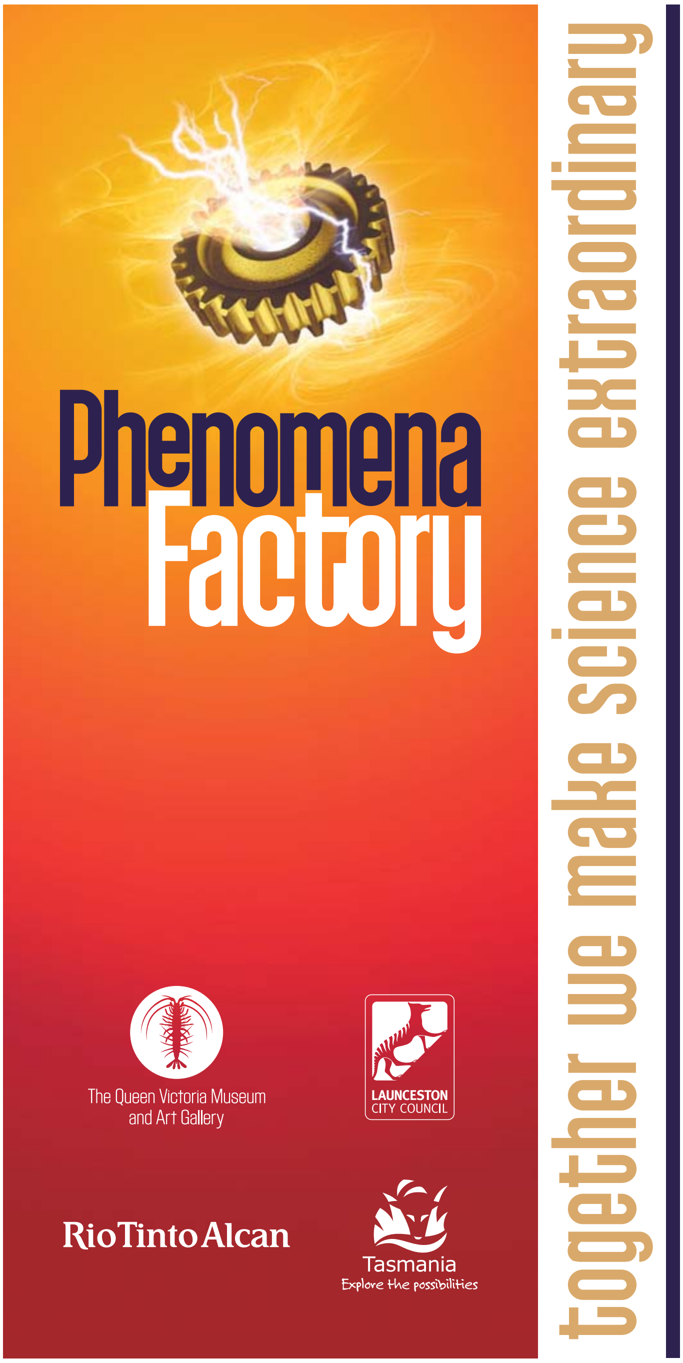

EDUCATION KIT

Part 2
Post-visit Activities

Queen Victoria Museum and Art Gallery at Inveresk
Opening hours 10 am – 5 pm
www.qvmag.tas.gov.au

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POST-VISIT ACTIVITIES

These activities are suggested ways of extending the experiences students receive through visiting *Phenomena Factory* at the Queen Victoria Museum and Art Gallery. As with all science experiments, there is no guarantee that they will work. Read through the experiments first and ensure you have all ingredients and equipment necessary. Some activities have been written for you to do with your students, others are able to be printed and directly given to students. Many of the activities are able to be used by all grades, others are appropriate for older groups.

Be prepared to talk to the students about the things that can go wrong in science, like variables. A variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled. Some examples may be: unclean equipment, out of date ingredients, the reaction between substances.

For fun scientific toys check out the Museum Shop at Inveresk.

Alternatively email shop@qvmag.tas.gov.au or call (03) 6323 3742.

ELECTRICITY AND MAGNETISM

Experiment Recipes

Make your own Magnetic Sculpture

What you'll need:

non metallic or stainless steel bowl
ball bearings, washers, nuts, paperclips or anything of that nature (depending on the age of the children)
large magnet

What to do:

Using a non-metallic or stainless steel bowl, add in ball bearings and place a large magnet underneath.

Snake Charmer

Rubbing certain things together gives one or the other a 'charge'. This is the form of electricity called 'static electricity'.

What you'll need:

tissue paper
plastic ruler
scrap of nylon fabric
snake template
scissors

What to do:

1. Copy the snake pattern on page 47 onto tissue paper and cut it out, cutting along the dotted line, then pull one end to make a spiralling snake. Make several if you wish.
2. Rub the plastic ruler several times with a scrap of nylon.
3. Wave the ruler close to the snakes. Can you lift them up without touching them?

Reference:
Angliss, S 2001, Hands-on Science: Electricity and Magnetism, Kingfisher, London

Hundreds-and-Thousands

Background information:

You may be familiar with getting a small electric shock while getting out of a car, or 'zapping' yourself, or someone else, after walking on carpet. These incidents involve static electricity. When you rub certain materials together you can separate charges. If the static electricity is strong enough, you can see and/or hear a spark moving from one object to another as it discharges. Discharging occurs when the charged object loses its electricity to an object that is in contact with the earth.

There are two types of charges: positive and negative.

- When two materials have the same charge (positive and positive or negative and negative) they repel each other.
- When two objects have different charges (positive and negative and vice versa) they attract each other.
- Charged objects attract neutral objects (objects that have no charge).

In this activity when wool is rubbed on a plastic lid some electrons are transferred from the wool to the lid. Electrons have a negative charge so the lid becomes negatively charged. The hundreds-and-thousands have a neutral charge and so are attracted to the negatively charged lid. After some time the lid starts to lose its charge so the hundreds-and-thousands drop back down. By rubbing your finger across the top of the lid the negative charge on the lid is discharged through your finger to the earth. The hundreds-and-thousands therefore drop back down into the container.

What you'll need:

hundreds-and-thousands, shallow (1 or 2 cm) container with a clear plastic lid, (e.g. a small take away food container) woollen clothing or cloth

What to do:

1. Put a small amount of hundreds-and-thousands into the container.
2. Put the lid on the container and charge the lid by rubbing it with a woollen cloth. Observe what happens.
3. Gently move a finger across the lid and observe what happens.

Questions for students:

1. Why do the hundreds-and-thousands stick to the lid?
2. Why do they sometimes fall back down?
3. What happens when you move your finger across the container?

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Magic Balloons

Background information:

Invisible forces that you can see! Rubbing a balloon against wool will charge the balloon with static electricity. Static electricity is made up of electrical charges which can move small things without even touching them. See what happens to sugar and paper when a charged balloon is held near. What happens when you hold the balloon against a wall or someone's back?

What you'll need:

balloons
sugar
small pieces of paper
woollen blanket or jumper

What to do:

1. Blow up and tie the end of a balloon.
2. To charge the balloon rub it on the woollen material.
3. Hold the balloon against a wall, what happens?
4. What happens when you hold it against someone's back?
5. Hold the balloon just above the torn pieces of paper, what happens?
6. Try holding a balloon just above some sugar, what happens?

Reference:
Challoner, J & Wilkes, A 1999, DK Kids First Science Book – A life size guide to simple experiments, DK Limited, London

Make your Own Magnets

Background information:

When you stroke a steel paperclip with a magnet, you turn the paperclip into a magnet too.

What you'll need:

steel paperclips
magnet
modelling clay

What to do:

1. Unroll a steel paperclip and lay it on a firm surface. Fix it in place with some modelling clay.
2. Hold the bar magnet in one hand and move it through the air in a circular motion from one end of the paperclip to the other. Repeat this several times. Take care to keep your magnet facing the same way and don't change the direction of the loop.
3. Move your magnet out of the way. Pick up the now magnetised steel paperclip and test it to see if it works. Can you pick up other paperclips with it? How many?

Reference:
Angliss, S 2001, Hands-on Science: Electricity and Magnetism, Kingfisher, London

Magnetic Fishing

What you'll need:

1 magnet per person
lots of paperclips
sticky tape
small sticks (skewers with the sharp end cut off)
string
aluminium foil
large bowl of water

What to do:

1. Fold the foil in half, then half again. Cut fish shapes out of the folded foil.
2. Slide a paperclip onto the front of each fish. Drop all of the fish into the bowl of water.
3. Cut pieces of string about 20 cm long. Tie a magnet to one end of each piece of string. Tie the other end of the string to a stick and tape it down.

How to play:

Catch the fish by picking them up using the magnets. If two players catch the same fish they must put it back into the bowl.

The player who catches the most fish is the winner. Try a longer piece of string so you have to stand up and catch the fish from the bowl on the floor. Does this make a difference?

Reference:

Challoner, J & Wilkes, A 1999, DK Kids First Science Book – A life size guide to simple experiments, DK Limited, London

Magnetic Fields

What you'll need:

dessertspoon
scissors
pencil
clear plastic tubs
golden syrup
plastic wrap
iron filings
string
selection of magnets

What to do:

To make the mixture sprinkle a dessertspoon full of iron filings into the golden syrup. Stir gently until the iron filings are evenly mixed through the syrup.

Make magnetic patterns

Pour some mixture into each tub. Place magnets underneath, or at the sides, of the tubs and watch as the magnetic fields appear. When a magnet is placed near the mixture the iron filings become magnetised. The filings line up in the field of the magnet and slide very slowly towards the ends of the magnets, where the magnetism is the strongest. When two magnets are near each other their field patterns change shape.

Fields of filings

Each magnet forms a magnetic field pattern. Test magnets of different shapes, sizes and strengths and compare the fields they make. Look at the fields that can be produced when two or more magnets are placed near each other.

