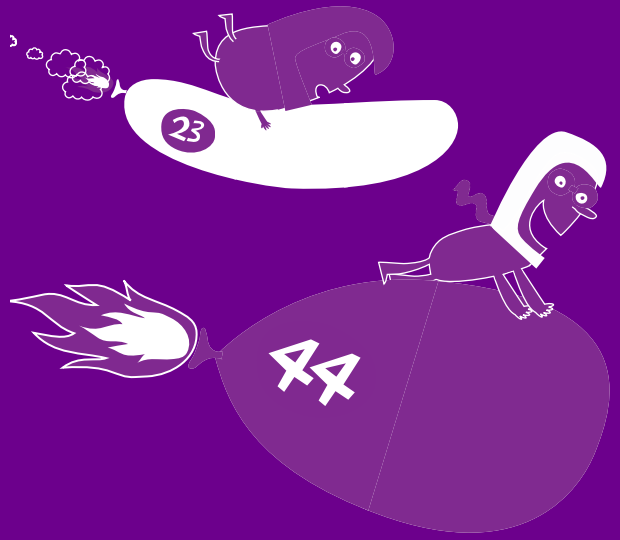
The Energy File

Ideas for teaching Energy in the SESE Curriculum

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND



seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

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EUROPEAN UNION STRUCTURAL FUNDS

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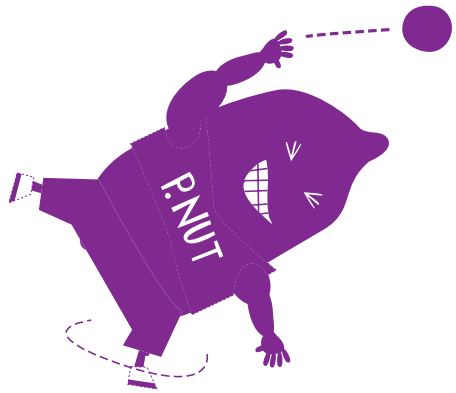

Introduction

Who produced this workbook?
Sustainable Energy Authority of Ireland, the national agency with responsibility for promoting sustainable use of energy. Why not log on to www.seai.ie for more information?

Why teach Energy?
Everything we do uses energy.

Energy use and production are the single biggest contributors to climate change. By thinking about how we use energy we can help our environment. We can all make a difference.

Fossil fuels are finite resources, we need to find new ways to meet our energy needs, and we need to use energy in a sustainable way.

Is this workbook relevant to the curriculum?
The activities in this workbook have been developed to integrate into the SESE Curriculum and to assist you, the teacher, in teaching about energy. To help you fit these activities into your SESE related lessons, curriculum links are included on individual activities.

How to use this workbook
There are experiments, things to design and make and worksheets in this workbook. These can be adapted to different classes and abilities, and most require only basic, readily available materials. You will know which activities suit your class best. The materials are designed to be suitable for photo-copying to facilitate distribution. You can pick and choose once-off SESE activities from the table of contents or put together a longer programme by picking a theme or project topic as a starting point.

The experiments are a good way to introduce science and working scientifically. The section on designing and making provides step-by-step instructions and the worksheets provide project ideas and simple exercises for use in the classroom and at home.

What other resources are available?
For a detailed list of resources available for primary schools go to www.seai.ie/schools or email schools@seai.ie

Safety first!

Caution: Supervision required

It is intended that all activities in this workbook be conducted under adult supervision. In the interests of safety, please be sure to look for the caution icon, which is featured on all activities where the teacher's assistance is specifically required, for example where hot water is needed for an experiment.

Some activities should only be demonstrated by an adult and are not suitable for children to attempt themselves. Please review activities with this in mind before beginning.

Table of Contents

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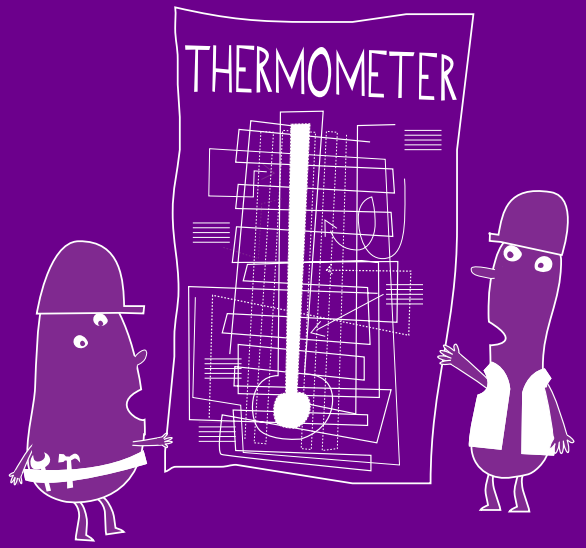


Section 1

Designing and Making

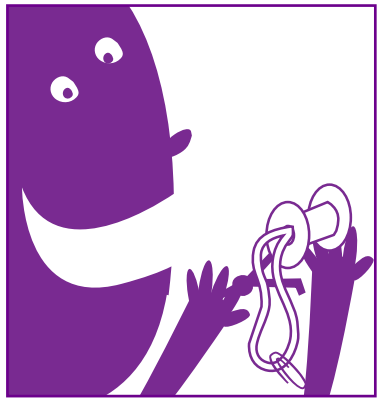
How to make a rubber-band fan

You will need:

- A rubber band
- Empty spool of thread
- Lolly stick

How to

1

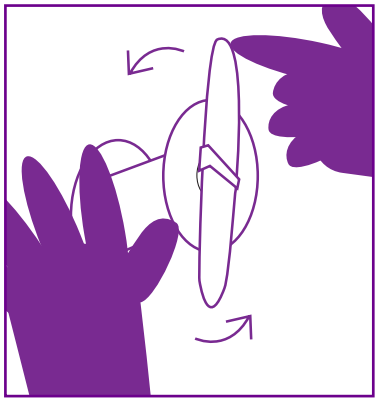


First put a paper clip on one end of a rubber band. Then, carefully using something like a compass or the handle of a fine paintbrush, push the rubber band through an empty spool of thread.

2

When the rubber band has been pushed through, slide a lolly stick through the loop. Next pull the stick away from the cotton reel.

3



Turn the lolly stick around and around until there are lots of turns in the rubber band.

4

Let go and see what happens! The energy you've put into twisting the rubber band is changed into energy to make the lolly stick spin.

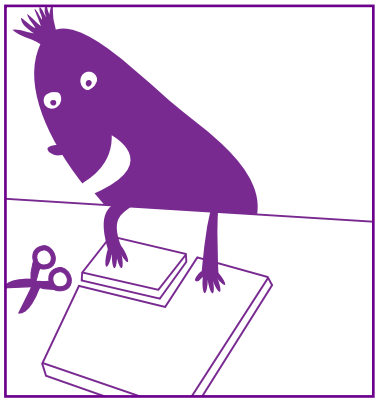
How to make a land yacht

You will need:

- Scissors
- A sheet of polystyrene
- Cardboard
- Four pins
- Four small beads (optional)
- Pen/pencil
- A €2 coin or a compass
- A lolly stick
- Sticky tape
- A piece of paper

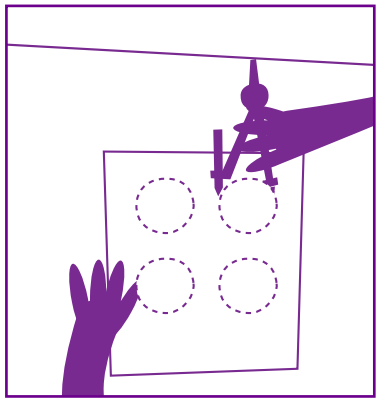
How to

1



Cut the polystyrene into a rectangle approximately 12cm x 6cm.

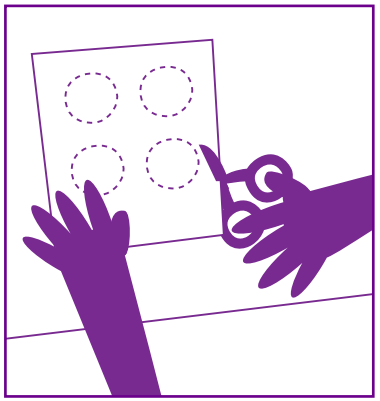
2



Draw four circles on the cardboard either:

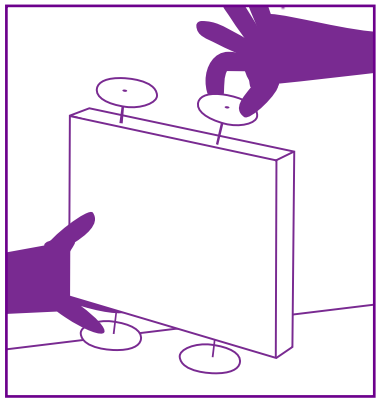
- using a €2 coin
- using a compass with a radius of 1.5cm. The compass method is better as the mark made by compass point tells you where to put the pin in.

3

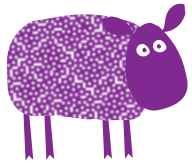


Cut out the circles.

4

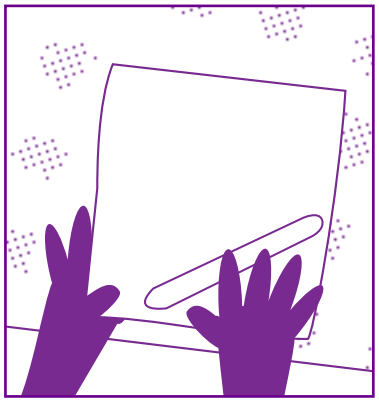


Fix two of the circles to one of the long sides of the polystyrene using pins. Turn the buggy over and fix two wheels on the other long side. Don't push the pins too far into the polystyrene as the wheels may not turn easily: you may need to have a small bead between the wheel and buggy.



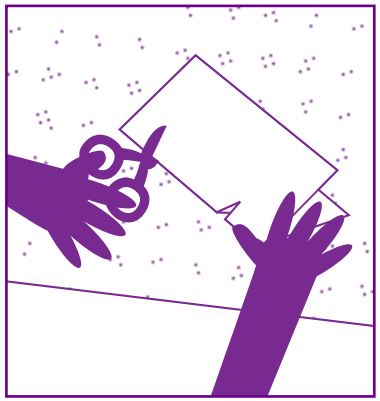
How to *continued*

5



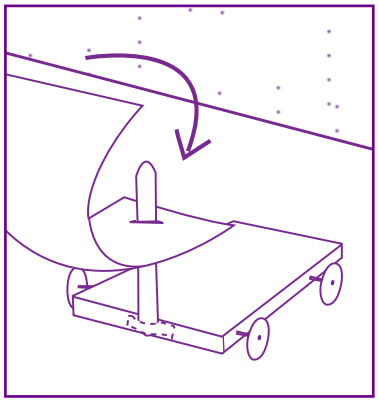
Get a lolly stick and a piece of paper. Cut out a square shape with sides roughly the same length as the stick.

6



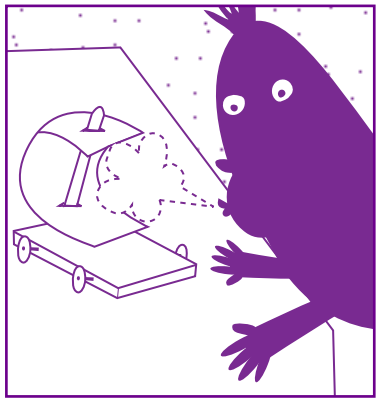
Fold the paper in two, mark the fold 1cm from either end, then make small cuts in the paper.

7



Tape the lolly stick to the front of the buggy. Slide the paper onto the stick by using the small holes made in the paper.

8



Blow into the sail and watch the land yacht move.

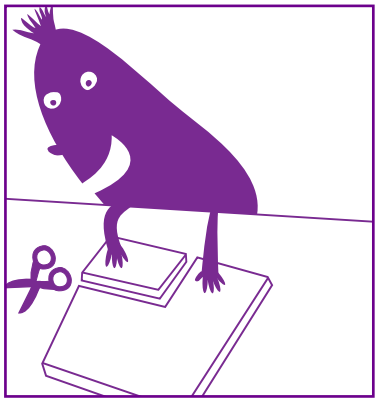
How to make a balloon buggy

You will need:

- Scissors
- A sheet of polystyrene
- Cardboard
- Four pins
- Four small beads (optional)
- Pen/pencil
- A €2 coin or a compass
- A balloon
- Double-sided sticky tape

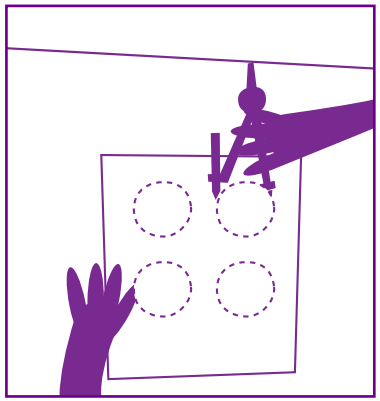
How to

1



Cut the polystyrene into a rectangle approximately 12cm x 6cm.

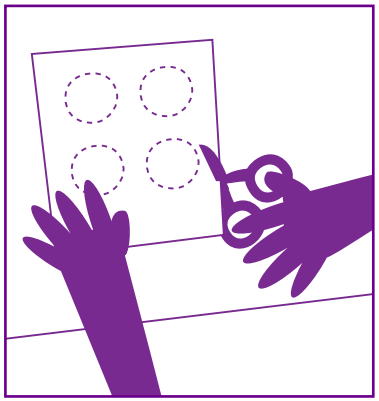
2



Draw four circles on the cardboard either:

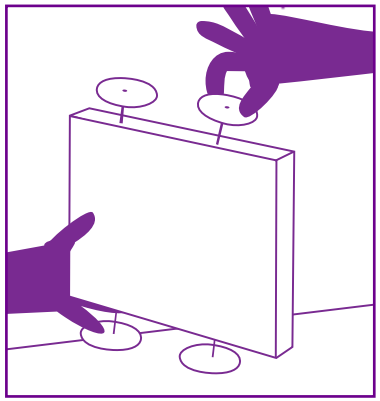
- using a €2 coin
- using a compass with a radius of 1.5cm. The compass method is better as the mark made by compass point tells you where to put the pin in.

3



Cut out the circles.

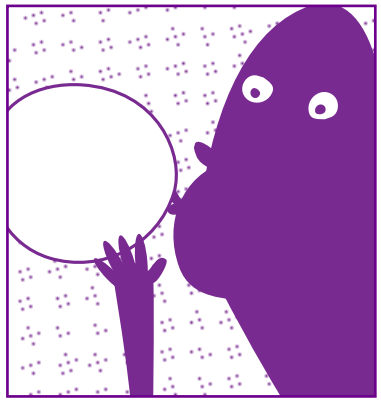
4



Fix two of the circles to one of the long sides of the polystyrene using pins. Turn the buggy over and fix two wheels on the other long side. Don't push the pins too far into the polystyrene as the wheels may not turn easily: you may need to have a small bead between the wheel and buggy.

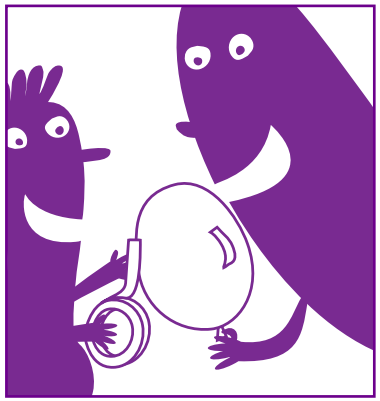
How to *continued*

5



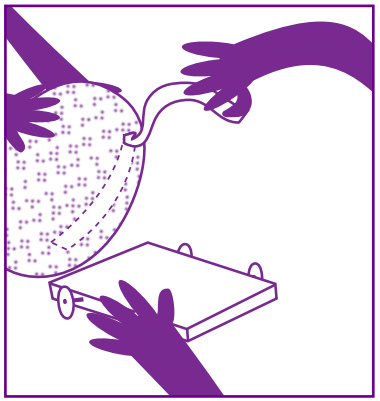
Blow up a balloon. If you can't blow it up yourself, ask a teacher or use a balloon pump.

6



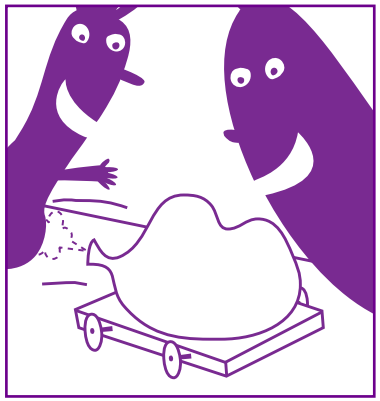
Get someone to hold the neck of the balloon to keep the air in it while you put the strip of double-sided sticky tape lengthwise onto the balloon.

7



Peel back the covering of the other side of the double-sided tape, then use it to stick the balloon to the buggy base.

8



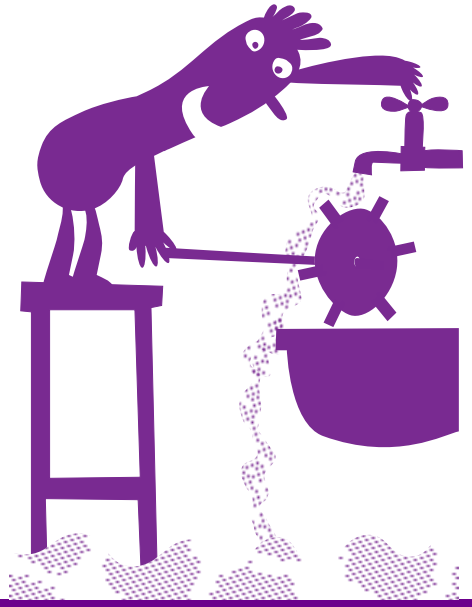
Put the buggy and balloon onto the ground or a long, flat surface. Tell the person holding the balloon to let go and watch it move!

How to build a waterwheel

You will need:

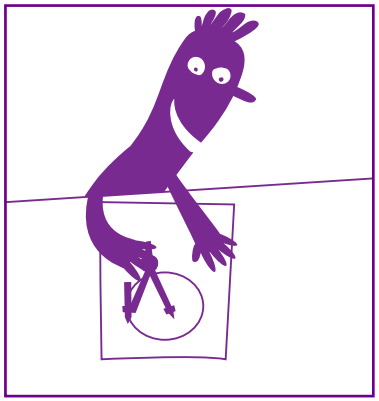
- Cardboard
- Wood or plastic
- Compass

Ideally a waterwheel should be made with a material like wood or plastic that will not go soggy and floppy in water. But, as these need to be cut out with hack-saws or very sharp knives, it is much safer if models are made with cardboard—though they will soon disintegrate when used in water.



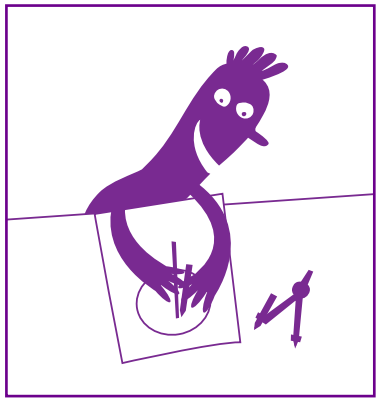
How to

1



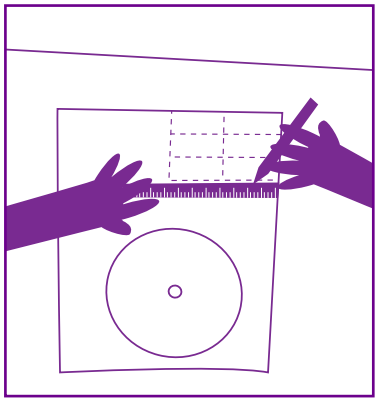
Draw a circle with a radius of 4cm on a piece of cardboard using a compass.

2



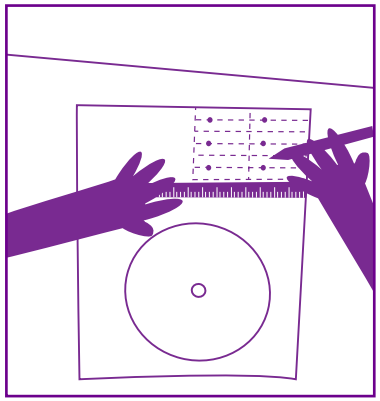
Put a rod or pencil on the centre point made by the compass and draw around this rod/pencil.

3



Draw six rectangles on some cardboard, each measuring approximately 3cm x 4cm.

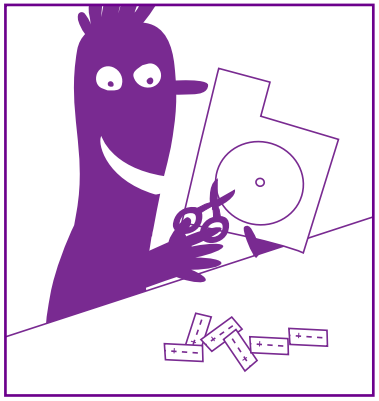
4



Draw a line up the middle of each rectangle and mark it 2cm from one end.

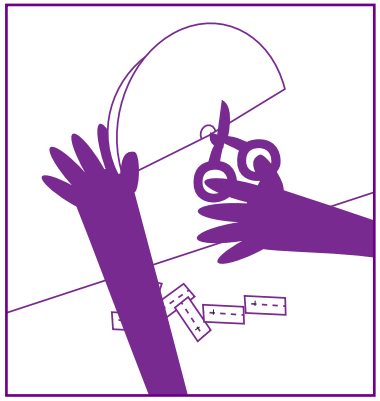
How to *continued*

5



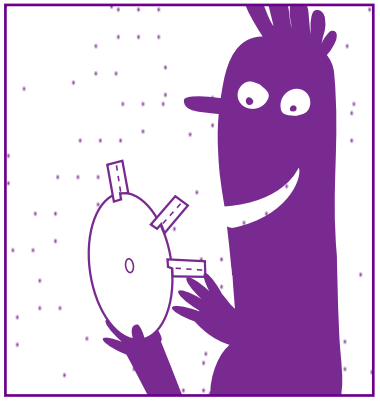
Cut out the circle and the rectangles.

6



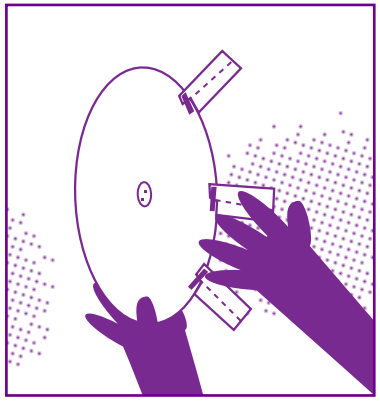
Cut out the centre hole of the circle and cut along the centre line of each rectangle as far as the mark.

7



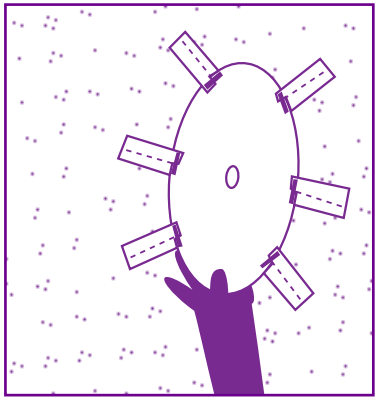
Slide the circle through the slit of a rectangle.

8



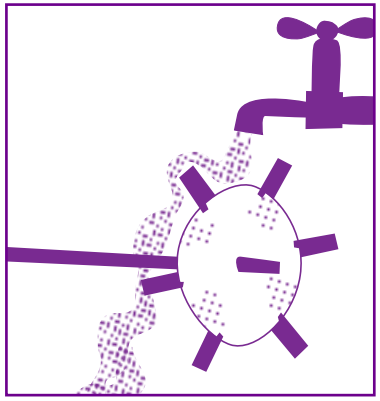
Secure in position with sticky tape.

9



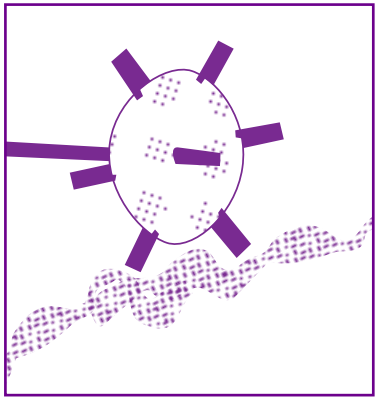
Repeat with the other 5 rectangles until you have a wheel with 6 blades

10



Slide the rod through the centre of the wheel and hold it in a stream of flowing water. Try it under water falling from above...

11



... and with water rushing underneath.

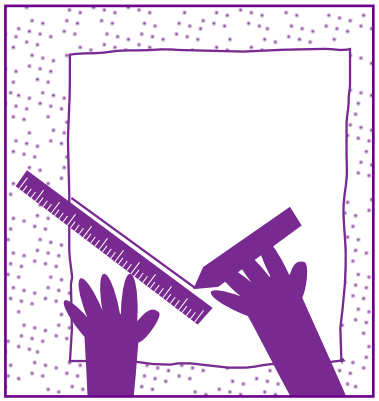
How to make a windmill

You will need:

- A sheet of paper
- A pencil
- Scissors
- A ruler
- Drawing pins

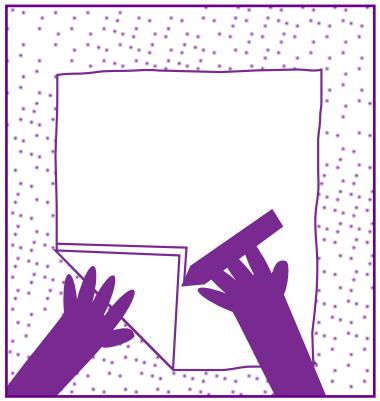
How to

1



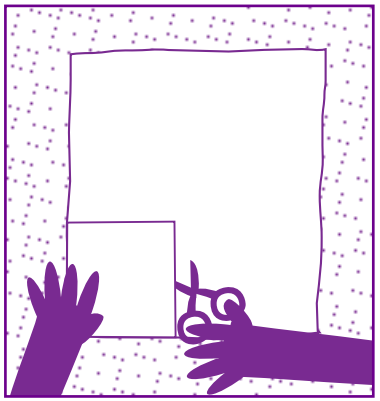
Get a piece of paper and make one mark 14cm up from one corner and another 14cm along from the corner. Then draw a line between the marks.

2



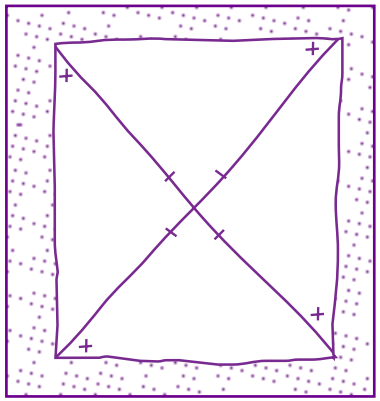
Fold the paper along the line. Then trace the outline of the corner onto the paper

3



When you open out the paper you will have a square. Cut this square out.

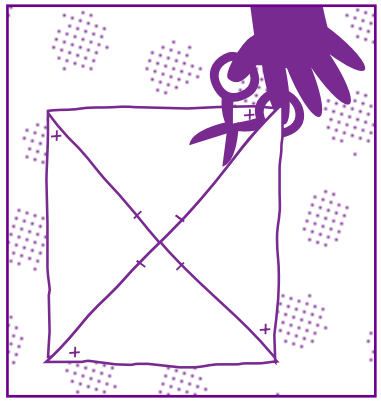
4



Draw two diagonal lines on the paper so that you have a cross shape. Mark a point on each line 2cm from the crossover. Finally, on the right-hand side of each diagonal line, make a mark like a cross. NB. If you want to decorate your windmill do so now.

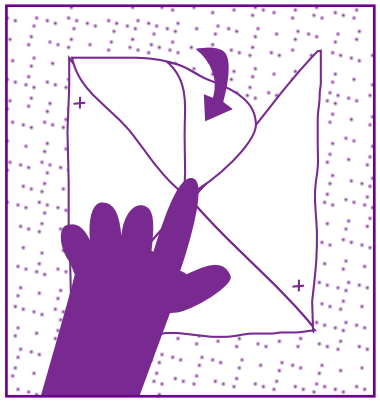
How to *continued*

5



Cut along each line until you reach the 2cm mark.

6

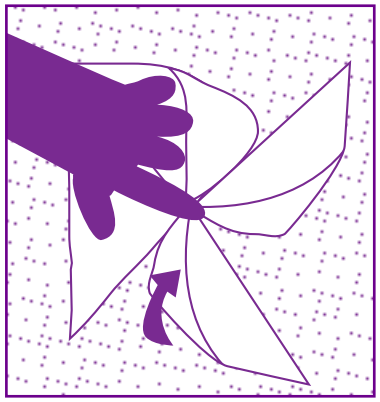


Bend a corner towards the centre.

7

Bend a second corner and…

8



…a third corner…

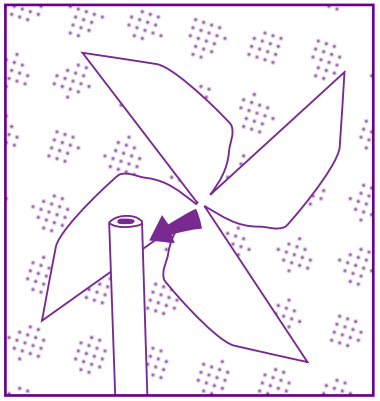
9

… and the fourth corner towards the centre.

10

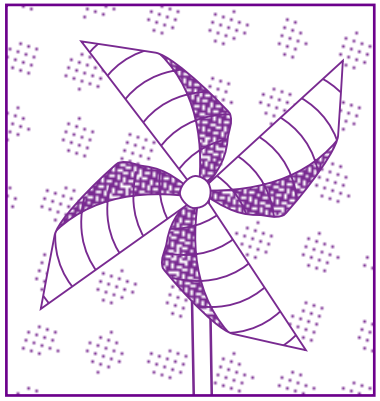
Carefully put a pin through the four corners and the centre of the paper

11



Put the pin into something like a rubber or pencil. You may need to push it into place with another rubber as the pin head can dig into your fingers.

12



You can change the size of your windmill but big ones won't work well.

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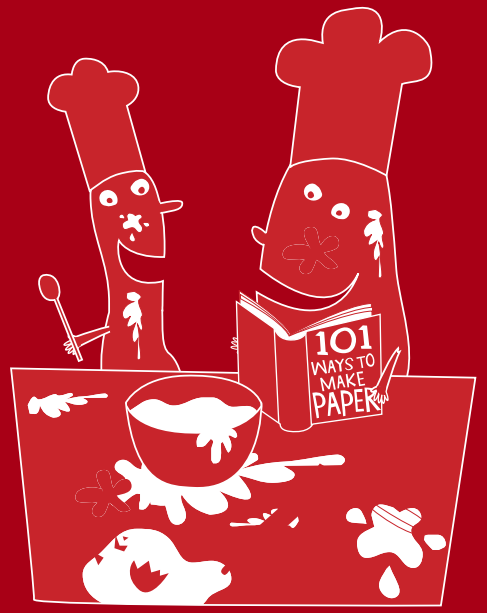
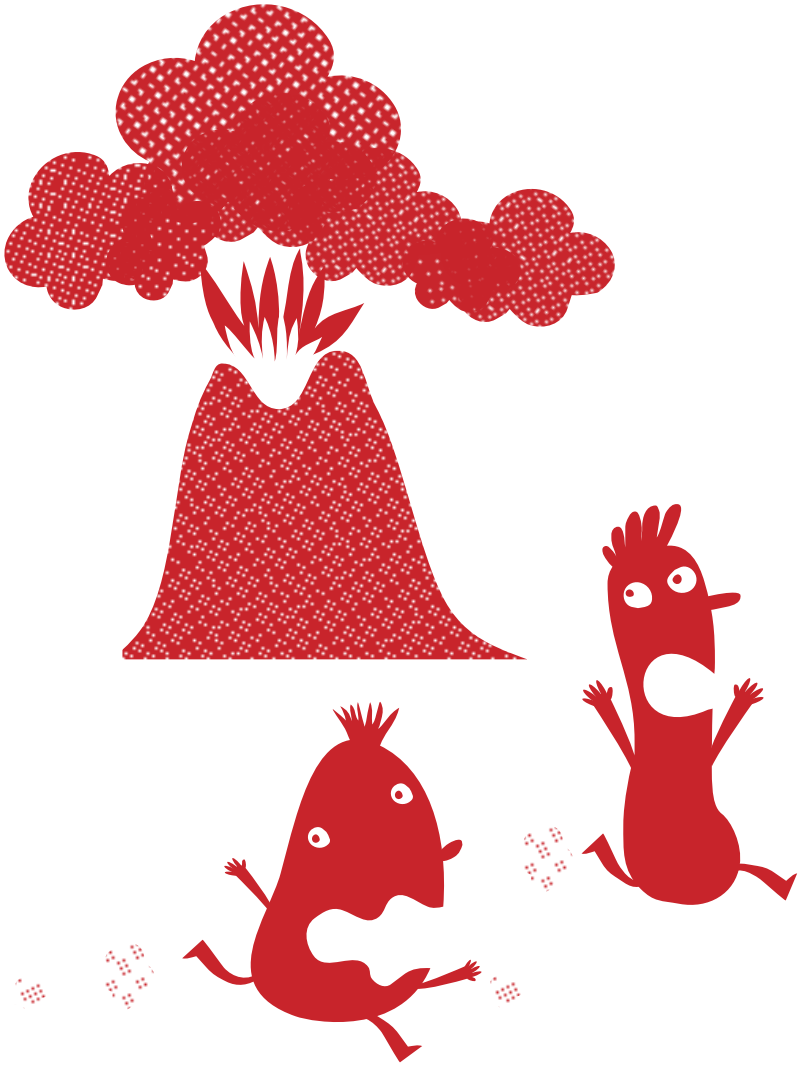


Section 2
Experiments

Erupting volcano

Concept—Chemical energy



Curriculum Link:
Science Curriculum—Designing and Making

Experiment

You will need:

- Salt
- Flour
- Cooking oil
- Water
- Bowl
- Plastic bottle
- Baking tray
- Red food colouring
- Washing-up liquid
- Baking soda
- Vinegar

To make 'salt dough'
Mix 6 cups of flour, 2 cups of salt, 4 tablespoons of cooking oil and 2 cups of water in a large bowl.