3-D fields

Fill a glass with the mixture. Cover a bar magnet in plastic wrap and then tie it to a pencil with string. Hang the magnet in the middle of the glass. Turn the glass around to see the field surrounding the magnet as it hangs in the middle of the mixture.

Reference:
Challoner, J & Wilkes, A 1999, DK Kids First Science Book – A life size guide to simple experiments, DK Limited, London

Poles Apart

Every magnet has a north and a south pole, like the earth. These poles are the two opposite ends or sides of a magnet where its powers are strongest. You can find out more about magnetic poles, how to identify them and why magnets behave oddly when they are together by experimenting with the following activities or making the turtle compass.

What you'll need:

compass
strong bar magnet
modelling clay
large needle
small bowl of water
bottle top
3 skewers
ring magnets

What to do:

North or south pole? – Hang a bar magnet just above a compass. When it stops moving, the end pointing to north is the magnet's north. Mark the bar magnet with chalk.

Pole position – Try pushing the north poles, then the south poles of two magnets together. What happens? Next try a north and a south pole. What happens?

Turtle compass

Stroke a needle 30 times from its point to its eye with a magnet. Make a light, flat turtle from modelling clay.

Press the turtle onto the open end of a bottle top. Push the needle-point firmly into the turtle's tail, directly opposite its head.

The needle has become a magnet and is affected by the earth's magnetic field. The turtle's head points to the north and the eye of the needle in its tail points south (check it with the compass).

Opposites attract—like poles repel

Push three skewers into the top of a square of modelling clay. Place ring magnets on the skewers and place another square piece of modelling clay on top. What do the magnets do, repel or attract?

Reference:
Challoner, J & Wilkes, A 1999, DK Kids First Science Book – A life size guide to simple experiments, DK Limited, London

Making Connections

Experiment with circuits to light a bulb or turn a motor!

A battery uses electricity to make things happen. As long as there is a path from one side of the battery to the other, then whatever is connected in between will be powered.

What you'll need:

wire
bulb holder
paperclips
paper fasteners (split pins)
4.5-volt battery
corrugated cardboard
duct tape

What to do:

1. To make a simple circuit attach two wires to the battery (one to each terminal), with duct tape.
2. Touch one wire to the bottom of the bulb and one to the side. If you have made a complete circuit, the bulb will light.
3. Screw the bulb into the bulb holder and attach the wires under the screws, the bulb still lights up.
4. Add a switch by removing one wire from the battery (the bulb will go out because the circuit is no longer complete).
5. Attach another wire to the disconnected terminal of the battery.
6. Carefully cut out a cardboard rectangle (about 3 cm by 5 cm). This is the base of the switch.
7. Wind the end of the wire that is attached to the bulb holder firmly around a paper fastener and push the end through the cardboard.
8. Do the same with the end of the new wire coming from the battery. This time put a paperclip around the paper fastener as well. The paper clip acts like a light switch.
9. To turn the switch on and off, complete the circuit by touching the unattached paperclip to the paper fastener.
10. Take a turn with Bug Probes (*below*) or see what other great creations you can make using circuits.

Bug Probes

What you'll need:

2 x 1.5-volt batteries
4.5-volt battery
3 pipe cleaners
2 x 2.5-volt bulbs
coloured card and paper
metal objects from around the home
wire
sequins
foil
3.5-volt bulb
bulb holder

What to do:

1. Put a square of foil between the top of one 1.5-volt battery and the bottom of the other. Tape the batteries together.
2. Cut 25 cm, 12 cm and 8 cm lengths of wire and strip the ends. Connect the 25 cm wire to the bottom of the battery.
3. Screw the 3.5-volt bulb into the holder. Connect the 12 cm and 8 cm wires to the holder. Tape the 8 cm wire to the top of the battery.
4. Tape the holder to the batteries. Wrap them in paper with two free wires sticking out at the top. Scrunch small pieces of foil tightly into balls and push the foil balls onto the wires.

More Bug Probes

Making a leggy bug

1. Decorate the body of the bug with tiny circles of coloured paper and card.
2. Tape pipe cleaner legs to the underside of the bug.
3. Attach coloured sequins onto two ovals of card for eyes.

Making a smiley bug

1. Decorate the 4.5-volt battery with coloured paper. Cut two wires and strip their ends. Attach a wire to each of the battery terminals.
2. Wind each wire round a screwdriver to make it curly. Twist the end of each wire firmly around a 2.5-volt bulb.
3. Make large eyes out of coloured card and attach a sequin.

A bug conductor

Touch the bulbs of the smiley bug or the foil balls of the leggy bug to the different metals around the room. The bulbs will light up if the material conducts electricity. Aluminium foil is a good conductor of electricity.

Reference:
Challoner, J & Wilkes, A 1999, DK Kids First Science Book – A life size guide to simple experiments, DK Limited, London

EYE LOGIC, NEUROPHYSIOLOGY AND REFLECTION

- Ask students to sketch a pencil at the top of the page and a pair of scissors at the bottom. Students need to complete three sketches in between to metamorphose the pencil into the scissors. The pencil would slowly take on characteristics of the scissors.
- Search the school library for MC Escher books; look at how Escher created his art. Recreate a piece of Escher's or look on-line for 'optical art' (using similar websites to those mentioned in the Pre-visit Activities section).
- From the State Library search for the CD ROM *Thames and Hudson's Escher interactive: exploring the art of the infinite* - call number L.CDR 769.9492 ESC. Explore and engage in the activities.
- Look on the internet for the woman with two faces; young woman and old.
- Look up Thaumatrope on the internet. This site has some great optical illusions.
- Make your own flick-a-book. Sketch a picture on the edge of the page. Redraw it but slightly different (moved) on the next page and so on. Or you could photocopy an image several times and stick it onto the pages. When you flick the pages the drawing will look like it is moving.

Experiment Recipes

How to See a Flying Saucer

What you'll need:

coloured pencils (the brighter the better)

What to do:

- Hold the pencils horizontally with the ends touching, and then bring them level with your eyes, a couple of centimetres away from your face. It is important to have the pencils exactly level with the pupils of your eyes. Now draw the pencils a little way apart and there in the middle will be sailing beautifully your IFO or Identifiable Flying Object.
- You can have a parti-coloured IFO, if you like, by using two pencils of different colours. If, instead of the two pencils, you hold your hands flat, with the finger tips touching and draw them slightly apart you'll see a multi-storeyed flying saucer.

Make a 3D Viewer

What to do:

1. Create a cross (similar to a Red Cross symbol) on card. It needs to be 5 cm high and make each arm of the cross about 1.3 cm wide.
2. Cut out the cross shape to leave a cross-shaped hole in the card.
3. Hold the card upright at right angles to a picture or photograph.
4. Stare hard down through the cross for a few seconds. You should see the picture stand out in three-dimensions.

What is happening:

The cross shape hides the edges of the picture so you can't see that it is really flat. Your brain is used to seeing the world in three dimensions and makes the picture appear to be three-dimensional.

How Many Pencils?

What you'll need:

glass of water
pencil

What to do:

1. Place a glass of water on a table and stand a pencil about 30 cm behind it.
2. Look through the glass and you will see the images of two pencils.
3. Close your left eye and the pencil on the right will disappear. Close your right eye and the left-hand pencil will disappear.

What is happening:

The water is working as a lens to produce the images but, because the water is held in a cylinder shape, each eye looks through the water at a slightly different angle. Therefore; with both eyes open you see two pencils, with one eye open you see only one.

Hole in Your Hand

What you'll need:

cardboard tube (or roll up a piece of paper to make a long tube)

What to do:

Look through the tube with your right eye and hold your left hand up next to the tube with the palm towards you. You should see what seems to be a hole through the middle of your palm!

What is happening:

Your right eye sees inside the tube and your left eye sees your open hand. The brain is confused because it receives such different signals from each eye. It therefore combines the images and you appear to see a hole in your hand.

Touch the Dot

What you'll need:

paper
pencil

What to do:

Draw a dot on a piece of paper and put the paper about 75 cm in front of you on a table. Sit at the table and put a hand in front of one eye. Use your other hand to try and touch the dot with a pencil.

What is happening:

You will find it quite difficult to touch the dot accurately at the first attempt because you cannot judge distances easily with only one eye. Normally you use both eyes to find the exact position of things.

Colour Separation Sheets

What you'll need:

colour separation sheets (available through Educational Experience)
white paper
coloured crayons
coloured pencils
paper squares
enlarged photocopied designs

What to do:

1. Collect three different square pattern sheets and three image sheets.
2. Experiment with the colours on top of a sheet of white paper.
3. Start with a square and lay it on the white paper, overlap a sheet of a different colour and watch how the two sheets create a new colour.
4. Create interesting optical illusions by placing one patterned square over the top of another and slowly rotate them.
5. For a spinning image use two circle designs.
6. For a flickering image use two square designs.
7. Experiment with other designs.
8. Use the paper squares to create your own optical illusions.
9. Use the coloured pencils or crayons to see how colours can change.

Reference: Colour Separation Sheets instruction sheet and www.roylco.com

FORCE AND MOTION

Force

- Identify the dominant forces that operate on a space rocket: when it is stationary at the launch pad; as it is fired and travels through the air; and then through open space, when its engines are switched off and it is in orbit around some planet; and finally when it enters through the atmosphere and lands on that planet.
- Marble Twister – This toy allows a group to discover the scientific principles of gravity, acceleration and centripetal force by means of racing marbles down the spirals of the metal vortex framework. When two marbles are used this toy also graphically illustrates the interesting relationship between distance from the centre of the vortex and speed of travel of the marbles. These are sold at most toy stores.