Volcano

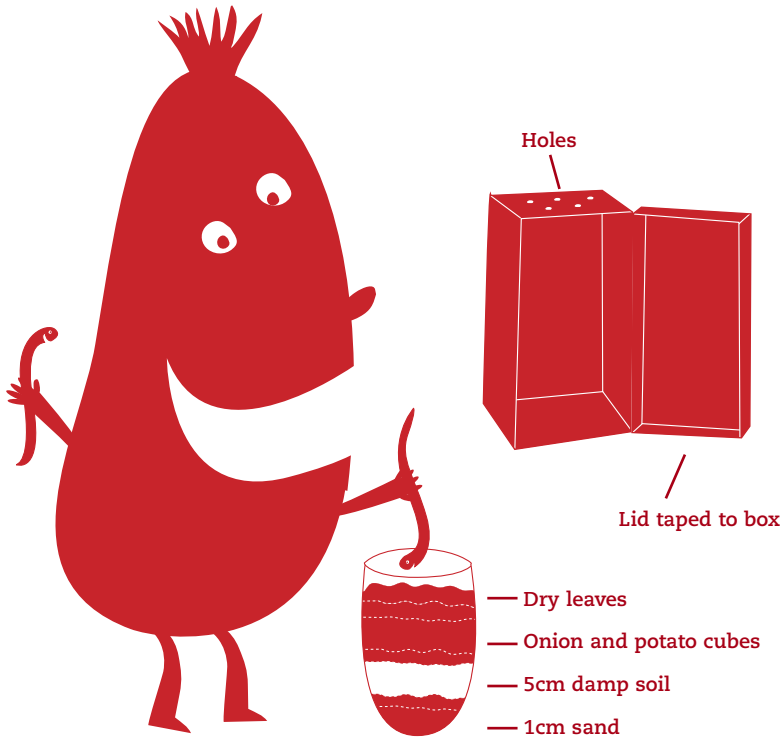
1. Fill the plastic bottle half-full with warm water and add a few drops of red food colouring.
2. Put a squeeze of washing-up liquid into the bottle.
3. Add two tablespoons of baking soda (you may need to use a funnel).
4. Stand the plastic bottle on the baking tray and mould the dough around the bottle, keeping the top open.
5. Slowly pour the vinegar into the bottle and watch your volcano explode.

When bread soda and vinegar mix there is a chemical reaction and the stored chemical energy is released. Carbon dioxide gas is formed and causes the red mixture to foam out of the bottle.

Do more:
Find other materials to build your volcano shape—you could use papier mâché.

Make a wormery

Concept—Organic waste can be made into compost and worms help this process



Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand

Experiment

You will need:

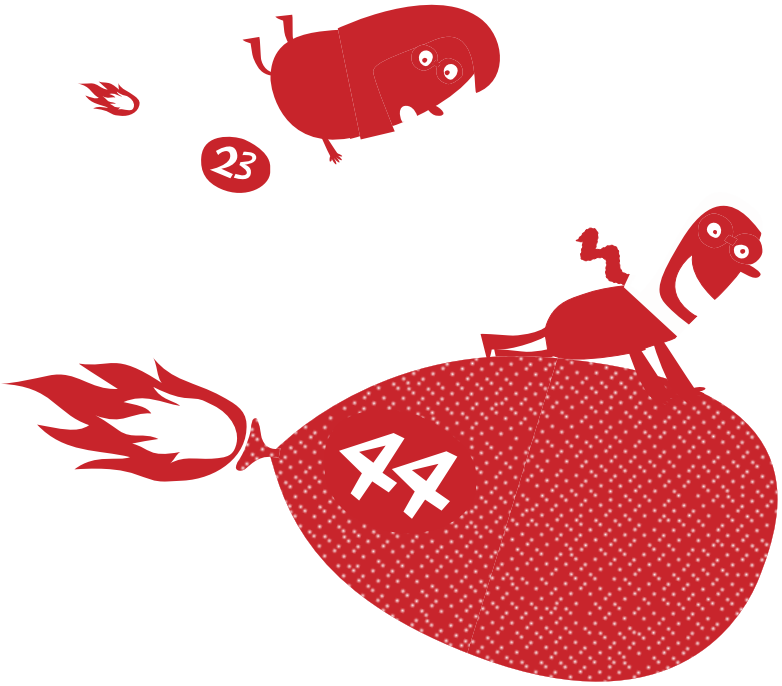
- Shoebox
- Sticky tape
- Ball-point pen
- 2 litre plastic bottle
- Scissors
- 3 cups of damp soil
- 1 cup of sand
- Dry leaves
- Small pieces of food like potato and onion

1. Stand the shoebox on its end so that the longer side is upright.
2. Tape the lid onto one side of the shoebox so that it opens like a door.
3. Make holes in the top of the box with the biro to let air in.
4. Cut the top off the plastic bottle and fill with layers of sand and soil.
5. Scatter food on the surface.
6. Collect a few worms from the garden and drop them on top of your wormery.
7. Stand the wormery outside in a dry place with the door closed.
8. Come back in a few days and you will notice the worms have mixed up the soil by coming to the surface for food and tunnelling back down through your wormery.

Worms eat food, decaying leaves and stems and other organic matter and are useful in a compost heap to aid the composting process. By composting organic waste we can reduce the amount of rubbish going to land fill. This saves energy by reducing the amount of fuel used by trucks collecting and transporting the waste to the dump.

Rocket balloon race

Concept—Anything that moves uses energy/fuel

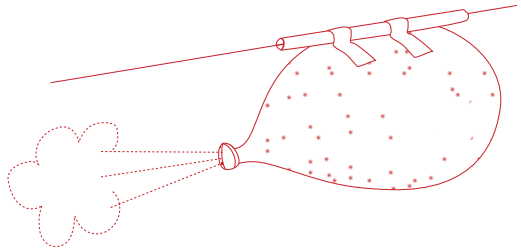


Curriculum Link:
Science Curriculum—Energy and Forces strand

Experiment

You will need:

- 2 long pieces of string (e.g. length of classroom)
- 2 straight drinking straws
- Sticky tape
- 2 ordinary round balloons

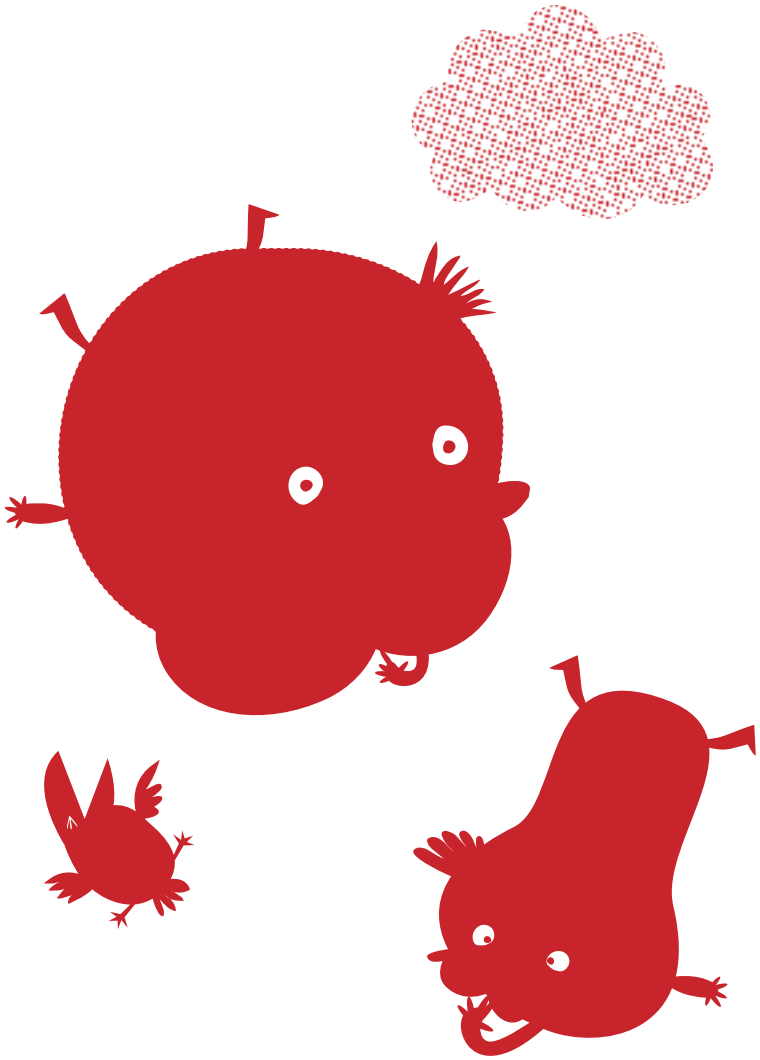


1. Hold either end of the string and stretch it tight across the room.
2. Blow the balloons up but do not tie them off.
3. Tape the balloons underneath the straws.
4. Thread the string through the straws: have each balloon starting from the same end with the nozzles pointing the same way.
6. Count down and let the balloon go.

You could have a balloon race by dividing the class into teams and setting up a couple of strings. Count down, release the balloons and see which team's balloon wins the race. The air rushing out of the nozzle in one direction pushes the balloon in the opposite direction. The release of air is the fuel of the rocket.

Try half-filling one balloon and filling the other and see what happens. You only get out the energy you put in. A space rocket is pushed upwards when hot gases, released from the burning fuel, are pushed out the bottom.

Note: See 'How to Make a Balloon Buggy' in the 'things to make' section of the web site.



Try out the self-inflating balloon

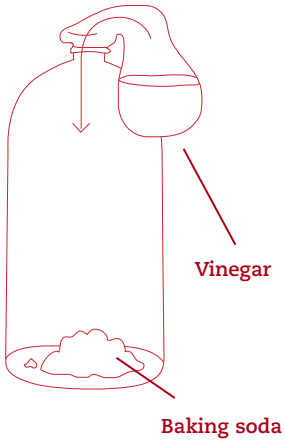
Concept—Chemical energy

Curriculum Link:
Science Curriculum—Materials strand

Experiment

You will need:

- Empty 500ml plastic drink bottle
- Balloon
- Funnel
- Half a cup of vinegar
- 8 teaspoons of baking soda (a common cooking ingredient found in the supermarket)



1. Before the experiment pre-stretch the balloon by blowing it up and letting the air out.
2. Place the baking soda in the bottle.
3. Through a funnel pour the vinegar into the deflated balloon.
4. Without spilling the vinegar, slide the mouth of the balloon onto the bottle.
5. Lift and squeeze the attached balloon so that the vinegar pours into the bottle.
6. Within a minute or two the balloon will inflate.

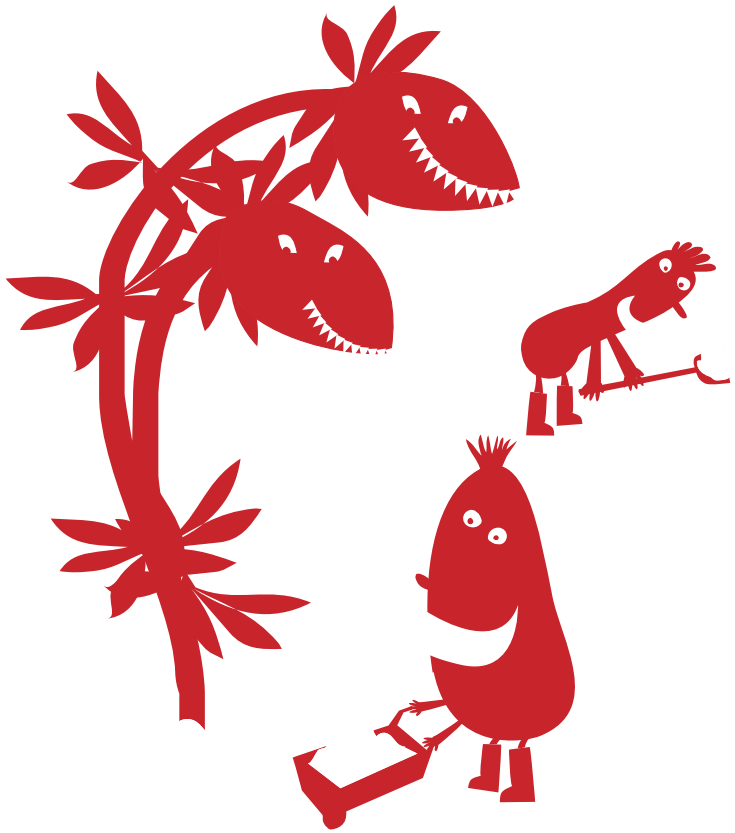
Note: If you find it difficult to put the balloon onto the bottle without spilling the vinegar, you could try putting the vinegar in the bottle and the bread soda in the balloon. When you mix the vinegar and bread soda a chemical reaction takes place. The chemical reaction makes a gas, carbon dioxide, that fills the balloon. Burning is a chemical reaction. When coal is burned the chemical energy is converted to heat energy, and CO_2 is released.

Do more:

- Try releasing the carbon dioxide in the balloon over a lit candle. Carbon dioxide is used in fire extinguishers as it keeps oxygen away from the flame and puts the fire out. Does the candle stay lighting?
- Try using the filled balloon from this experiment in your rocket balloon race. By doing this you are using the chemical energy that was stored originally in the bread soda and vinegar to power your rocket balloon.

Composting

Concept—Composting is a way to reduce waste



Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand

Experiment

You will need:

- Garden
- Apple core
- Scrunched piece of newspaper
- Scrunched plastic bag
- Shovel

1. Dig three holes approximately 30cm deep.
2. Place one item (apple core, newspaper or plastic bag) in each of the holes and cover with soil.
3. Identify where each of the three items have been buried so you will be able to find them in two weeks.
4. After two weeks dig up each of the three items (but do not remove) to see how much they have decomposed.
5. Take photos or draw pictures of what they now look like and compare how much each has decomposed.
6. Cover the three items with soil and leave for another two weeks.
7. Repeat steps 4 and 5.

Composting is a great way to help reduce the amount of waste going to landfill. It also is a way of reusing the sun's original energy. How? The sun provides energy for an apple tree to grow, and the tree uses nutrients and water from the soil to produce apples. By composting an apple core, its nutrients can be used by another plant to grow.

Newspapers, grass clippings and any fruit and vegetable scraps are all good to compost. Plastic bags do not decompose.

Alka-Seltzer pop

Concept—Releasing chemical energy

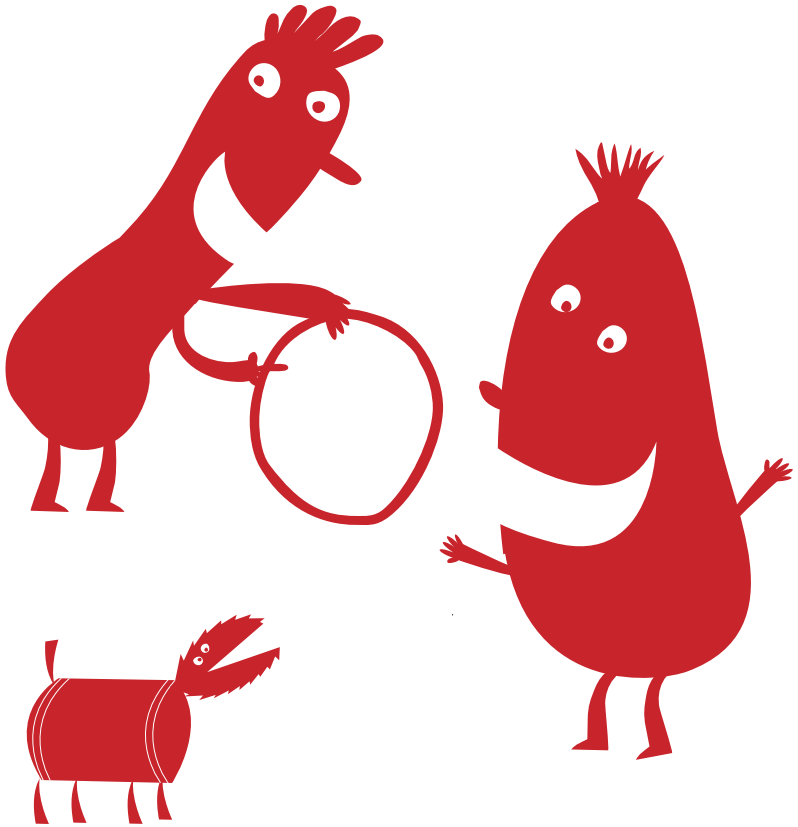
Curriculum Link:
Science Curriculum—Energy and Forces strand

Experiment

You will need:
- Film canister
- Alka-Seltzer or vitamin C tablet
- Blue tack

1. Using blue tack, stick the Alka-Seltzer to the underside of the lid of the film canister.
2. Half fill the canister with water.
3. Close the lid.
4. Give the canister a good shake and place upside down (lid downwards) on the ground.
5. Stand back!

The water reacts with the tablet causing it to fizz (releases the chemical energy) and there is a build-up of gas in the film container. Gases take up lots of space so the canister is too small to contain the gas—pressure builds up and the lid pops.



The obedient tin can

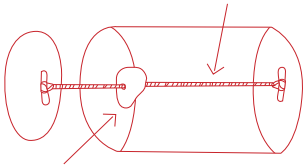
Concept—Stored energy

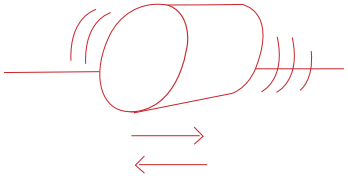
Curriculum Link:
Science Curriculum—Energy and Forces strand

Experiment

You will need:

- Large can or cylindrical container with a snap lid (for example: a small Pringles tube or a gravy granules container)
- Thick rubber band (the experiment works best if the rubber band is about the same length as the can)
- Two paper clips
- Large nut (off a bolt) or large lump of plasticine



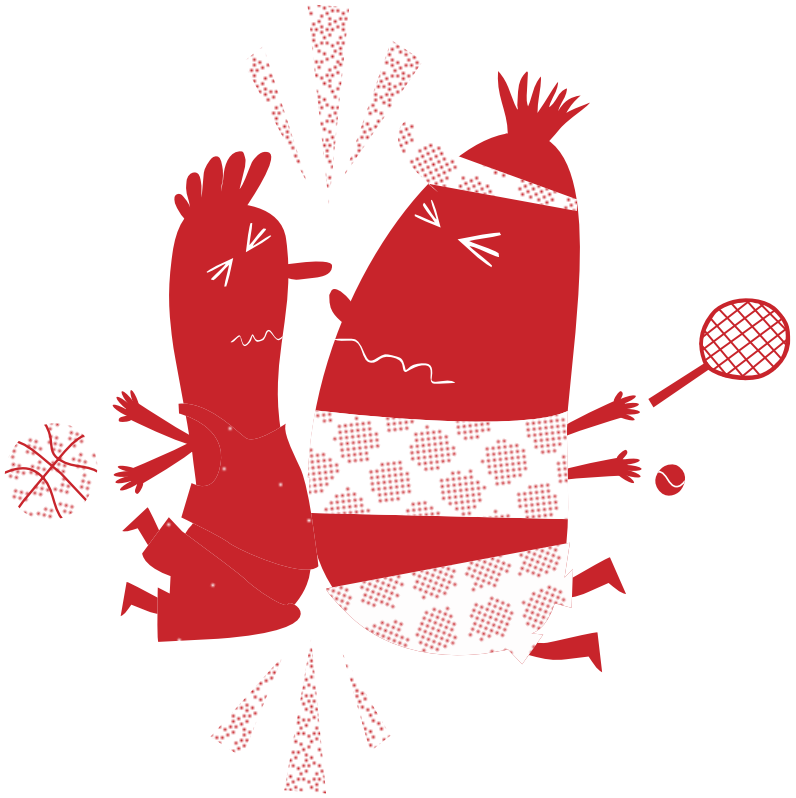


1. Pierce a small hole in the lid and bottom of the can. Make sure the holes are in the centre.
2. Tie the nut or shape the plasticine into a ball around the middle of the rubber band.
3. Feed one end of the rubber band through the hole in the bottom of the can from the inside.
4. Put a paper clip through the rubber band to stop it slipping back into the can. Feed the other end of the rubber band through the hole in the lid and secure it with a paper clip.
5. Close the lid and put the can on its side on the floor.
6. Roll the can gently away from you and watch it stop and come back.

Although the can rolls, the heavy weight does not—it hangs stationary inside the can. The rubber band is forced to twist on each side of the weight. When the rubber band can wind no further it stops the can. As the rubber band unwinds the can rolls back. Energy is stored in the twisted elastic band. The stored energy is changed into moving energy that moves the can forward.

Sporting collisions

Concept—Energy transfer



Curriculum Link:
Science Curriculum—Energy and Forces strand

Experiment

You will need:

- Basketball
- Smaller plastic ball
  or tennis ball

1. Lift the basketball to about shoulder height.
2. Imagine a scale of 1–10 with the floor rated 1 and your shoulder 10, now drop the basketball and notice how high on your scale it bounces back to.
3. Do the same with the smaller ball.
4. The basketball doesn't have enough energy to come back up to shoulder height (10 on the scale) so some of the energy must have been lost by the basketball. Where did it go?
5. Close your eyes and drop the ball again—with your eyes closed how do you know when the ball hits the ground?
6. Put the palms of your hands flat on the ground and get somebody else to drop the basketball nearby, do you feel anything when the basketball drops?
7. From 4 and 5 above you should have discovered 2 places where the energy of the basketball went—can you think of any others?
8. Try dropping the basketball with the smaller ball balanced on top (you will have to hold onto the smaller ball until you drop them). NB. Do this outside or in an open space.
9. This time the smaller ball shoots up in the air—where did it get the energy to bounce so high?

Energy can never be destroyed. In this experiment it is transferred between the two balls and changed into different forms, such as sound, heat and vibrational energy.

Insulation

Concept—Insulation can save energy

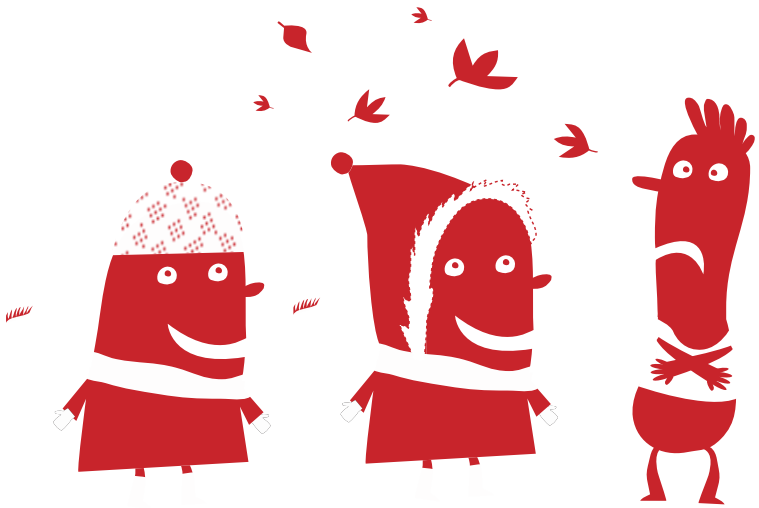
Caution: Supervision required

Curriculum Link:
Geograpy Curriculum and Science Curriculum—Envrionmental Awareness and Care strand

Experiment—Caution: Hot Water!

You will need:
- Thermometer (scale to 100°C)
- Two small teapots
- Tea cosy
- Small flask
- Kettle (or a hot-water tap)

1. Fill the kettle and heat enough water to fill the two teapots and flask (for safety reasons do not use boiling water).
2. Take the temperature of the water. Place equal amounts of water in each teapot and vacuum flask.
3. Place a tea cosy over one of the teapots and close the vacuum flask.
4. After five minutes take the temperature of the water in each container and record.
5. Continue taking the temperature at 5 minute intervals for at least 20 minutes.



The flask is well insulated—it is designed to prevent the transfer of heat. The tea cosy provided an extra layer of insulation similar to a lagging jacket on a hot-water cylinder. Walls, roofs and windows in our homes should also be insulated to keep the heat from escaping. If we did not have insulation we would waste a lot of energy. In hot climates houses are insulated from the heat of the sun.

Peanut power

Concept—Food energy

Caution: Supervision required

Curriculum Link:
Science Curriculum—Living Things strand

Experiment—Caution: ONLY to be carried out by an adult or teacher!

You will need:

- Peanuts
- Constant flame (Bunsen burner/flame torch)
- Skewer
- Test tube of water

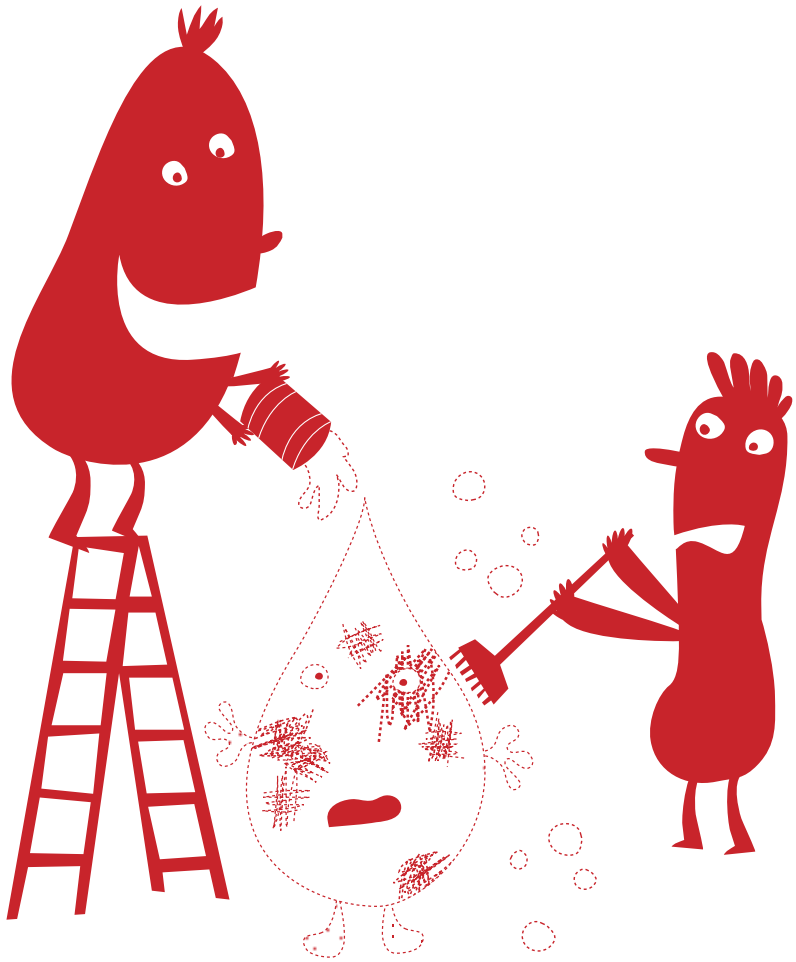
1. Push the peanut onto the skewer.
2. Place the test tube with a little water in a clamp/stand.
3. Place the peanut into the Bunsen flame until it lights.
4. Hold the burning peanut under the test tube of water.

Peanuts are a high-energy food. By burning the peanut you are releasing its chemical energy and changing it to heat, light and moving energy. The heat energy released causes the water in the test tube to boil.

Make water pure

Concept—Wasting water is a waste of energy

Caution: Supervision required

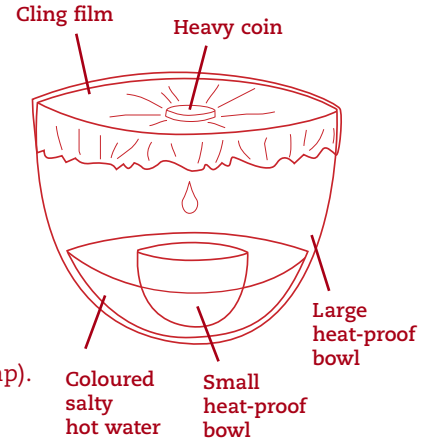


Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand

Experiment—Caution: boiling water, assistance required!

You will need:

1. Large heat-proof bowl
2. Salt
3. Food colouring
4. Cling film
5. Small heat-proof bowl
6. Heavy coin



1. Carefully pour about 2cm of boiling water into the large bowl.
2. Stir in 3 tablespoons of salt and some food colouring.
3. Stand the smaller bowl into the bowl of boiling water.
4. Cover the large bowl with the cling film.
5. Place the coin in the middle of the cling film (if the cling film can't hold it you may need to use stronger plastic wrap).
6. After a couple of hours some water will have collected in the smaller bowl.

The water collected in the smaller bowl should be clear and not salty. You have distilled pure water from the salty coloured water in the bigger bowl. The water vapour from the boiling salty water rises up to the plastic cover, it cools, condenses and forms water droplets, which run into the smaller bowl. This process is called distillation.

Many countries don't have a ready supply of clean water—it can take a lot of energy to make clean drinking water. In this experiment we needed energy to heat the water in the large bowl. Rain is also made in a type of distillation process: the energy of the sun causes water to evaporate. The warm water vapour rises and meets colder air and condenses to form clouds. When the water droplets in the clouds get too heavy they fall as rain. (See the water cycle experiment on p. 38).

Acid rain indicator

Concept—Acid rain

Caution: Supervision required

Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand
For more information on acid rain, go to www.seai.ie/schools - Energy Resources in Ireland (chapter 4)

Experiment—Caution: involves using a cooker and boiling water!

Start by making your acid indicator. You will need:

- Half a red cabbage chopped into small pieces
- Saucepan
- Sieve
- Large jar

1. Place the cabbage in the saucepan with enough water to cover it.
2. Boil the cabbage for 10 minutes, cool and strain. This liquid is your acid rain indicator.
3. Store in a plastic bottle. (Keep it in the fridge or it will go off!)

Now test for acid, you will need:

- Half a teaspoon of baking soda
- Three jars
- Vinegar
- Rainwater

1. Pour equal amounts of the cabbage indicator into each of the three jars.
2. Add the baking soda to one jar.
3. Add some vinegar to another jar.
4. The baking soda is an alkali (opposite to an acid) and should turn the red cabbage juice blue. Vinegar is an acid and should turn the red cabbage juice pink.
5. Now add some of the rainwater to the third jar.
6. How acidic is the rainwater you collected? Compare the colour of the rainwater to the other two jars.

Acid rain occurs when large amounts of gases such as sulphur dioxide and nitrogen dioxide are released into the air. Power stations and car exhausts produce these gases. These gases dissolve in water vapour in the air and fall to the ground as acid rain. Acid rain destroys forests, pollutes lakes and corrodes buildings and statues.