Motion

- Create a model racetrack with hills, valleys and loops and use it to study various kinetic concepts (stationary, acceleration, constant speed, deceleration, forwards and reverse motion etc).
- Two identical PET bottles (one filled with water and the other with sand) are raced down an incline. The water-filled bottle is observed to beat the sand-filled bottle every time. This occurs because (in comparison to the sand-filled bottle) less of the 'potential' energy of the water-filled bottle is converted to 'rotational' kinetic energy (because most of the liquid contents can remain stationary inside the bottle as the bottle rolls). Consequently more energy is available to be converted into 'translational' kinetic energy and therefore it moves more quickly initially and reaches the finish line faster.
- Consider 'aspects of design' and 'suitability of material' concepts by building mousetrap car racers of various types and studying their performance characteristics under speed and duration conditions.
- Research the ways hovercrafts and rockets are made, the typical parts they contain and the principles by which they work.
- Engage in measurement tasks whilst rolling balls down various shallow inclines. For example measuring distance covered in what time on the incline, on level ground or time taken to cover an initial or final set distance for different initial heights. Engage in calculation tasks by using such measurements to calculate acceleration, speed and deceleration values for these systems.
- Build and experiment with toy models of either a rocket (air- or water-powered) or a hovercraft (a balloon attached to a CD—see instructions below) and make comparisons to the real thing.
- By studying motion in terms of rolling, spinning and strange rotational effects. Students could be asked to indicate some of the reasons why most ground-based vehicles make use of round wheels for movement. For an older group, comment on why an ice skater's spin rate increases when they draw their arms and legs close in towards their body when spinning.
- Look at floating and flying motion. Students could be asked to describe different ways something can be made to float in the air. For an older group, comment on the energy changes that occur as a model rocket leaves the ground, flies upwards through the air until it runs out of thrust and then falls back to the ground again.
- Use a marble run to consider the fact that track height energy (gravitational potential energy) is being converted into motion energy (kinetic energy) of the marble as it runs along a suspended track. These can be purchased at most toy stores including the Queen Victoria Museum and Art Gallery Shop, Toyworld, Birchalls, etc.

Bubbles

- Investigate the geometry of strange soap bubbles (angles of 120° between faces and 109° 28' between edges) by making matchstick models of simple polyhedra, and exposing them to soap bubble solution.
- Create large soap bubbles and shine light sources (mini torches for example) onto them to study various properties of light (reflection, refraction, colour formation etc.).

Experiment Recipes

Make an Arch

What you'll need:

newspaper
foil tray
two house bricks
ruler
six wooden toy building blocks
sand
builder's plaster
plastic spoon
plastic knife
water

What to do:

1. Cover the working surface in newspaper. Place the two bricks on the work surface about 20 cm apart.
2. Pile sand between the bricks and smooth it with your hands to make a curved mound. Place the wooden blocks side by side across the sand. They should touch the outer blocks.
3. The inner blocks touch each but have a V-shaped gap between them. Mix the plaster with water until it forms a stiff paste. Use the knife to fill gaps between the blocks with plaster.
4. Make sure you have filled each space where the arch meets the bricks. Wait for the plaster to dry. Once dry, remove the sand from underneath the arch.
5. Push down on the arch and feel how firm it is. The weight that you are putting on the bridge is supported by the two bricks at the side. The bridge is stronger than a platform bridge and does not sag in the middle. Like stone blocks in real bridges, the wooden toy blocks make a remarkably strong curve.

Reference:
Oxlade, C 2001, 150 Great Science Experiments, Lorenz Books, London

The Suspenseful Egg

What you'll need:

large glass jar
egg
water
teaspoon
salt

What to do:

1. Half fill a glass jar with fresh water. Put in a raw egg. What happens?
2. Take out the egg
3. Add two teaspoons of salt and mix well.
4. Now put the egg back in the jar. What happens now?

What is happening?

The gravity of salt water is more than that of fresh water. This allows the egg to float.

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victoria

Magical Marbles

What you'll need:

2 rulers
marbles
sticky tape

What to do:

1. Tape the rulers to a flat surface—they need to be parallel and about 2.5 cm apart.
2. Put two marbles in the middle of the rulers about 5 cm apart.
3. Gently tap one marble so that it rolls and hits the second one. What happens?

What is happening:

Did the marble that had been rolling stop and the one that had been stationary start rolling? The force of the rolling marble transfers to the other one, it stops the first and sets the second one going. Try it again with three marbles. Place two marbles centrally between the rulers so that they touch and the third 5 cm away. Tap the single marble into the others. What happens? Try other combinations.

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victoria

Are you the Swing King

What you'll need:

watch
outside playground swing
ruler
three people

What to do:

1. Assign jobs to each person. You will need a pusher – to push the swing;, a timer, and a swinger.
2. The pusher needs to hold the back of the swinger's seat and move back three or four steps.
3. Ask the swinger to put the ruler on the ground in front of their feet.
4. The timer needs to use the watch. Start timing as soon as the swing is let go. Don't push the swing, just let it go. Count the number of times the swing goes back and forth in ten seconds.
5. The timer must call out when ten seconds is up.
6. Repeat the experiment with an empty swing
7. The pusher needs to pull the swing back until it is behind the ruler like the first time.
8. Start timing once the swing is let go. Don't push the swing. Count the number of times the swing goes back and forth in ten seconds.
9. Were there any differences? Why?

What is happening?

Gravity is working at its best here. It pulled on the swing and made it fall when the swing was let go. The swing would have moved faster when it was close to where the person was in an upright position, and then slowed as it moved upward. This is the same way pendulums work; they stop at the highest point of their swing before beginning the downward swing.

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victori

Spinning Balls

Background Information:

This activity is based on inertia, the first law of motion described in Newton's Laws.

On earth the outside forces that affect inertia are friction and gravity. In this activity you need to hypothesise which ball will spin the longest based on your example experiment – Spinning Eggs.

What you'll need:

golf ball
marble
tennis ball
stopwatch
soccer ball
AFL football
touch football
hardboiled and raw eggs

What to do?

1. Spinning eggs – how can you tell the difference between raw and cooked eggs? Spin a hard-boiled egg and a raw egg on their sides, what happens? The hard-boiled egg spins faster and longer because inside the contents are hard and spin with the shell, whereas the raw egg has liquid that moves in different directions to the shell.
2. What happens with a ball? Hypothesise which ball will spin the fastest – marble, golf ball, tennis ball, soccer ball, Australian Rules or touch football.

Reference:
Questacon – the National Science and Technology Centre 1997, Science on the Move Teacher Resource Book, Questacon, Canberra

Rolling Cars

What you'll need:

toy cars/utes/trucks
block
ramps or planks
ruler
measuring tape

What to do:

1. Set up a ramp. Measure the height from the ground to the top of the ramp.
2. Choose a toy car/ute/truck to use.
3. Let the toy roll, using gravity, down the ramp and measure the distance that the toy rolls.
4. Record the distance. Repeat twice using the same toy.
5. Lower the height of the ramp, repeat three times and record.
6. Make the ramp a greater height, repeat three times and record.
7. Were there any changes? What are the results telling you?
8. What other adjustments can you make to the ramp to create a new component to the experiment?

Reference:
Pels, M 2001, Primary Physics 2 – Simple Machines, Sunshine Educational, NSW

Straw Through a Potato (teacher demonstration)

Safety note:

Even if you are confident of your aim, you should demonstrate safety precautions by wearing a gardening glove to protect your hand in case you miss the potato. Although an accident may be unlikely insist that students wear a glove if they decide to repeat this demonstration at home.

What you'll need:

plastic straws (sturdy ones are best)
potatoes
gardening glove (for safety)

What to do:

1. Propose that you are going to pierce a potato with a flimsy plastic straw to the class.
2. Some students may suspect you are playing a trick so allow them to inspect the straw and the potato.
3. Hold the straw firmly but without crushing it. Wear a glove on the hand holding the potato. Hold the potato in your fingertips to allow the straw to visibly penetrate right through. Note: There is no need to put your thumb over the end of the straw.
4. Take aim and stab the potato as hard as you can! If you are having trouble getting the straw all the way through, you're probably hesitating. Just pretend it is as rigid as a pencil and stab the potato harder.
5. Ask if anyone can explain how this simple trick works.

To create an environment where students feel safe to 'have a go', tell them your first guess was wrong when you first saw this trick (even if it wasn't!). Give some hints to encourage responses: 'Well, what shape is a straw?' (cylinder), 'In what direction are cylinders strong?' (end to end). 'Is the plastic thick or thin, blunt or sharp?' (thin and sharp).

What is happening:

The straw penetrates the potato easily because it is a strong cylinder made from thin plastic which also makes it sharp. Cylinders are strong if compressed from end to end, but not from the sides. Raw potatoes are hard, but easy to cut with a sharp knife (or straw!).

A common misconception:

A common published misconception is that air pressure in the straw keeps it rigid, allowing it to pierce the potato. Be careful to give praise for this theory before explaining that it is actually a common misconception. To prove it has nothing to do with air pressure repeat the demonstration with your thumb clearly not covering the end of the straw. Now no air pressure can build up yet the trick still works.

Reference:
www.abc.net.au/science/surfing/pdf/teacher_demonstrations.pdf

Water Rocket (for older groups)

Safety note:

For safety reasons this activity is best done as a teacher demonstration.

- Launch only from an outdoor area well away from buildings.
- Never lean over the rocket.
- Stand back as far as possible when pumping up the rocket.
- Ensure that spectators are at least 20 metres from the launch area.

Background information

Gravity forces the resting rocket down towards the ground. The bike pump compresses air in the bottle. The compressed air pushes against the sides of the bottle and the surface of the water. Finally, the larger stopper is pushed out and the air and water escapes from the opening. Air pressure in the bottle is unbalanced when the rubber stopper gives way. The pressure at the top of the bottle is unopposed and pushes the bottle up.

Water adds mass to the rocket. Without water the rocket will not go far. The momentum of the water expelled from the rocket causes an equal and opposite thrust in the direction the rocket is pointed. At blastoff the rocket has maximum force but is not moving very fast. The rocket accelerates as the water escapes.