Bubbling yeast

Concept—Food energy

Curriculum Link:
Science Curriculum—Living Things strand

Experiment

You will need:

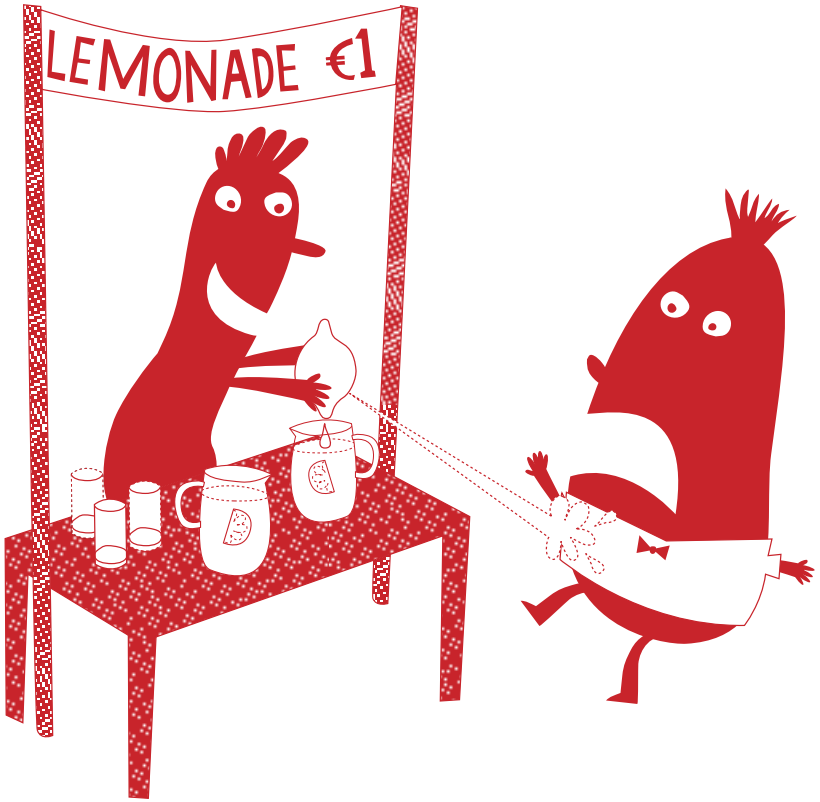
- Dried yeast
- Sugar
- Jug
- Glass bottle
- Balloon
- Bowl

1. Mix 2 teaspoons of yeast with 2 tablespoons of warm water in the jug.
2. Stir in a teaspoon of sugar.
3. Pour this yeast mixture into a glass bottle and stretch the balloon over the neck of the bottle.
4. Stand the bottle in a bowl of warm water.
5. Watch the balloon inflate!

Yeast is a microbe that needs food and heat to live. The yeast feeds on the chemical energy stored in the sugar and produces carbon dioxide, which inflates the balloon.

Acid attack

Concept—Acid rain



Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand
For more information on acid rain, go to www.seai.ie/schools - Energy Resources in Ireland (chapter 4)

Experiment

You will need:
- Two jam jar lids
- Cotton wool
- Bean or wheat seeds
- Lemon juice

1. Place five seeds on a layer of moist cotton wool in each lid.
2. Label one lid 'acid rain'.
3. Water the cotton wool in both lids to stop the seeds from drying out.
4. Each day squeeze a few drops of lemon juice onto the seeds in the 'acid rain' lid.
5. Watch the seeds for a few days.

Lemon juice is a weak acid, representing acid rain. Acid rain occurs when large amounts of gases such as sulphur dioxide and nitrogen dioxide are released into the air. Power stations, factories and car exhausts produce these gases. These gases dissolve in water vapour in the air and fall to the ground as acid rain. Acid rain destroys forests, pollutes lakes and corrodes buildings and statues.

Do more:
To see how acid affects buildings try this simple experiment: find a small piece of cement on a path or at the bottom of a brick wall; put the piece of cement in a glass and pour vinegar over the top; leave the piece of cement soaking in vinegar for a few days and see what happens.

Recycling paper

Concept—Recycling is a way of saving energy

Caution: Supervision required

Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand
Science Curriculum—Materials strand

Experiment—Note: Get help from an adult to use the blender!

You will need:

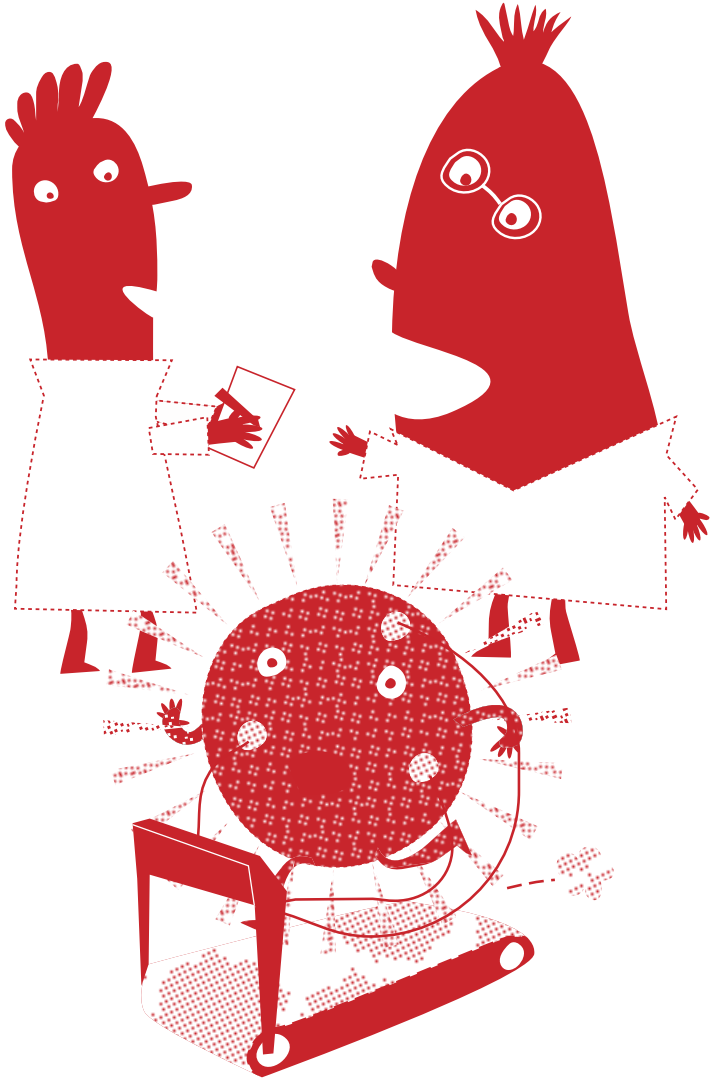
- Old newspaper
- Blender
- Coat hanger
- Nylon tights
- Bowl
- Rolling pin
- Chopping board
- Paper towels

1. Take several sheets of old newspaper and tear into little pieces.
2. Put the pieces of paper in the blender.
3. Add hot water and let the mixture sit for about 10 minutes.
4. Blend the paper mixture well.
5. Bend the coat hanger into a circular loop.
6. Cover the loop with the tights. Pull them taut and tie to form a kind of screen.
7. Lay the screen over the mixing bowl and pour the mixture from the blender onto the screen.
8. Wait until the liquid has drained into the bowl.
9. Spread the paper pulp around the screen and place the screen between two sheets of paper towel.
10. Place this paper towel sandwich on the chopping board and flatten it out with the rolling pin.
11. Remove the paper towels, allow your paper to dry (this can take a while!) and peel off the screen.

Recycling something often uses less energy than making it all over again. By recycling more of our waste we can save energy.

Do more. You could:

- Experiment with making coloured paper by adding food colouring to the blender, or splashing some on the damp paper pulp at the end.
- Experiment using different types of waste paper to get different textures of recycled paper.



Test the effect of light energy

Concept—Light is a form of energy, plants need light to grow

Curriculum Link:
Science Curriculum—Living Things and Energy and Forces strand
Geography Curriculum—Natural Environments strand

Experiment

You will need:

- Cotton wool
- Three jam jar lids
- Bean or wheat seeds
- Two small cardboard boxes

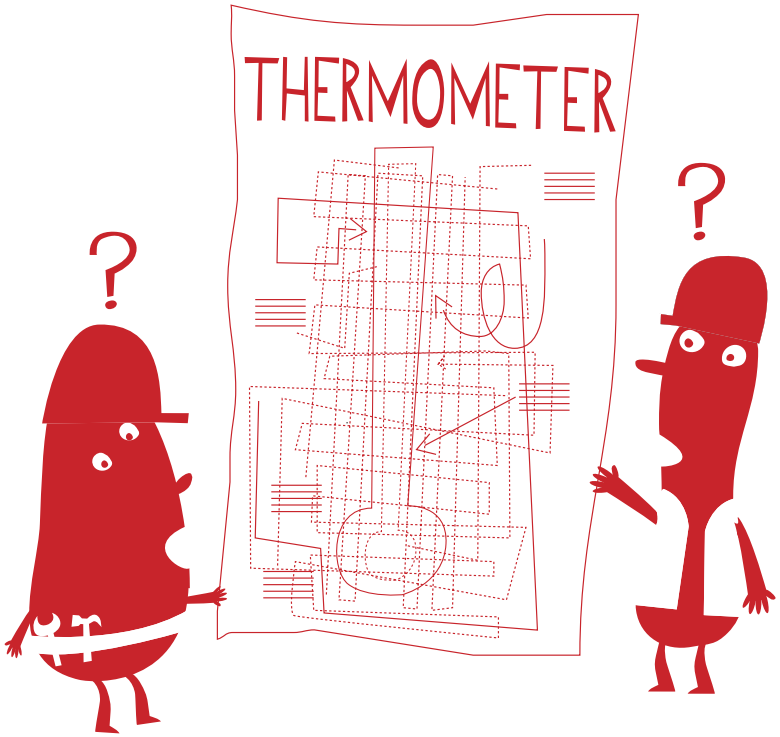
1. Place cotton wool in each of the three lids.
2. Plant several seeds in each lid.
3. Place all lids where there is plenty of light.
4. Add enough water each day so that the cotton wool in each lid stays moist.
5. Once the plants have grown about 5cm tall leave one lid in plenty of light.
6. Put the second lid in a small cardboard box that does not let any light in.
7. Put the third lid in a small cardboard box with a small hole (about the size of a pencil) in one side.
8. Remember to water the plants each day.
9. After a week observe how the plants have grown.

Plants need light energy (from the sun) to make food for growth using a process called photo-synthesis. In the box with the hole in it, the plants grow towards the hole—towards the light. Growth towards light is called phototropism.

All our energy comes from the sun. It shone on trees and other plants millions of years ago. These died and decayed into coal, oil and gas. Today the sun shines on crops and grass, which provide food for humans and animals. The sun also causes weather patterns: the sun warms the air and causes it to rise, forming air currents or wind; the sun dries up water, which turns into clouds and falls to the ground as rain, causing the rivers to flow.

Make your own thermometer

Concept—Measuring temperature

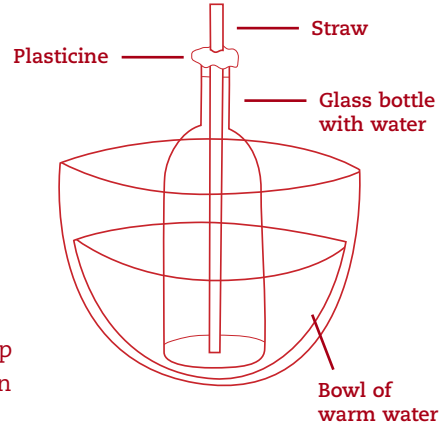


Curriculum Link:
Science Curriculum—Energy and Forces strand

Experiment

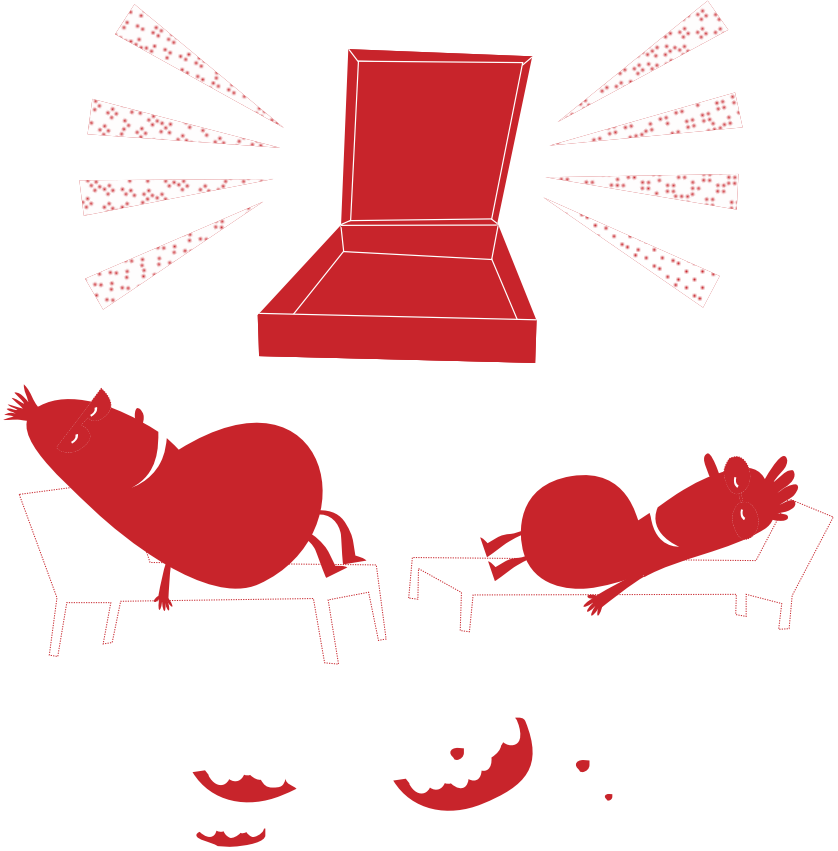
You will need:

- Glass bottle
- Food colouring
- Narrow drinking straw
- Plasticine
- Bowl
- Cardboard
- Pen
- Sticky tape



1. Fill the glass bottle with cold water and add a few drops of food colouring.
2. Top up the bottle with water until it overflows.
3. Mould some plasticine around the straw leaving 10cm of the straw above the level of the plasticine.
4. Push the straw into the bottle of water and seal the top of the bottle with the plasticine making sure no air can escape around the edges.
5. Stand the bottle in a bowl of warm water for five minutes—the level of water in the straw should rise.
6. Take the bottle out of the warm water—the level of water in the straw should fall.

Thermometers measure temperature. Thermostats are a type of thermometer used to control the heating systems in buildings so that the heating shuts off when it gets warm enough. Using thermostats wisely in buildings can save a lot of energy used for heating.



The pizza-box solar oven

Concept—We can use the sun's energy directly to cook

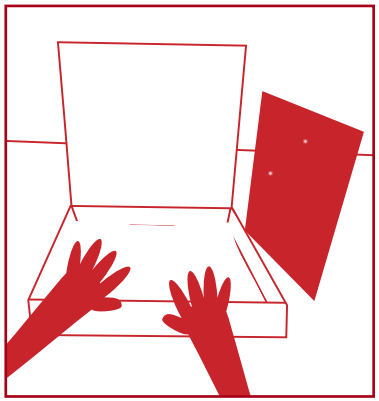
Curriculum Link:
Geography Curriculum—Natural Environments and Human Environments strands

Experiment

You will need:

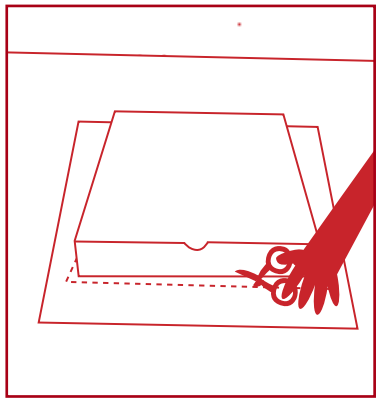
- A medium size pizza box
- Stiff black paper
- Aluminium foil
- Clear plastic (plastic cellophane works well)
- Glue
- Sticky tape
- Scissors
- Ruler
- Marker
- String
- Nail

1



Tape foil to the inside bottom of the box, cover the foil with black paper and tape both in place.

2

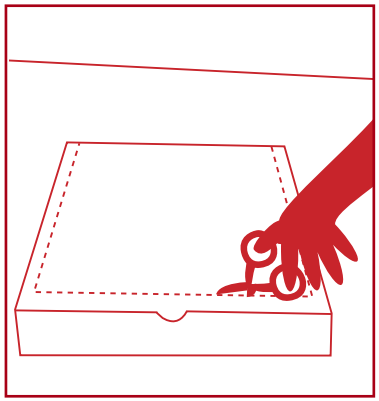


Put the box on the plastic and draw the outline of the box on the plastic with the marker. Cut the plastic about 1.25cm inside the mark.

In developing countries, such as in some places in Africa, lots of homes do not have electricity to work the type of cookers that we use in developed countries, so people use solar energy or burn wood for heat and to cook food.

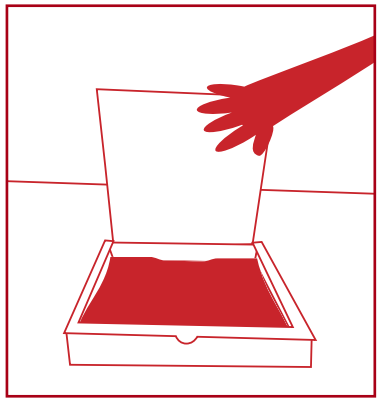
Pizza-box solar oven *continued*

3



On the top of the box draw a line 2.5cm from all sides. Cut along the front and side lines BUT NOT along the back—this will be a hinge for a flap.

4



Carefully fold open the flap and bend back.

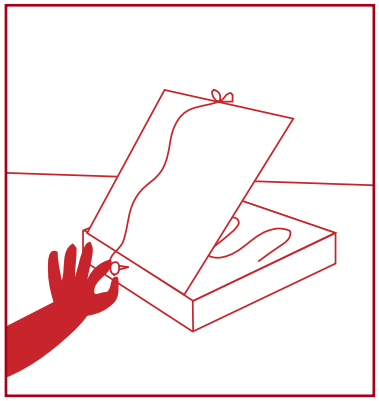
5

Cut a piece of foil the size of the flap. Glue it to the side of the flap that faces INTO the box: this is the reflector.

6

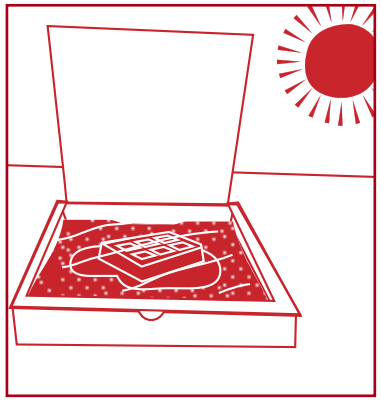
Tape the plastic inside the window you cut on the lid of the box (i.e. on the underside of the lid). Make it tight so it looks like glass and try to make sure it is airtight.

7



Cut a piece of string and tape one end to the top of the flap. Push a small nail into the back of the box and wrap the string around the nail to keep the flap open.

8



Place the box in direct sunlight with the reflector facing the sun and try melting chocolate in your oven (put it on a plate so you don't make a mess).

Model the greenhouse effect

Concept—Greenhouse effect

Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand
For more information on the greenhouse effect go to www.seai.ie/schools - Energy Resources in Ireland (chapter 4)

Experiment

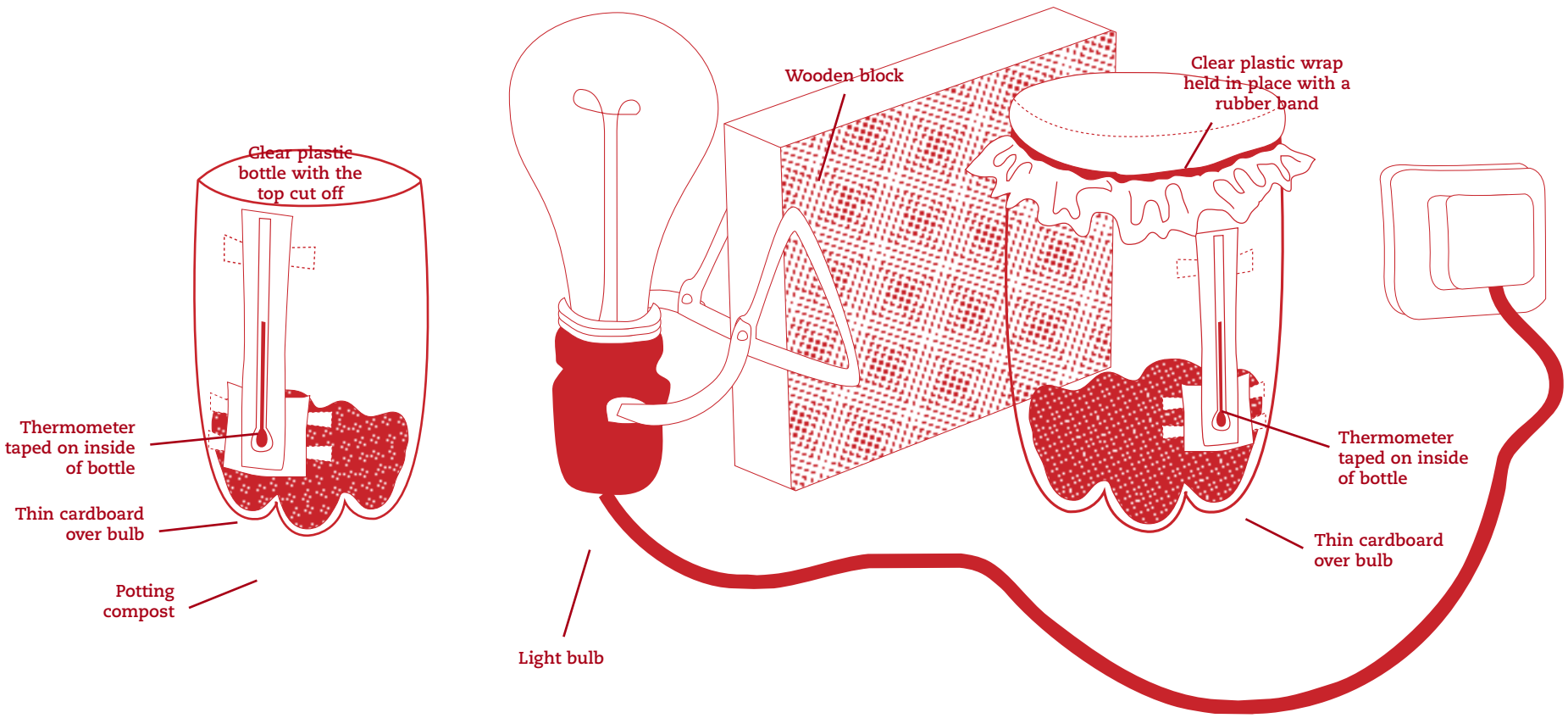
You will need:

- 2 clear plastic 2l bottles
- 2 thermometers
- Thin cardboard
- 3 cups of compost
- Masking tape
- Clear plastic/cling film
- Rubber band
- Clip-on lamp with 100W light bulb
- Book or piece of wood to secure the lamp

1. Cut the top off the plastic bottles.
2. Tape the thermometers to the inside of the bottles.
3. Tape some cardboard over the bulb of the thermometers (to block the direct heat from the 100W bulb).
4. Put about 1½ cups of potting compost into each bottle.
5. Cover one of the bottles with the clear plastic and secure with the rubber band.
6. Put the bottles on a table about 20cm apart.
7. Place the bulb between the bottles using the book or wood for the lamp clip.
8. Take the temperature in each of the two bottles (it should be the same).
9. Turn on the bulb and monitor the temperature over about 10 minutes.

The covered bottle should heat up more than the open one. The same thing is happening in the earth's atmosphere. Greenhouse gases act as a heat trap for the sun's energy, causing our planet to heat up. This is known as the greenhouse effect.

Modelling the greenhouse effect



The water cycle

Concept—Water moves in a cycle

Curriculum Link:
Geography Curriculum—Natural Environments strand
For more information on energy chains (cycles), go to www.seai.ie/schools - Energy Resources in Ireland (chapter 5)

Experiment

You will need:
- Plastic bag with a seal—a freezer bag or sandwich bag
- Lamp

1. Pour about half a cup of water into the plastic bag and seal the top.
2. Place the bag near (but not touching) the bulb of the lamp. If it is sunny outside, you don't need to use a lamp—put the bag out on the window sill.
3. After about an hour have a look at the bag and see if you notice any changes.

Water moves in a cycle. The heat from the sun causes water to evaporate (you will have noticed droplets of water on your plastic bag). As water vapour rises it cools and condenses to form small water droplets, which make up clouds. The water then falls as rain to rejoin water in rivers, lakes and oceans to start the water cycle again.

Do more:
Above is a very simple model of the water cycle. You could design and make a better model to show various parts of the water cycle, such as sun, clouds, rain, rivers, lakes and oceans.

Air pollution

Concept—Emissions from many sources pollute the air

Curriculum Link:
Geography Curriculum and Science Curriculum—Environmental Awareness and Care strand
Geography Curriculum—Natural Environments strand

Experiment

You will need:
- Sticky tape
- Paper clips
- Graph paper (paper with a grid)

1. Cut the sticky tape into small strips (about 6cm long).
2. Unbend a few paper clips so that one end can be attached to the sticky tape, leaving a hook at the other end.
3. Hang these strips in different places (classroom, roadside, playground) to collect any solid particles in the air.
4. After a few days remove the strips and stick them to the graph paper.
5. For each sample, use a magnifying glass to count the number of solid particles on one square in the grid, then in a second and then a third square.
6. Calculate the average number of particles per square.
7. Record your results in the table to the right.

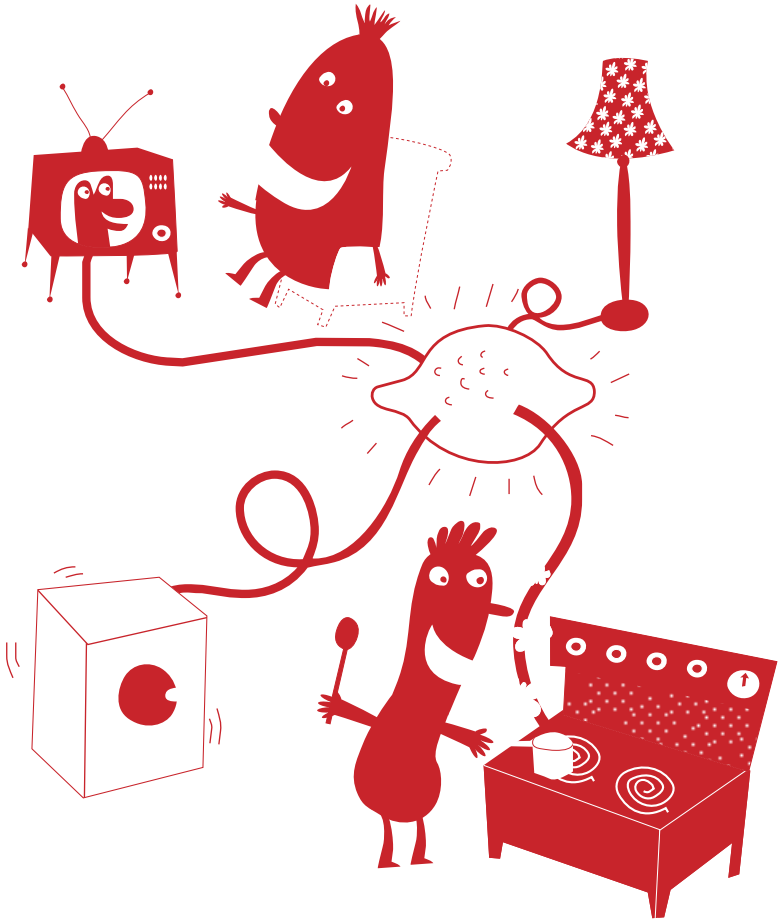
Date	Location	Weather	Average particles per square

Which sample collected the most particles?

Do more:
You could do this experiment over a longer time period. Find out how the weather affects the number of particles. Are there more particles collected in summer or winter. Are there more at times of the day when the traffic is heavy? The particles that collect on the sticky strips come from many different sources, including car exhausts, burning fossil fuels or building work. When we use fossil fuels to run our cars or to make the electricity we use to heat and light our homes, schools and offices, air pollution can result.

Lemon battery

Concept—Food contains stored chemical energy



Curriculum Link:
Science Curriculum—Living Things and Energy and Forces strands

Experiment

You will need:

- Three fresh lemons
- Three copper coins
- Three zinc washers (purchase from a DIY store)
- Six paper clips
- Four pieces of wire with stripped ends (available from electronics shops)
- Low-current LED (light emitting diode—available

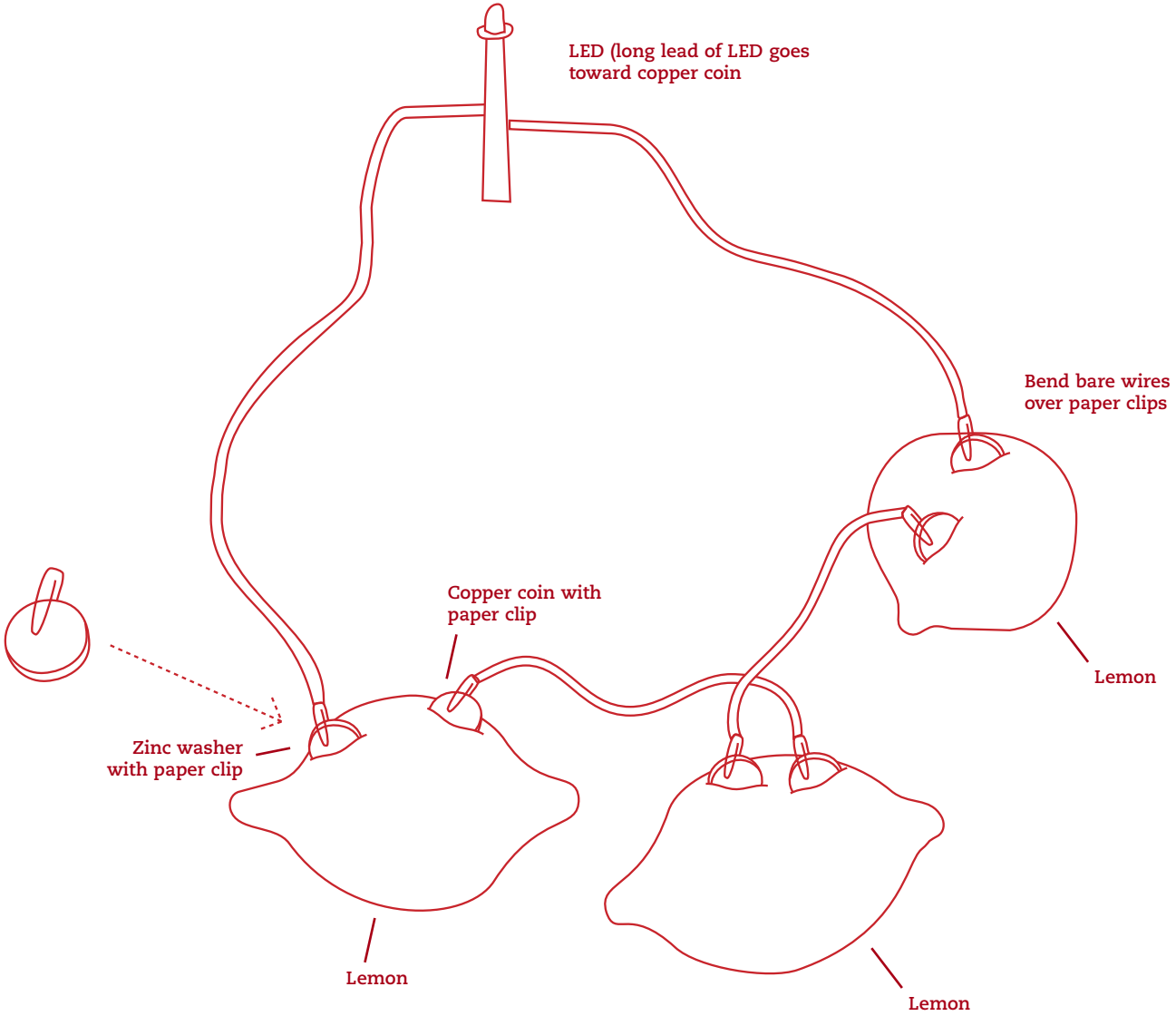
1. Make two slits in the skin of each lemon.
2. Push a copper coin and a zinc washer into the slits of each of the lemons.
3. Attach the wires as shown in the diagram to make a circuit—coin to washer, coin to washer and so on.
4. The long lead of the LED must be connected to the copper coin.
5. Use the paper clips to keep the wires touching the copper coins and washers.
6. When the circuit is complete the LED will shine.

A chemical reaction takes place between the metals (copper and zinc) and the acid of the lemon, causing a current to flow. The lemons are acting as a battery that is a store of chemical energy. In the circuit the chemical energy is converted into electrical energy.

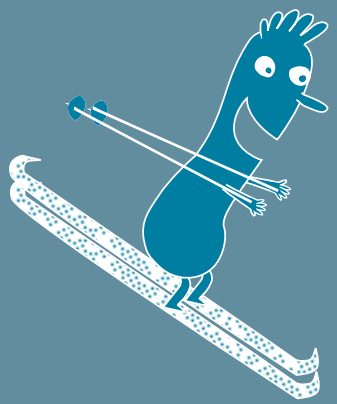
Note: It can be difficult to get the LED to light. In this case you could also connect the circuit to a voltmeter to get a reading of the voltage of electricity being produced.

You can replace the lemons with other fruits and even vegetables (potatoes work well), and see which ones store the most energy (give the highest reading on the voltmeter).