What you'll need:

plastic bottle (2-litre PET)
large stopper (rubber or cork with a diameter the same as the inner diameter of the neck of the plastic bottle)
copper tubing (0.5 cm outer diameter, about 5 cm long)
plastic tubing (0.5 cm inner diameter, about 2 m long)
small stopper/cork (outer diameter 0.5 cm)
waterproof glue
bricks to provide firm launch pad and to support rocket
3 x plastic fins glued to side of bottle (optional)
bike pump with inflation needle attached
water

What to do:

1. Drill a 0.5 cm hole in the centre of the larger stopper.
2. Tightly glue the copper tube into the hole in the larger stopper. Leave about half of the copper tubing protruding from the top of the larger stopper.
3. Tightly glue one end of the plastic tubing to the copper tubing. Push the plastic tubing down until it is flush with the top of the larger stopper.
4. Coat the end of the inflation needle with glue and push it through the small stopper/cork. Ensure that the thread for attaching the needle to the pump protrudes above the small stopper/cork.
5. Tightly glue the small stopper/cork into the remaining end of the plastic tubing.
6. If using plastic fins, glue these to the side of the bottle.
7. Let the glue dry overnight.

Remember: Safety first when launching the rocket!

8. Fill the bottle about one-third full of water.
9. Fit the larger stopper firmly into the bottle.
10. Place the rocket on the launch pad.
11. Attach the bike pump to the valve needle.
12. Put on safety glasses. Make sure that everyone is at least 20 m back and that the rocket is aimed safely.
13. Pump! When the air pressure is high enough, the larger stopper will release, the water and air will shoot out and the rocket will launch. If this doesn't happen, be careful. The rocket is pressurized and will take off when you jiggle it.
14. Try the rocket with different amounts of water and air. A rocket with just air will not go far. Add a cone to the nose of the rocket and see if it goes further.

Reference:
http://www.kidscanmakeit.com/SC002.htm
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Whirlpool in a Bottle

Background information

This activity demonstrates the formation of a vortex in a body of water that is draining from its base. The vortex makes it easier for air to come into the bottle and allows the water to pour out faster. If you look carefully you will be able to see the hole in the middle of the vortex that allows the air to come up inside the bottle. If you do not swirl the water and just allow it to flow out on its own then the air and water have to take turns passing through the mouth of the bottle.

What you'll need:

two 2-litre PET soft drink bottles
a rubber washer
electrical tape
water
food dye
stopwatch

What to do:

1. Remove caps from the two bottles.
2. Fill one of the bottles two-thirds full of water.
3. Add a couple of drops of food dye.
4. Tape the bottles together with the washer between them. Make sure the electrical tape seals the bottles well to prevent leakage.
5. Place your bottles in a vertical position, so that all the water flows into the bottom bottle.
6. Invert your bottles and time how long it takes for the water to flow from the top to the bottom bottle. Carefully watch the motion of the water.
7. Record the time and describe the motion of the water.
8. Repeat Step 6. This time, swirl the top bottle a few times as you invert it. Time how long it takes for the top bottle to empty, and carefully watch the motion of the water.
9. Record the time and describe the motion of the water.

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/ - school based activities.

CD Hovercraft

Background information

To move an object across a table we have to keep pushing it because the object rubs against the table which causes friction. Friction is the force that resists the movement of an object and makes it slow down.

In this activity a thin layer of air is created between the CD and the table. This means that there is hardly any friction so the hovercraft slides around easily. When the air runs out, the CD comes back into contact with the table.

What you'll need:

balloon
CD
pop top lid from water or juice bottle
glue

What to do:

1. Glue the spout over the centre of the CD. You can use craft glue or a hot glue gun. (Masking tape or duct tape would work too, but be sure the seal is airtight.)
2. Push the spout down so that it is closed and no air can pass through.
3. Blow up a balloon. Don't tie it! Carefully stretch it so that it is over the spout.
4. Hold the bottom of the balloon in place with one hand. With the fingers of the other hand, carefully pull open the spout. Watch what happens!

What is happening:

The air in the balloon is forced out through the drinking spout. It creates a blanket of air and an almost frictionless surface, like a hovercraft. The CD is propelled by the balloon, and moves randomly across a smooth surface (floor/table).

When your 'hovercraft' stops, just blow the balloon up again for more fun!

Note: It is possible to replace the CD with a clean inverted polystyrene meat tray. Make a hole in the meat tray and carefully glue the drink bottle spout over it as above.

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Orbits of the Planets

Background information

Johannes Kepler (1571–1630) developed several laws to describe his observations of the orbits of the planets. His laws state, among other things, that planets that are distant from the sun will have a slower orbital velocity (speed) than planets that are closer to the sun.

Kepler's work has contributed to a more general law describing the motion of spinning and turning objects known as the 'conservation of angular momentum'. This law explains why a ball rolling around the Gravity Well in the *Phenomena Factory* goes faster as it moves towards the centre, why an ice skater spins faster when her arms are at her sides, and why a whirlpool or cyclone spins fastest near its centre.

What to do:

Complete the table below. You will be able to obtain the information you need by consulting an astronomy book or searching the Internet. Be sure to clearly indicate the units that you are using for distance and velocity.

Name of Planet	*Distance from the Sun*	*Orbital Velocity*
Mercury		
Venus		
Earth		
Mars		
Jupiter		
Saturn		
Uranus		
Neptune		

Kepler was correct!

Planets that are closer to the Sun have a faster orbit than planets that are further away from the Sun.

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/
Detailed information on the planets of the Solar System is available from NASA at http://nssdc.gsfc.nasa.gov/planetary/factsheet/index.html
An animation showing the orbits of the inner planets is at http://www.ac.wwu.edu/~stephan/Astronomy/planets.html
For more information, search the Internet for 'Kepler' and 'Conservation of Angular Momentum' (e.g. http://csep10.phys.utk.edu/astr161/lect/history/kepler.html)

Hubble Bubble

Bubble mixture

1 tablespoon of dishwashing liquid: one-half cup of water.

More detergent than water gives you bigger bubbles—make the mixture a couple of days before using. Store bought mixture works best if it is refrigerated for few minutes before using.

What you'll need:

plastic cup
bubble blower
bubble mix (store bought or homemade)
plastic drinking straw
loop of wire made from a coat hanger or pipe cleaner

What to do:

1. Turn the plastic cup upside down.
2. Wet the bottom of the cup, which is now on top.
3. Use the wire loop to make a large bubble. Attach the bubble to the wet plastic cup.
4. Wet the plastic straw in the bubble mix.
5. Gently push it through the large bubble.
6. Blow a smaller bubble inside the larger one.
7. Carefully push the straw through the smaller bubble and blow an even smaller bubble.

What is happening:

Bubbles are bits of air or gas trapped inside a liquid ball. Bubbles are very fragile, with a thin surface. They prefer to be wet and can cope well if anything wet enters the bubble however, when they touch a dry object the soap film sticks to the object and this puts a strain on the bubble.

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victoria

Bubble Recipes

Light Bubbles

100 ml concentrate detergent
900 ml water
50 ml glycerol (also called glycerine)

Heavy Bubbles

Good for big bubbles or making bubbles inside of bubbles

300 ml detergent
700 ml water
50 ml glycerol

MECHANICS, DYNAMICS AND MOTION

- Design and build a model robot using one of the common toy construction sets (Technics, Meccano, Capsela, Erector, LEGO, K'NEX, DUPLO etc) and use it to identify the functional parts of a robot and their uses.
- Look at motion in terms of walking, moving legs, weight distribution etc. Students could be asked to outline some of the advantages and disadvantages of having two legs for walking (in comparison to four or more). For an older group explain force and weight concepts as they apply to bipedal walking.

Experiment Recipes

Make your own Windmill?

1. Take two pieces of square coloured paper. Place one on top of the other.
2. Rule two faint lines diagonally across the squares.
3. Cut each of the four lines two-thirds of the way towards the centre.
4. Fold every second corner so that it meets the middle point. Sticky tape it to the middle point.
5. Fold the wire in half. Bend the pointy end over and stick it through the middle of the paper.
6. Blow into the sails and watch your windmill spin.

Design your own Machine!

1. Design your own machine using any of the types of gears, pulleys or springs you want. You may even wish to use more than one type in your drawing.
2. Make the machine a really pointless one. For example a machine to help Bugs Bunny lift carrots. You can think of many more, such as a simple machine that waves a false hand at passers-by.
3. Cost your invention. It could be very expensive.
4. Make sure you add a copyright symbol so that no one can steal your idea.
5. Make it as silly as possible.

Which Shape is the Strongest?

- Fold A4 pieces of paper into the following shapes: a triangle, a square, a circle, a rectangle and a four-pointed star. See http://wwwkorthalsaltes.com/ or http://members.enchantedlearning.com/math/geometry/shapes/index.shtml for help.
- Which shape do you think will hold the most weight?
- Place pieces of paper on top and find out.
- If you cut shapes in half, so that they are shorter, will they hold the same amount of weight, more or less?
- Can you explain the answers that you have discovered?

Playing Bernoulli Ball

Background information:

Bernoulli's principle says that the faster air flows over a surface, the less the air pushes on that surface. Therefore, air that is moving at higher speed produces lower pressure than air that is moving at slower speed.

The air from the hair dryer flows upwards, hits the bottom of the ball, slows down, and creates a region of high-pressure air, which holds the ball up by balancing the pull of gravity. As the air moves around the ball it speeds up and creates a pocket of low air pressure that keeps the ball suspended.

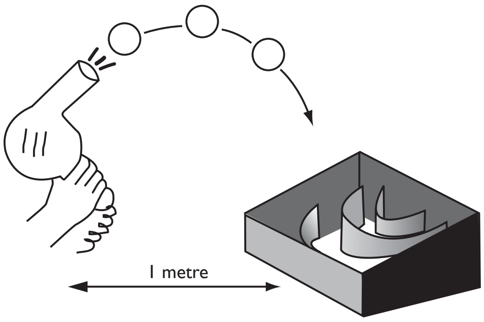
When the ball moves to the side of the air column, the slower moving air on the outer side of the ball creates a region of higher pressure. This pushes the ball back into the lower pressure region at the centre of the air stream.