Lemon battery diagram



SUSTAINABLE ENERGY AUTHORITY OF IRELAND



Section 3
Worksheets

Sort out your rubbish

Curriculum Link:
Science Curriculum and Geography Curriculum—Environmental Awareness and Care strand
For more information on saving energy at school, go to www.seai.ie/schools - Energy in Our Lives (chapter 8)

Check the rubbish being thrown out either in school or at home. Fill out the table below by putting the type of rubbish (e.g. paper, food scraps) in the first column and ticking which of the five classifications the rubbish fits.

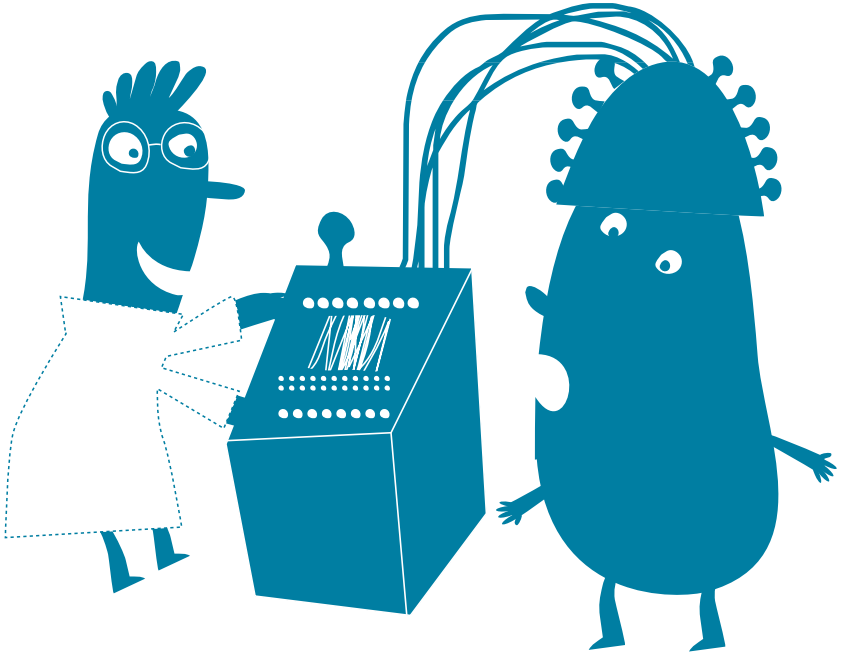
Type of rubbish	Recyclable	Non-recyclable	Re-useable	Packaging (could be reduced)	Bio-degradable

Over one day in school, divide the rubbish, keeping out of the bin anything that could be recycled, is biodegradable (can be composted) or could be reused. Did this exercise reduce the amount of rubbish going into the bin?

Find out where paper, glass, cans and cardboard can be brought in your area for recycling.

Test your energy IQ

How much do you know about energy? Try out the quiz below to find out!



Quiz

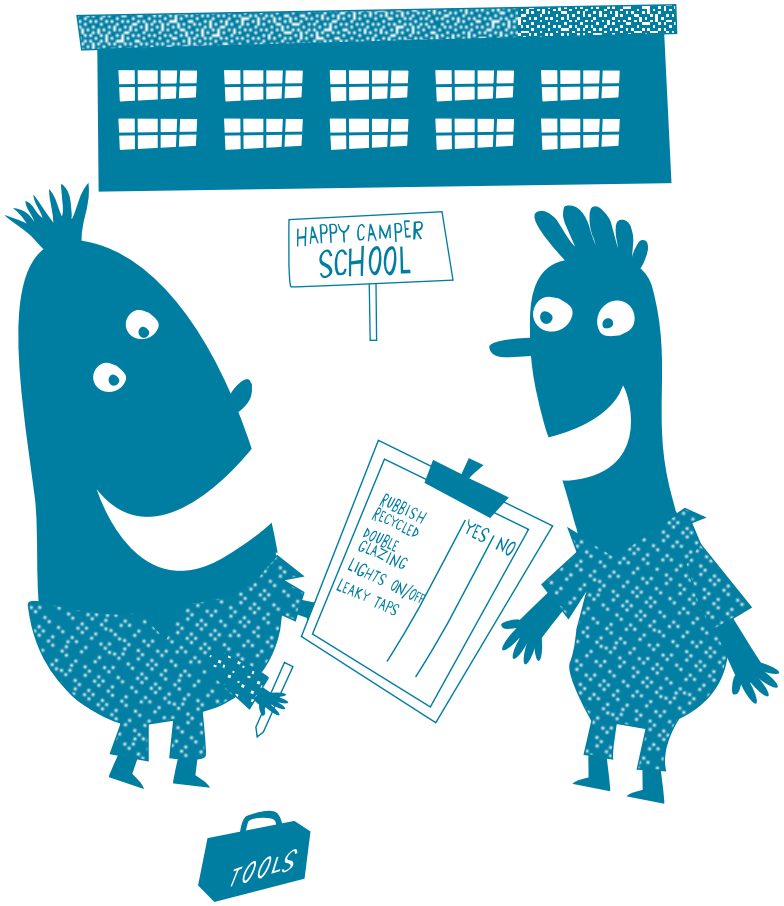
1. What is our planet's greatest energy resource?
2. Where do plants get the energy to grow?
3. Does it take more energy to recycle a can or make a new one?
4. Is there more energy in a chocolate bar or an apple?
5. Can you think of a renewable type of energy you could use to dry clothes?
6. Is food a renewable or non-renewable type of energy?
7. Is it better to throw something out or reuse it?
8. Name two types of fossil fuel.
9. Name one type of renewable energy.
10. Which type of boat uses renewable energy: a sailing boat or a motor boat?
11. Can just one person make a difference to our energy resources?
12. Two people in the same class arrive in school: one travelled by car; the other took the bus. Which one is more energy efficient?

Check your answers on the answer sheet.

- 1–4 correct.....there is a lot more to know about energy!
- 5–8 Correct..... you are learning about energy !
- 9–12 Correct.....you know lots about energy!

ANSWERS: 1. The sun. 2. Plants get the energy to grow from the sun. 3. It takes more energy to make a new can. 4. There is more energy in a chocolate bar. 5. You could use sun or wind to dry clothes. 6. Food is a renewable type of energy. 7. It is better to reuse something rather than throw it out. 8. Coal, oil, gas, peat. 9. Sun, wind, water, food, trees, crops. 10. A sailing boat uses renewable energy. 11. Yes—one person can make a difference to our energy resources. 12. The person who took the bus to school is more energy efficient.

Energy in School



For more information on saving energy at school, go to www.seai.ie/schools - Energy in Our Lives (chapter 8)

Go through the points below to see how energy is used in your school.

1. How many people in the class used renewable energy to travel to school (walked or cycled)?
2. How many people in the class used non-renewable energy to travel to school?
3. Count the number of cars in the school car park and if possible see how many people arrive in each car.
4. Check lights around the school to see if any are left on in empty rooms.
5. Check taps around the school to see if any are left running or leaking.
6. Are the windows in the school double-glazed?
7. Are any of the doors or windows left open while the heating is on?
8. Is any of the school rubbish recycled?

Having gone through the eight exercises above, can you think of ways energy could be used more efficiently in your school?

Make a sign for the light switch in your classroom to ensure the lights are off when the room is empty.

Energy in your home

For more information on saving energy at home, go to www.seai.ie/schools - Energy in Our Lives (chapter 7)

Go through the exercises below to see how energy is used in your home.

1. Is the attic insulated?
2. Count the number of CFL bulbs in your home.
3. Count the number of ordinary bulbs in your home.
4. Is the hot-water cylinder insulated?
5. Do you have thermostats in any of your rooms?
6. If you have any of the electrical appliances below at home, check to see if they had an energy label when they were bought and if so what letter (from A–G) was on it. A-rated appliances are the most energy efficient.

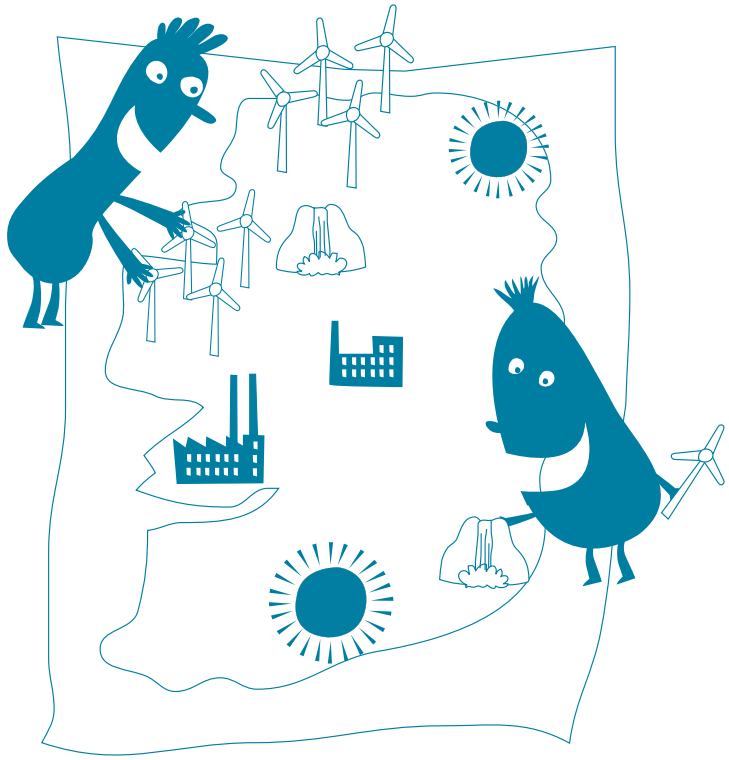
   • **Fridge** • **Washing machine** • **Drier** • **Freezer** • **Dishwasher**

7. Do a quick check around the house to see if any electrical appliances or lights are left on while not being used—make a list of any you find.
8. Check to see if the TV and VCR are turned off completely or just left on standby.
9. Check all the taps around the house—are they turned off properly or are any leaking?

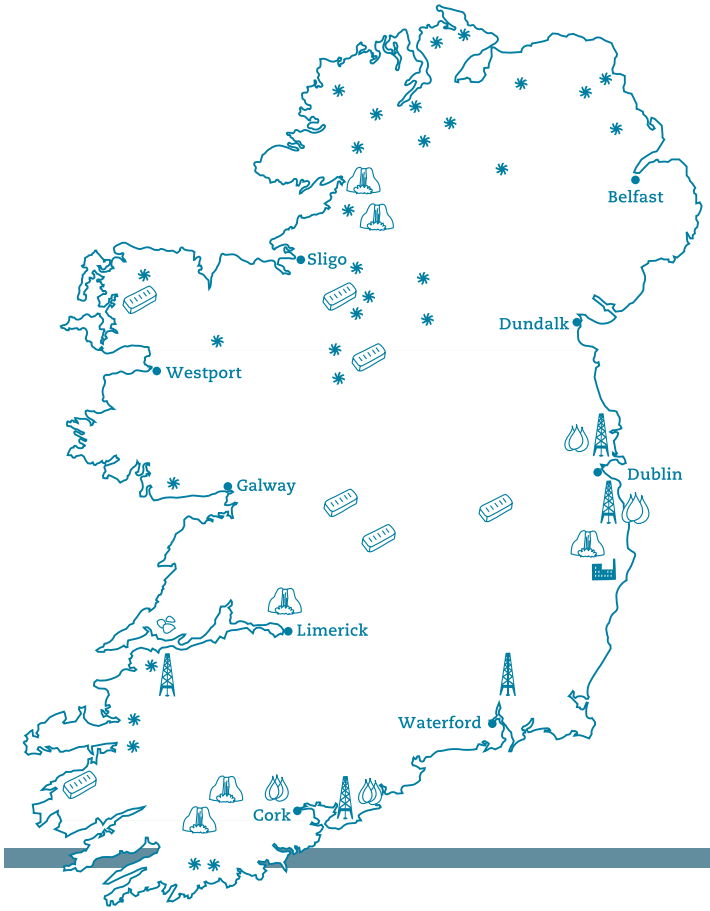
Look at what you found from the list above. Can you think of any ways that energy could be used more wisely or saved in your home?

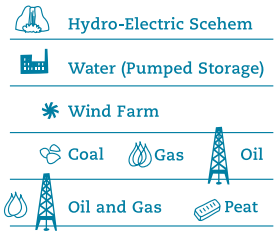
We use lots of energy in our homes. Homes in Ireland use as much or more energy than all the offices and factories put together. How we use energy in our homes can really make a difference to our energy resources. This worksheet could lead to a class discussion

Energy in Ireland



The map below shows power stations around Ireland and the type of fuel they use to make electricity. Make a list of the types of energy resources used to generate electricity near your school. Even though there are a lot of wind farms, only 6.7 % of our electricity currently comes from wind. Look at the percentage of electricity generated from each fuel and discuss how this might effect our environment.





Percentage of electricity generated from different fuels in Ireland in the year 2007

Non-renewable resources (fossil fuels)

Coal	**18.8%**
Peat	**7.4%**
Oil	**6.8%**
Gas	**52.9%**

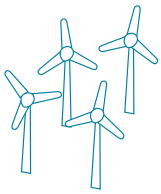
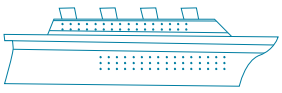
Renewable Resources

Hydro	**2.28%**
Wind	**6.7%**
Biomass	**0.46%**
Energy imported	**4.6%**

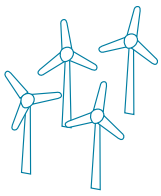
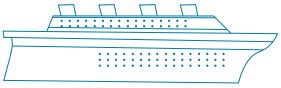
Energy sources

For more information on energy sources, go to www.seai.ie/schools - Energy Resources in Ireland (chapters 1 and 3)

For each of the pictures below, fill out the type of energy used (e.g. coal, wind etc.) and also whether this is renewable or non-renewable energy. Remember electricity is a form of energy, but not an energy resource. In Ireland we generate most of our electricity by burning fossil fuels in power stations.

	Source of energy	Renewable/non-renewable
		
		
		
		
		
		
		

Energy sources answers

	Source of energy	Renewable/non-renewable
	Electricity	Can be renewable or non-renewable depending on how the electricity is generated
	Wind	Renewable
	Petrol/diesel	Non-renewable
	Solar energy (sun gives plants the energy to grow)	Renewable
	Food	Renewable
	Wind	Renewable
	Fossil fuel	Non-renewable

Energy chains

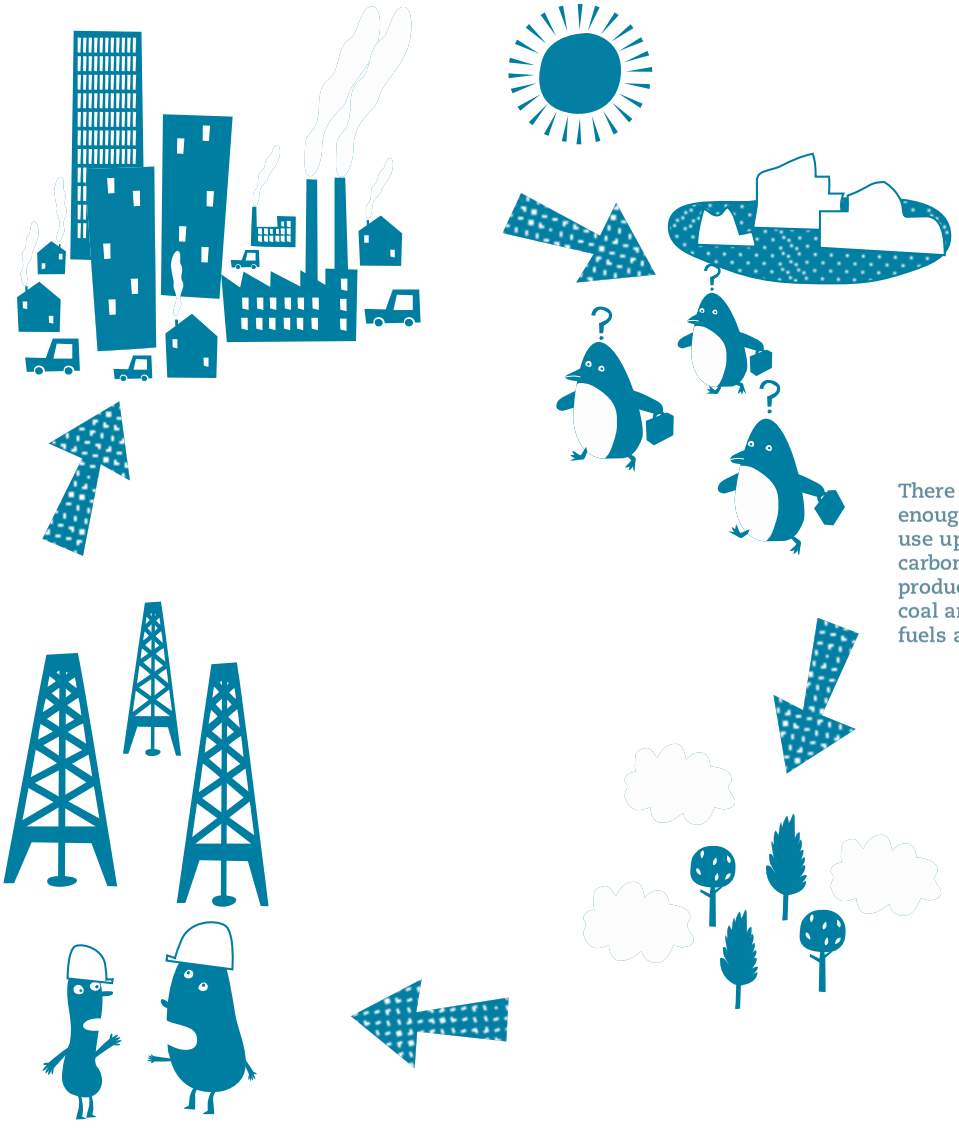
For more information on energy chains, go to www.seai.ie/schools - Energy Resources in Ireland (chapter 5)

The ways energy resources are made and used often forms a cycle or a chain. These cycles may be repeated and repeated or may be broken.

Here are three energy chains. One of the three is a chain that is broken. Can you tell which one? Mark on the chain where you think the break in the energy cycle is.

The Fossil Fuel Energy Chain

When we burn fossil fuels, such as coal, oil and gas, there is a build-up of carbon dioxide and other greenhouse gases in the atmosphere. This leads to global warming and climate change.



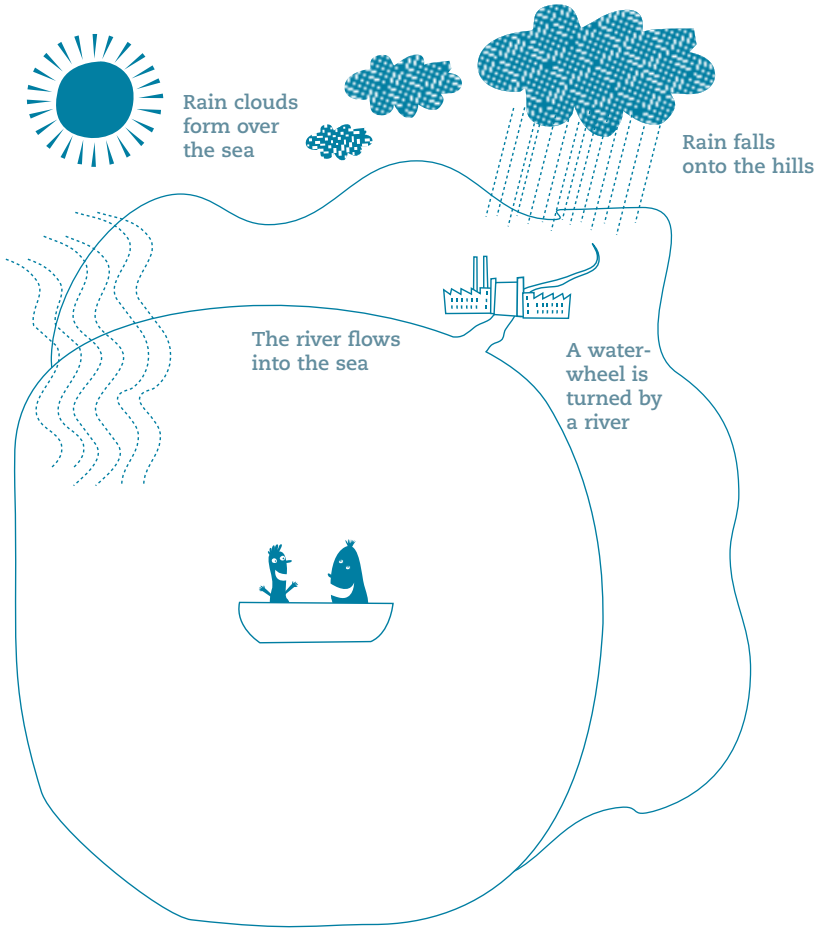
There aren't enough trees to use up all the carbon dioxide produced when coal and other fuels are burned

Millions of years ago trees died and were slowly turned into oil—this oil is extracted today

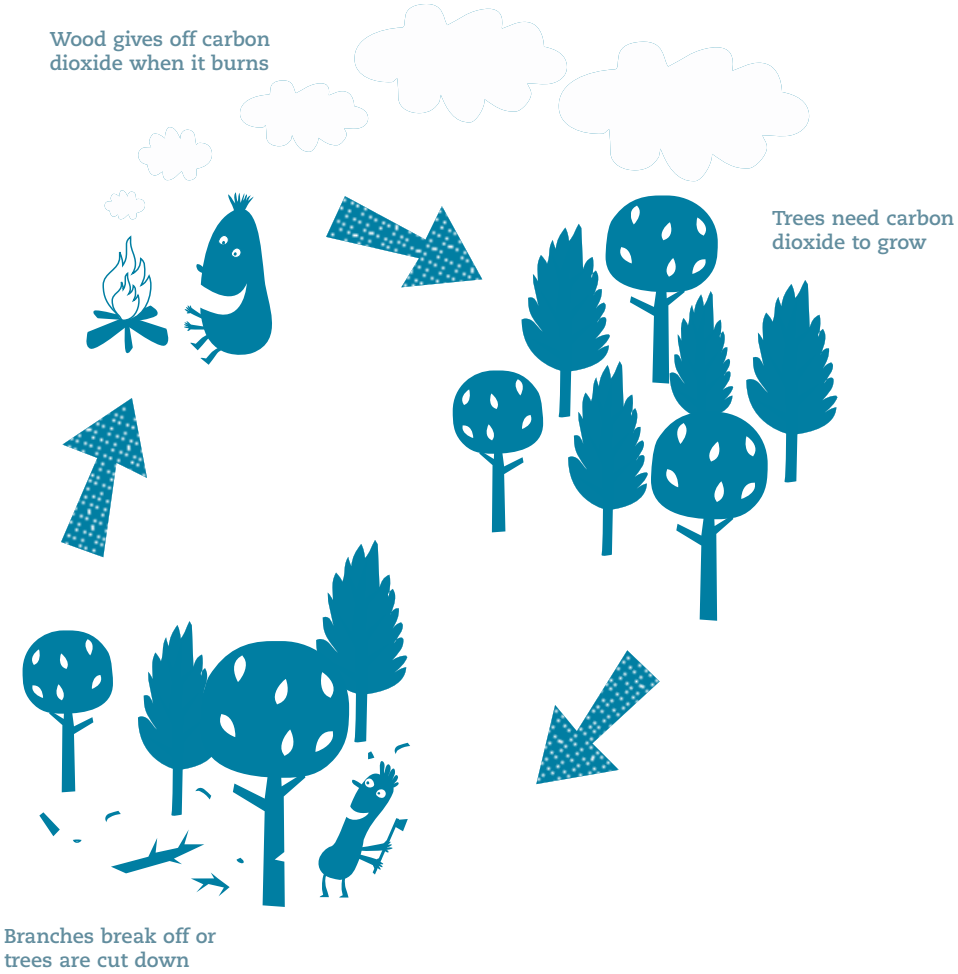
Trees cannot be turned into oil in our lifetime—it takes millions of years

Energy Chains

The Water Chain



The Wood Chain



Energy Chain worksheet solution:
The Fossil Fuel Energy Chain is not continuous between the steps 'trees cannot be made into oil in our lifetime, it takes millions of years' and 'millions of years ago, trees died and were slowly turned into oil'

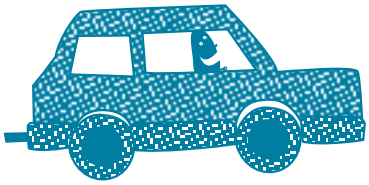
Transport and energy

For more information on transport and energy, go to www.seai.ie/schools - Energy in Our Lives (chapter 4)

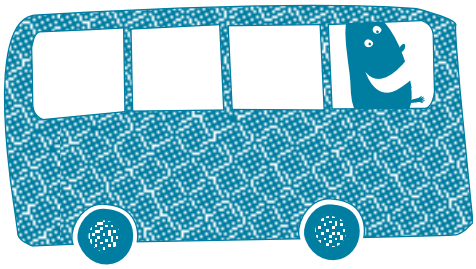
Transport uses lots of energy, particularly fossil fuels which are a non-renewable type of energy. What can we do to save on the amount of energy we use to travel? Fill in the blanks below to see which method of transport is more energy efficient.

A car with 1 litre of fuel can carry 5 passengers 14 kilometres. That is 70 passenger kilometres per litre.

5 Passengers x 14 kilometres = 70 passenger kilometres.



A bus with 1 litre of fuel can carry 72 passengers 2.5 kilometres. That is_____ passenger kilometres per litre.



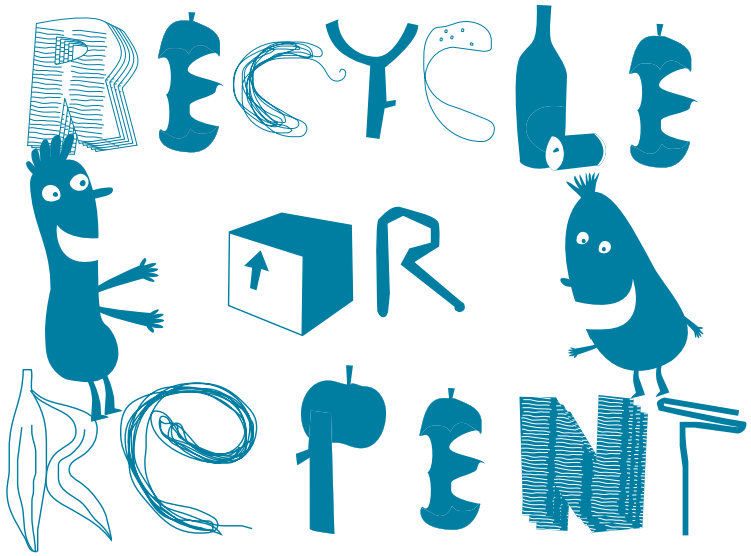
A train with 1 litre of fuel can carry 700 passengers 0.5 kilometre. That is _____ passenger kilometres per litre.

- Which of the three is the most energy-efficient way to travel?
- Do a survey of the class to see how each person travelled to school. Fill out the results in the table below.

Transport	Number
Car	_____
Bike	_____
Walking	_____
Bus	_____
Train	_____
Other	_____

- How many of the class used renewable energy to travel to school?

The fun worksheet



Curriculum Link:
Designing and Making aspect of Science Curriculum.
Go to www.seai.ie/schools - Energy in Our Lives and Energy Resources in Ireland for ideas about some of the challenges in this worksheet.

Energy Challenges

1 – Making Something new from something old

- Collect as many interesting reusable bits of rubbish as you can and use them to design something new (corks, coloured bottles or jars, wool, string, fabric, plastic bags, magazines, old beads, food packaging).
- Here are some ideas: a container, something fashionable, jewellery or a mural for the classroom.
- You could have a competition in the class or between classes to come up with the most interesting designs from reused materials.

2 – Recycling poster

- Design a poster to encourage recycling. The poster can be three-dimensional and must only use recycled/reused materials.

3 – Renewable energy in Ireland project

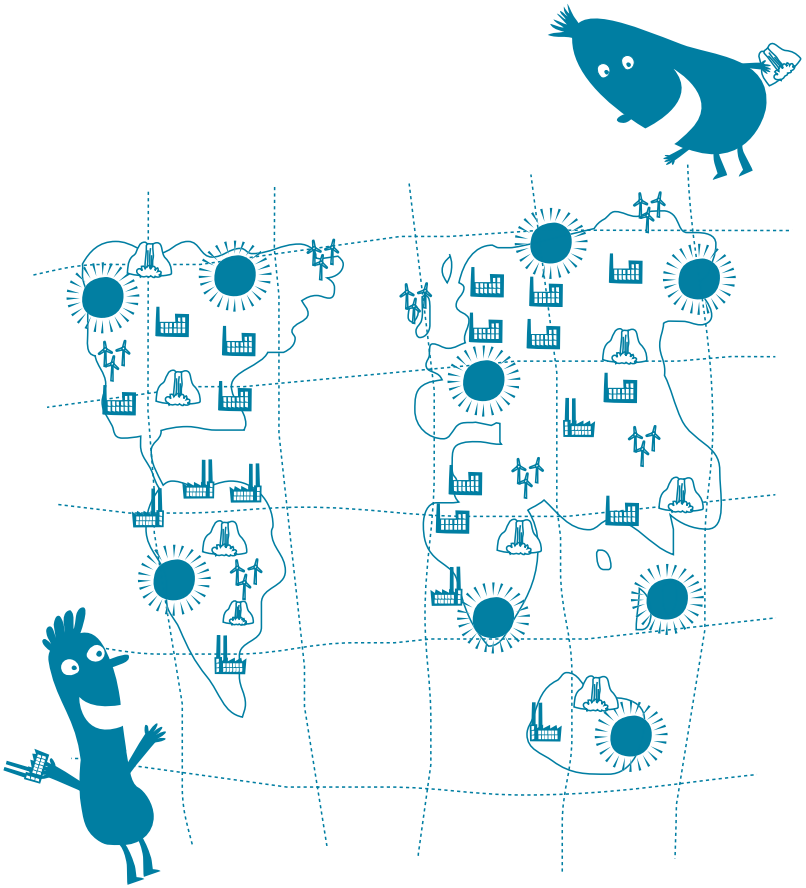
- Locate as many places as you can where renewable energy is used in Ireland. Include sites where electricity is generated from renewable resources.
- Design and make a renewable energy map of Ireland.

4 – Make yours an energy-efficient school

- Make signs for the school promoting good energy use. You could start by making signs for the sinks reminding people to turn off the taps or signs for the light switches reminding people to turn them off when they are leaving the room.

This work could lead the class/school to plan and run a bigger campaign to promote recycling and energy conservation.

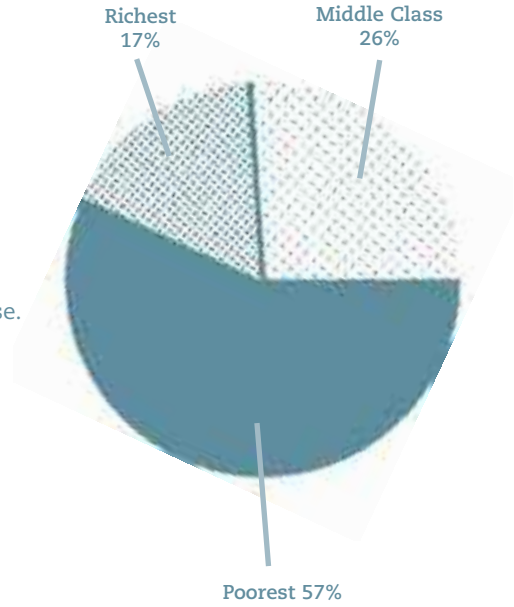
Energy worldwide



Curriculum Link:
Geography Curriculum—Human Environments strand
For more information on energy worldwide, go to www.seai.ie/schools - Energy in our lives (chapter 5)

- This is an exercise that involves the whole class.
- You will need a large bag of coloured sweets (smarties/M&Ms)

1. Divide the sweets so that you have 50 of one colour, 30 of a second colour and 20 of a third colour.
2. Make a larger version of the chart to the right. Make a spinner for the chart (you could stick an arrow onto a coin and spin it).
3. Spin for each member of the class to decide to which type of country they are going to belong for this exercise.
4. Divide the class up into those born in the richest, poorest and middle countries. (You should end up with most of the class in the poorer countries, least in the richest countries. This is how the world's population is divided out. The larger the class the closer you will get to the proportions on the chart).
5. Now divide out the energy the world uses among the different countries. The smallest group (the richest countries) gets the largest number of sweets (50). The middle class group get 30 sweets. The poorest group with the most people get only 20 sweets.
6. Ask the class does this seem fair? This is how our energy use is divided in the world. The poorest countries with the highest population use the least energy.



Note: You could make a much larger chart and use a bigger spinner to make the game more visual

Note: This exercise could lead to a class discussion.

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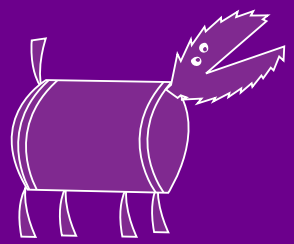

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