What you'll need:

hair dryer with a cylindrical nozzle
polystyrene ball (4-5 cm in diameter)
two cardboard boxes of different sizes

What to do:

1. The player sits in a chair or on a stool, holding the hair dryer about 1 m away from the target box.
2. Place cardboard boxes inside each other to serve as the target. Alternatively, cut and shape cardboard into curved sections and place in box. If you position the back of the box against a wall, you won't have to chase as many stray balls.
3. Scores for each part of the target are: inner box – 3 points; outer box – 1 point; outside of boxes – 0 points
4. Use the hair dryer on the cold, low-speed setting.
5. Each player is allowed five practice shots and five shots for official score.
6. To start the game, turn the dryer on and point the nozzle straight up. Place the polystyrene ball in the airstream about 30 cm above the nozzle.
7. The player shoots the ball by smoothly tilting the dryer so that the ball falls out of the airstreams and continues on a curved path towards the target.
8. If the ball hits the dryer, the player gets to try again.



Questions for students:

1. Why does the ball stay in the airstream when the dryer is pointed straight up?
2. Does the ball fall out of the airstream as soon as you start to tilt the dryer?
3. Why does the ball leave the airstream when you continue to tilt the hair dryer?
4. After playing the game, do you have any suggestions for someone who has never played it?

Reference:
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/jumbojet2.html
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Robotic Arm (for older groups)

Background information:

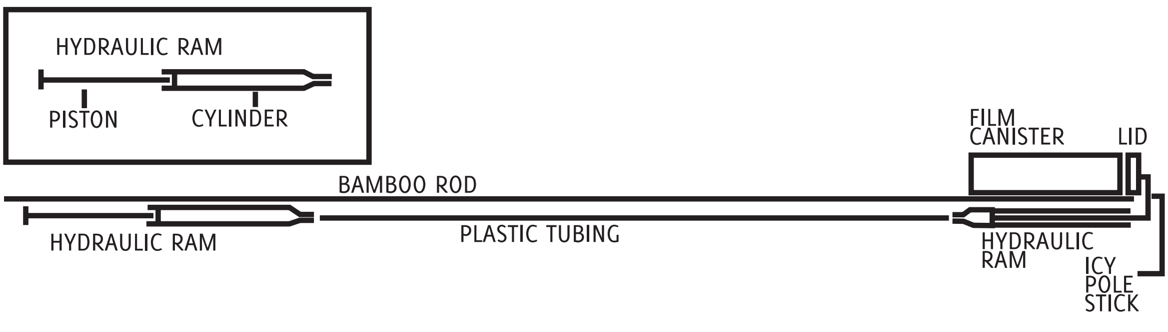
This activity uses airpressure to remotely lift a lid on a container. This is similar to the hydraulic systems used in industry for remotely controlled machinery, except that oil rather than air would normally be used to transfer the force to its destination.

What you'll need:

a bamboo rod
a length of 3 mm plastic tubing
a film canister
icy pole stick
masking tape
strong glue
2 x 25 ml hydraulic rams/syringes

What to do:

1. Tape the hydraulic rams/syringes to each end of the bamboo rod. Make sure that the piston on hydraulic ram/syringe '2' is pushed in and that the piston on hydraulic ram/syringe '1' is pulled out.
2. Cut the plastic tubing to length and attach each end to the hydraulic rams/ syringes.
3. Securely tape the film canister next to hydraulic ram/syringe '2', taping around rod, canister and syringe. The robotic arm works best when the canister lid is parallel to the top of the piston on hydraulic ram/syringe '2'.
4. Connect the canister lid to the end of the piston of hydraulic ram/syringe '2' by gluing the icy pole stick to them both. Make sure that the film canister lid is just sitting on top of the canister, rather than snapped on tightly.
5. Operate the robotic arm by pushing in and pulling out the piston on hydraulic ram/syringe '1'. You should be able to lift and replace the lid on the film canister, and you may be able to use the lifted lid and canister as 'fingers' to remotely pick up a small object.



Hydraulic ram/syringe 1 h

Hydraulic ram/syringe 1 h

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Robot Trail

Background information:

This activity demonstrates interactions between a 'robot' and its 'controller'.

- Robots can't think for themselves but follow instructions very precisely using a predetermined vocabulary (program).
- Robots are often used in space missions. Earth-based controllers must rely on the robot's video cameras for visual orientation.
- Robots may be able to send data from sensors to the controller.
- If the controller is on earth and a robot is on a distant space craft or planet there will be a time delay between the transmission and receipt of what to do. From Earth to Mars the delay is from 8.8 to 41.9 minutes.

Safety note:

Be sure that courses are safe and that there are sufficient people on hand to prevent the 'robot' from falling over obstacles. Robots must proceed slowly!

What you'll need:

cardboard box
blindfold
basketball
rubbish bin

What to do:

1. Form pairs and decide who will be the robot and who will be the controller.
2. If time allows make a square 'robot head' out of a cardboard box. This is to be fitted over the head of the student who is to be the robot so that they can't see. Alternatively a blindfold can be used.
3. The 'robot' is to carry a basketball around a pre-determined course and put it in a bin or other container. The controller must tell the robot how to avoid obstacles and complete the course and the robot must follow the directions of the controller exactly. The robot can't talk or ask questions.
4. The robot and the controller switch roles.
5. Discuss your success or otherwise. Which commands caused problems? Make up an agreed list of commands that would help the robot to function. You might like to precisely define some commands, e.g. the length of a 'step', how many degrees in a 'half-turn' etc.
6. Both complete the course again. Was the list of commands useful?
7. Make up a new obstacle course. Draw a map of the course.
8. This time the controller must sit facing away so that they can't see the robot or the obstacle course, but the robot can see. The controller uses the map to give directions, which the robot must follow exactly. The controller can question the robot about their location; the robot answers yes/no.
9. You could pretend that the controller is on earth and the robot is on a space craft 3 million km away. This would cause a ten second delay between when directions are given and received.
10. Challenge another robot/controller pair of students to a competition to complete an obstacle course that the original pair has devised.

Reference:
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/nasa.html
htt://museumvictoria.com.au/Scienceworks/Education-Kits/Sci-Quest/

REFLECTIONS

- Am I upside down? Hold a spoon up to your face with the inner curve pointing away from you. Move it away from your face. How does your face change? Did it change as you expected? What happens when you turn the spoon around?
- Foiled reflection. Cut off about 25 cm of foil from a roll, being careful to keep it smooth. Look into it, what do you see? Scrunch up the foil and spread it out again? Is your reflection still there?

Experiment Recipes

Investigate Reflections

1. Cut a 2.5 cm diameter hole in a piece of card and tape a comb across the hole.
2. In a darkened room place the card in front of the torch so that narrow beams of light come through the teeth of the comb.
3. Hold a mirror in the beams of light so that it reflects the light.
4. Move the mirror to a different angle. What happens to the beams of light?

Secret Writing

1. Put a piece of paper in front of a mirror.
2. While looking at the mirror carefully write your message on the paper.
3. When you look at the paper what has happened to the writing?
4. Ask a friend to decode the writing.

References:
Walpole, B 1987, Fun with science: experiments, tricks, things to make, Kingfisher Books, London

More and More Reflections

1. Find an object, place two mirrors at right angles, with the object inside the angle.
2. How many images of the object do you see?
3. Move the mirrors close together and further apart. What changes?
4. Change the position of the mirrors so that they are facing each other with the object in the middle. How many times can you see the reflection of the object now?

References:
Walpole, B 1987, Fun with science: experiments, tricks, things to make, Kingfisher Books, London

Make a Kaleidoscope

Background information:

Light bouncing between the mirrors inside a kaleidoscope creates patterns.

What you'll need:

3 small same-sized mirrors
sticky tape
card or paper
coloured paper shapes
beads or a marble

What to do:

1. Tape the mirrors together in a triangle.
2. Stand them on the card or paper and draw around their shape.
3. Cut out the triangle of card or paper and tape it to one end of the mirrors.
4. Drop pieces of coloured paper or beads inside. Alternatively, tape the marble with clear tape to the bottom of the triangle.
5. Look inside your kaleidoscope. How many patterns can you see?

References:
Walpole, B 1987, Fun with science: experiments, tricks, things to make, Kingfisher Books, London

SOUND, WAVES AND RESONANCE

- Explore concepts of sound (loudness, pitch, hollowness or fullness) using various types of toy (or real) musical instruments.
- Investigate air movement and sound production waves. Ask students to comment on how sounds are produced, travel from place to place and can be detected by living creatures. For an older group explain the concept of 'resonance' and give examples of when that concept is important in regard to sound production.
- Waves are 'white' light and its component colours. Students could be asked to indicate the colours of the visible spectrum (in sequential order if appropriate) and how they can be created from normal white light. For an older group explain (with appropriate diagrams) why soap bubbles display coloured bands when illuminated with normal 'white' (polychromatic) light.
- Create interesting wall patterns by shining light from a purchased or constructed torch (involving batteries, wires, lights, switches) onto a small mirror glued to the centre of an old speaker that vibrates to music from a radio or similar.

Experiment Recipes

Turn It Up and What's That Sound

What you'll need:

2 large pieces of strong cardboard
a friend
sticky tape

What to do:

1. Roll up the pieces of cardboard to make two funnels. You should have a large hole at one end and a small hole at the other end, about the size of your mouth.
2. Tape the cardboard together so that it stays in place.
3. Now ask your friend to stand at a distance so that you have to shout for them to hear you. Say something nice to your friend.
4. Ask your friend to put their funnel to their ear. Put the small end of the cardboard cone to your mouth. Talk normally.
5. Can your friend hear you? Take it in turns to try out the whisper dishes that you have made.

Reference:
Singleton, G 2007, 501 Science Experiments, Hinkler Books, Victoria

Echo Echo

What you'll need:

2 blocks of wood
enclosed corridor with a bare floor
carpeted area

What to do:

1. Go to the enclosed area.
2. Bang the wood together softly. Now increase the volume and bang them together louder. What do you notice is happening?
3. Now go to the carpeted area, repeat the above. What happens?

What is happening:

An echo is produced when sound reflects off a hard surface. The sound is duller in a carpeted area because carpet absorbs the sound waves.

Reference:
Singleton, G 2007, 501 Science Experiments, Hinkler Books, Victoria

Paperclip and Cup Party Telephone Line

What you'll need:

4 paperclips
2 pieces of string (each 90 cm to 180 cm long)
4 paper cups

What to do:

Two-party line

1. Punch a hole in the bottom centre of two paper cups.
2. Push one end of a piece of string through the hole in each of two cups from the outside to the inside. Make sure that the open ends of the cups are facing away from each other.
3. Inside each cup, tie a paperclip to the string.
4. Pull the cup tight and speak into one. A person listening at the other end will hear you through the string.

Four-party line

1. To have a four-party line make another set of phones in the same way as the two-way line.
2. Connect them to the centre of the first set you made. Now you and three friends can have a party-line talk on your own personal telephone system.

Reference:
Moje, SW 1996, Paperclip Science – Simple and Fun, Sterling Publishing Company Inc., New York

Ruler Guitar and Rubber Band Guitar

Background information:

When a string is attached to the sound box of a guitar, its vibrations cause the sound box and the surrounding air to vibrate at the same frequency. This is called resonance—it results in a louder sound.

The faster a string vibrates, the shorter the wavelength and the higher the frequency of the sound waves. This causes a higher pitched sound.

- A tight string produces higher-pitched sounds, while a lower tension string produces lower-pitched sounds.
- A heavier string produces slower vibrations and therefore a lower pitch.
- A shorter string vibrates at a higher frequency and produces a higher pitch. Guitar players play different notes by pressing a string against the neck of the guitar. This shortens the length of the string and produces a higher pitch.

What you'll need:

wooden ruler
shoe box
small wooden sticks
rubber bands of various sizes
pair of scissors

What to do:

Ruler Guitar

1. Hold the ruler on a table with half its length over the edge. Pluck the end of the ruler and listen to the sound.
2. Now move the ruler so there is only a short length over the edge of the table and pluck it again. Try the same thing with a long length of ruler over the edge of the table.
3. As you move the ruler, what happens to the sound? If more of the ruler is over the edge of the table, does the sound become higher or lower? Why does this happen?

Rubber Band Guitar

1. Cut a hole in the middle of the lid of a shoe box, return lid to the base of the box.
2. Stretch several rubber bands of various lengths and thicknesses across the top of the box. Leave a gap of about 1 cm between each rubber band. Pluck the rubber bands in turn to hear what sound they make.
3. Make a bridge by inserting two wooden sticks about 1.5 cm square under the rubber bands on each side of the hole in the box. Compare the sound that the rubber bands make before, and after, the bridge is installed. Why is there a difference?

Reference:
http://www.iit.edu/~smile/ph9301.html
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Good Vibrations

Background information:

When objects vibrate they do so with a resonant (or natural) frequency that is determined by the size and shape of the object. Large objects produce vibrations that have a long wavelength, which make low-pitch sounds. Small objects produce vibrations that have a short wavelength, which make high-pitch sounds.

What you'll need:

mailing tubes of various shapes
pieces of PVC pipe of various lengths
rubber thong

What to do:

Mailing Tube Whackers

1. Whack the ends of mailing tubes of various sizes with a rubber thong to produce sounds of different pitch. With both ends of the tube open the wavelength of the sound produced is twice the length of the tube.
2. Put a lid on one end of a tube. The wavelength now produced is four times the length of the tube and the sound is an octave lower than when both ends of the tube are open.
3. Arrange the mailing tubes, with and without lids, from lowest pitch to highest pitch. Can you play a simple tune?

PVC Pipe Whackers

1. Whack the ends of pieces of PVC pipe of various lengths with the rubber thong.
2. Arrange the pieces of pipe from lowest pitch to highest pitch. Try to play a simple tune.

Get a group together to form an orchestra using the mailing tubes and PVC pipes.

Questions for students:

Short pipes make a sound of s _ _ _ _ wavelength and h _ _ _ pitch.

Long pipes make a sound of l _ _ _ wavelength and l _ _ pitch.

Reference:
http://museumvictoria.com.au/Scienceworks/Education/Education-Kits/Sci-Quest/

Straw Oboe

What you'll need:

drinking straws
scissors

1. Pinch flat 1–2 cm at one end of the straw and fold over.
2. Cut little triangles off the corners of the folded-over part of the straw. These make the reeds.
3. Unfold the straw and put the straw far enough into your mouth so your lips do not touch the reed corners.
4. Press with your lips on the straw. Blow gently just past the reeds. Listen to the sound. Keep trying, it may take a few tries to get a noise.
5. Cut three small slits along the length of the straw about 2.5 cm apart.
6. Cover one of them and blow as before.

What is happening:

Each time you blow you hear a different sound. Like a real oboe the reeds open and close at a high speed to allow the air to flow and then to stop. The vibrating air makes the sound. You decide which sound comes out by covering or uncovering the holes.

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victoria

Shake, Rattle and Roll

What you'll need:

paper cups
plastic bottles with lids
sticky tape
rice, lentils, chickpeas, beads or pebbles

What to do:

1. To make a paper-cup shaker, put a handful of rice or lentils into one cup. Turn another cup upside down and tape the two cups together, rim to rim.
2. To make plastic bottle shakers, simply pour a handful of beads or chickpeas into the bottle, and put the lid on tight. Try other filling material, such as the pebbles. You could decorate the shakers with coloured paper if you wish.
3. Try making shakers with different-sized bottles. You will find that larger bottles which hold more air make deeper sounds.
4. Experiment with the different instruments and make up a song!

Reference:
Parsons, A 1995, Make it work! Sound – Wendy Baker & Andrew Haslam, Two-can Publishing Ltd, Sydney

Squawking and Clucking Cups

What you'll need:

paper or plastic cups
cotton string
2 medium-sized paperclips
waxed paper
piece of fabric

What to do:

1. Poke a small hole in the bottom centre of a paper cup. To make the hole, you can use a pen or a partially straightened paperclip.
2. Push one end of a piece of cotton string through the hole from the outside in. Tie the inner end of the string to a paperclip. Gently pull on the string until the paperclip rests against the inside bottom of the cup.
3. To make your cup squawk pull the outside end of the string tight with one hand, away from the bottom of the cup. Slowly rub along the string with the other hand. Wet your rubbing hand to get a louder sound. Listen to the cup make strange squawking noises! To get a different sound, try dragging some waxed paper along the string between your fingers.
4. To make your cup cluck, wet a piece of fabric and hold it firmly around the string while you pull downwards. Do you hear a loud 'clucking' sound?

References:
Squawking cups –
Moje, SW 1996, Paperclip Science – Simple and Fun, Sterling Publishing Company Inc., New York

Clucking cups -
Questacon – the National Science and Technology Centre Science on the Move Teacher Resource Book, Canberra: Questacon 1997

Drums

What you'll need:

cardboard tubes
string
balloons
glue or sticky tape
thick paper
rubber bands
eyelet punch
sheet of plastic or plastic bag
tins
boxes
thin wooden dowels

What to do:

Bongo Drum

1. Cut cardboard tubes into several different lengths to make bongo drums that will produce different notes.
2. Cut some flat pieces of balloon rubber to make the drum skins, and fix across the tops of the cardboard tubes with elastic bands.
3. Attach a dowel to each drum on the side, you can hang them up and the notes will sound more clearly from the open ends of the drums.

Tin Drum

1. Take both ends off a tin can. Wash the tin, being very careful not to cut yourself on any sharp edges.
2. Stretch balloon rubber over the ends of the can, and secure it with elastic bands.
3. Test the sound.

Tuneable drums

1. Take a large can or cardboard tube which is open at both ends.
2. Cut two circular pieces of thin plastic sheeting. Make small holes around the edge of each circle.
3. Now reinforce the holes in the plastic. Use the eyelet punch to press small metal rings in place around the holes or use reinforcing rings made out of sticky-backed card.
4. Thread string through the holes from one drum skin to the other. When you pull the string tight the pitch of the drum will be higher.

Biscuit-tin Drums

1. Take the lid off a biscuit tin.
2. Cut a sheet of thick paper or plastic slightly larger than the top of the tin.
3. Cut slits around the edge of the paper or plastic and glue or tape it down

Reference:
Parsons, A 1995, Make it work! Sound – Wendy Baker & Andrew Haslam, Two-can Publishing Ltd, Sydney

RENEWABLE ENERGY

- Go to http://www.eere.energy.gov/education/lessonplans/—an American website with an amazing amount of resources—or the Queensland site http://www.sustainableenergy.qld.edu.au/
- Create a journal with paper-clippings and comments about the effects of non-renewable energy. Do the same for renewable energy. Have a class debate about the pros and cons of each.
- Look into each of the renewable energies. Renewable energy effectively uses natural resources such as sunlight, wind, rain, tides and geothermal heat, which are naturally replenished. Renewable energy technologies range from solar power, wind power, hydro-electricity/micro hydro, biomass and biofuels for transportation. Make a brochure of the ways that people can use renewable energy in their daily lives.
- Look at ways you can save energy at your school. Implement change through your SRC or school council meetings. Look up http://www.environment.gov.au/programs/greenvouchers/index.html, see if there are ways to create change through this website.
- Older grades could watch *An Inconvenient Truth* and then work through the activities on the website.

  http://www.climatecrisis.net/ for the education materials
  http://www.takepart.com/events/EventDetails.do?ec=ddd580fa02bd7a37592bca4068165e0e

Experiment Recipes

Make a Waterwheel

There are two main types of waterwheels; undershot and overshot. Undershot (like the one in *Phenomena Factory*) is moved around by the flow of the water as it pushes against the paddles sticking out from the wheel. Overshot wheels use their bucket-shaped paddles to catch the water, which flows from above.

What you'll need:

large cotton reel
a long round pencil or knitting needle
card
scissors
glue

What to do:

1. Cut four pieces of thin card about 3.5 cm x 2 cm
2. Fold each 'blade' in half and glue half of it onto the cotton reel.
3. Push the pencil or knitting needle through the hole in the middle of the cotton reel and hold it under a gently running tap. The force of the water will turn your 'waterwheel' round.

References:
Walpole, B 1987, Fun with science: experiments, tricks, things to make, Kingfisher Books, London

Hot Diggity Dog

Use solar energy to cook.

What is happening:

The oven is a solar collector, as are solar panels. Sunlight hits the reflective surfce, focusing on the hot-dog, which will cook but it may take a few hours! You can always try the same activity with your favourite cookie dough.

What you'll need:

an adult
a very hot sunny day
pizza box
black construction paper
wide aluminium foil
sheet of plastic
glue
tape
scissors
ruler
string
marker pen
nail
skewer
hot-dogs or sausages

What to do:

1. Tape the foil to the inside bottom of the clean pizza box.
2. Cover the foil with the black paper. Tape it down.
3. Put the box on the sheet of plastic.
4. Draw the outline of the box on to the plastic with the marker pen.
5. Cut the plastic about 0.5 cm inside the marks.
6. On top of the box draw a line 10 cm in from all sides.
7. Cut along the front and side lines of the box. Do not cut along the back. This will be the hinge for the flap. Carefully fold open the flap.
8. Cut a piece of foil the same size as the flap. Glue it to the side of the flap that faces into the box. Flatten out any wrinkles.
9. Wipe off any glue with a damp towel before it dries.
10. Tape the plastic to the inside of the box lid. Make it tight so it looks like glass.
11. Tape the other edges. Make sure it is tight so no air can get in.
12. Cut a piece of string as long as the box. Tape one end to the top of the flap.
13. Push a small nail into the back of the box so you have a place to tie the string.
14. Poke a metal skewer through the middle of your hot-dog. It will cook more quickly if cut in half.
15. Put the hot-dog in your solar oven. Place the oven in a hot spot. The sun needs to shine right into the box. The best time to use your solar oven is between 12 pm and 2 pm. This is when the sun is the strongest

Reference:
Chapman, H 2002, 101 Cool Science Experiments, Hinkler Books, Victoria

Solar Energy to Heat Energy

Aim:

When you have completed these activities you will have experienced the conversion of solar energy to heat energy.

What you'll need:

magnifying glass
2 ice cubes
stopwatch or timer
2 jam tins (one shiny, one painted matt black)
thermometer

What to do:

1. Place ice cubes on saucers.
2. Hold magnifying glass over one ice cube.
3. Time the difference the magnifying glass makes to melting.

Use two identical jam tins. One has a shiny outside. The other has the outside painted dull black. Put the same volume of water in each tin, then leave them in the sunlight.

After some time test the temperature of the water with a thermometer. Is the water in the black tin warmer than the water in the shiny tin?

The tin with the black outside has absorbed solar radiation which has changed into heat energy. The tin with the shiny outside has reflected the solar radiation.

Reference:
http://www.sustainableenergy.qld.edu.au/activity/activity3_2.html

Make a Pinwheel

Aim:

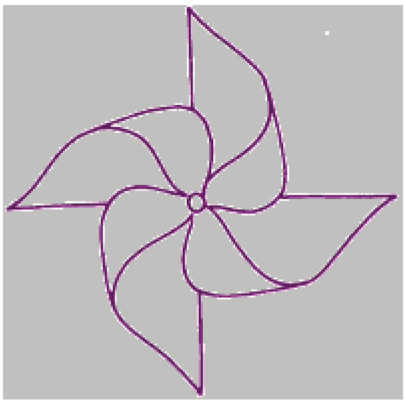
When you have completed this activity you will have made a pinwheel and used it to measure wind speed.

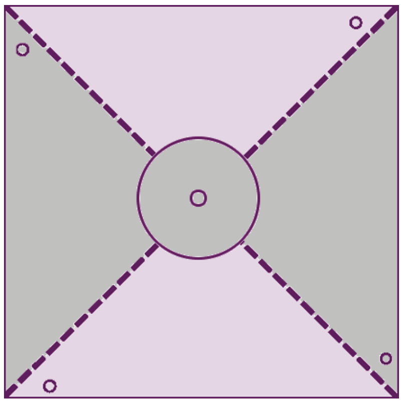
What you'll need:

thin cardboard
ruler
pencil
scissors
pin or long needle
rubber

What to do:

1. Cut out a square of thin cardboard with sides of 11 cm. Colour as in the diagram.
2. Draw guidelines on the square and cut along the diagonal broken lines.
3. Make five small holes where indicated, then bend the cardboard to align the holes.
4. Pass a long needle through the five holes, then push the sharp end into a rubber.
5. Hold the pinwheel near a fan. Change the speed of the fan and try to count the number of revolutions per ten seconds of the pinwheel, at different fan speeds.





Reference:
http://www.sustainableenergy.qld.edu.au/activity/activity8_1.html

Establishing a Small-Scale Hydro System

(for older groups)

Aim:

When you have completed this activity you will have formed opinions on the relative merits of run-of-river and dammed hydro systems.

What you'll need:

paper
pencil

What to do:

- A farmer asks you for advice about installing a micro hydro-electric power supply. He wants to put a power unit just below a small waterfall on his property. One adviser proposed he build a dam (or barrier) above the waterfall to make sure that the power plant would always have a head of water. Another adviser told him to dig a channel from the side of the river to conduct water to the power plant and then to let the water go back to the river.
- Draw a diagram of the two suggestions showing: water upstream of the waterfall, dam or side channel; water entering the power plant through (penstock), turbine, generator; water leaving the power plant through the tail race, (river downstream of waterfall). If the waterfall is 10 m high, show the head of the system. What advice would you give the farmer about where to put his hydro-electric plant?

Reference:
http://www.sustainableenergy.qld.edu.au/activity/activity9_2.html

Where is the Wind

What you'll need:

2 sticks about 15 cm long
string/twine
8 spoons
tape

What to do:

1. Tie the two sticks together in the centre with the twine. Ensure you wrap the twine around enough times to keep it steady.
2. Cut nine more pieces of string about 30 cm long.
3. Tie one end of a piece of string to the centre of the cross.
4. Tie the remaining eight pieces of string to one spoon each.
5. Tie the other end of the string to the sticks so that there are two spoons hanging from each stick.
6. Hold the wind chimes by the string from the centre of the cross. Go outside and tie it to hang somewhere.
7. You'll know when it is windy because the spoons will clang against each other and you will hear a noise.

Reference:
Singleton, G 2007, 501 Science Experiments, Hinkler Books, Victoria

Tracking the Sun

What happens to the sun when the earth moves?

What you'll need:

large piece of paper (butcher paper—at least 1 m)
sticky tape
marker pen

What to do:

1. Sticky tape the piece of paper to the floor in front of a window the sun shines through.
2. Draw a line with the marker exactly where the edge of the sunlight appears on the floor as it shines through the window. Write the date and the time beside the line.
3. Each week, at exactly the same time, mark the edge of the sunlight on the paper and record the date.
4. Continue marking the edge of the sunlight until you run out of paper. What do you notice?

Reference:
Singleton, G 2007, 501 Science Experiments, Hinkler Books, Victoria

Biomass Energy

(for older groups)

When you have completed these activities you will have produced and studied the biogas methane (CH_4). You will need to make up each part individually and construct as per diagram.

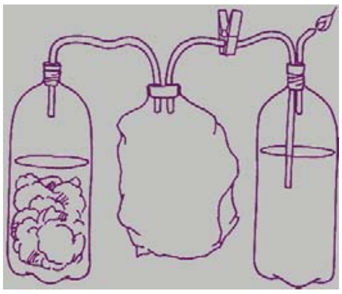
Methane

What you'll need:

plastic drink bottle
mud from the bottom of a pond (or manure)
matches

What to do:

- Fill a plastic drink bottle with mud or a mixture of manure and water. Screw the top on the bottle tightly and keep it in a warm place. Bubbles of methane will appear in the bottle. If the methane bubble in the top of the bottle is small, squeeze the bottle and (under your teacher's supervision) try to set the gas alight. Methane burns with a pale blue flame.



Biogas

You will need:

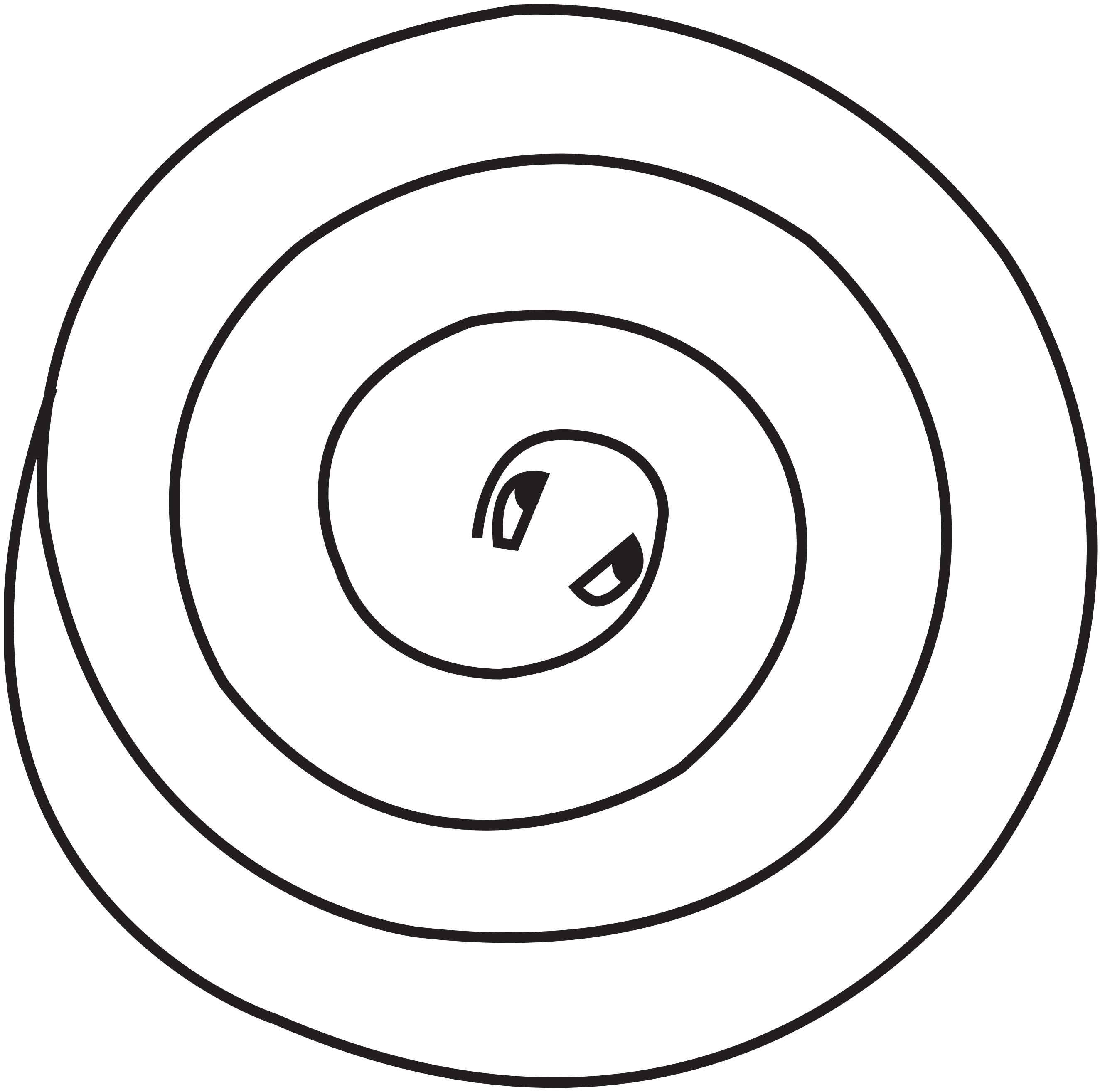
two plastic drink bottles
mud from the bottom of a pond (or manure and water)
wine cask inner bag
two hole stoppers to fit into plastic bottles and wine cask bag
or plastic tubing
weak solution sodium hydroxide (caustic soda)
spring clothes peg

What to do:

- Set up a model biogas generator (see the diagram). The manure mixture should be kept in a warm place or warmed with an aquarium heater.

What is happening

The wine cask bag is used to store the gas. The sodium hydroxide solution absorbs carbon dioxide gas, which does not burn. The tubing from the wine cask bag should dip under the surface of the sodium hydroxide solution, because that bottle acts as a flashback trap. It prevents a flame at the gas nozzle from flashing back and exploding the gas stored in the wine cask bag. Pure methane has no smell, but there is always some smell associated with fermentation.



REFERENCES FOR *PHENOMENA FACTORY*

Angliss, S 2001, *Hands-On Science: Electricity and Magnetism,* Kingfisher, London

Challoner, J and Wilkes, A 1999, *DK Kids First Science Book: A life size guide to simple experiments,* DK Limited, London

Chapman, H 2002, *101 Cool Science Experiments,* Hinkler Books, Victoria

Churchill, ER, Loeschnig, LV, Mandell, M and Zweifel, F 1997, *365 Simple Science Experiments,* Black Dog & Leventhal Publishers, New York

Kerrod, R and Holgate, Dr. SA 2002, *DK The Way Science Works,* Dorling Kindersley, Melbourne

Gore, A 2007, *An Inconvenient Truth,* Penguin Books, Victoria

Morgan, S 2002, *Global Warming,* Heinemann, Melbourne

Moje, SW 1996, *Paperclip Science – Simple and Fun,* Sterling Publishing Company Inc., New York

Oxlade, C 2001, *150 Great Science Experiments,* Lorenz Books, London

Parsons, A, Wendy Baker & Andrew Haslam, 1995, *Make it work! Sound,* Two-can Publishing Ltd, Sydney

Pels, M 2001, *Primary Physics 2 – Simple Machines,* 3rd revised edition, Sunshine Educational, NSW

Questacon – the National Science and Technology Centre 1997, *Science on the Move Teacher Resource Book,* Questacon, Canberra

Richards, J 2003, *Solar Power,* Macmillan Education Australia Pty Ltd, Melbourne

Richards, J 2003, *Water Power,* Macmillan Education Australia Pty Ltd, Melbourne

Richards, J 2003, *Wind Power,* Macmillan Education Australia Pty Ltd, Melbourne

Rainford, J 2004, *Science encyclopaedia,* Bardfield Press, Essex

Singleton, G 2007, *501 Science Experiments,* Hinkler Books, Victoria

Snedden, R 2001, *Energy Alternative,* Heinemann, Melbourne

Walpole, B 1987, *Fun with science: experiments, tricks, things to make,* Kingfisher Books, London

Sci-Quest Teachers Book 2006 version 9

INTERNET LINKS FOR *PHENOMENA FACTORY*

http://www.qvmag.tas.gov.au/education.html
http://www.exploratorium.edu/xref/phen_index.html
http://museumvictoria.com.au/scienceworks/Education/Educationkits/sci-quest/

Electricity and Magnetism

http://www.csiro.au/resources/ps1xm.html

Lightning / Light
http://science.howstuffworks.com/lightning.htm
http://www.strattman.com/products/lightning/
http://csep10.phys.utk.edu/astr162/lect/light/properties.html
http://theory.uwinnipeg.ca/physics/light/

Eye Logic, Neurophysiology and Reflection

http://www.psychologie.tu-dresden.de/i1/kaw/diverses%20Material/www.illusionworks.com/html/figure_ground.html
http://www.gcsec.org/overviewshimmer.htm
http://www.csiro.au/resources/ps1th.html
http://www.csiro.au/csiro/channel/pcha2.html
http://www.artcyclopedia.com/history/optical.html

Reflections
http://www.kettering.edu/~drussell/Demos/reflect/reflect.html

Force and Motion

http://www.abc.net.au/science/experimentals/experiments/episode24_2.htm
http://www.abc.net.au/science/experimentals/experiments/episode28_2.htm
http://www.abc.net.au/science/experimentals/experiments/episode14_3.htm
http://www.abc.net.au/science/experimentals/experiments/episode7_1.htm

Rocket
http://joannenova.com.au/Demos/Rocket/Rokitdem.html
http://www.spaceed.org/seiclassroom/cappdf/air_rocketry.pdf
http://bradcalv.customer.netspace.net.au/wrbook.htm#appnd1
http://www.members.shaw.ca/applytech/at/water.htm
http://exploration.grc.nasa.gov/education/rocket/bgmr.html
http://www.abc.net.au/science/experimentals/experiments/episode27_4.htm

Vortex
http://en.wikipedia.org/wiki/Vortex
http://www.dynamical-systems.org/vortex/
http://www.findarticles.com/cf_dls/m1200/20_156/58037882/p1/article.jhtml?term=

Cycloid
http://www-sfb288.math.tu-berlin.de/vgp/javaview/demo/PaCycloid.html
http://personal.atl.bellsouth.net/e/d/edwin222/enter.htm
http://www.univie.ac.at/future.media/moe/galerie/geom3/geom3.html

Hovercraft
http://www.hovercraftmodels.com/How_a_Hovercraft_works.htm
http://www.springhurst.org/students/hovercraft.htm
http://www.geocities.com/davidvwilliamson/hover.html
http://www.seibunusa.com/Support/Hovercraft/What to do:.htm

Bubbles
http://www.cln.org/themes/bubbles.html
http://micro.magnet.fsu.edu/primer/java/interference/soapbubbles/index.html

http://www.fortunecity.com/emachines/e11/86/bubble.html
http://www.softcom.net/users/sbmathias/bubbles.htm
http://www.abc.net.au/science/experimentals/experiments/episode13_1.htm
http://www.abc.net.au/science/experimentals/experiments/episode13_2.htm
http://www.abc.net.au/science/experimentals/experiments/episode12_1.htm
http://www.abc.net.au/science/experimentals/experiments/episode12_2.htm

Mechanics, Dynamics and Motion

Bernoulli
http://www.abc.net.au/science/experimentals/experiments/episode14_4.htm
http://www.abc.net.au/science/experimentals/experiments/episode14_2.htm
http://www.abc.net.au/science/experimentals/experiments/episode14_1.htm

Robot
http://en.wikipedia.org/wiki/Robot
http://www.robotics.com/report.html
http://www.dai.ed.ac.uk/groups/mrg/robots.html
http://chaoskids.com/ROBOTS/directory.html

Sound Waves and Resonance

Sound
http://www.glenbrook.k12.il.us/gbssci/phys/Class/sound/soundtoc.html
http://www.umanitoba.ca/faculties/arts/linguistics/russell/138/sec4/acoust1.htm
http://www.glenbrook.k12.il.us/gbssci/phys/Class/sound/u11l5a.html
http://www.abc.net.au/science/experimentals/experiments/episode27_1.htm
http://www.abc.net.au/science/experimentals/experiments/episode19_2.htm

Lissajou Figures
http://www.rfbarrow.btinternet.co.uk/htmasa2/Param1.htm
http://www.lifesmith.com/lissajou.html
http://www.mathsnet.net/graphanim.html#Lissajou
http://www.kettering.edu/~drussell/Demos/superposition/superposition.html
http://www.walter-fendt.de/ph11e/stlwaves.htm
http://www.colorado.edu/physics/2000/microwaves/standing_wave2.html

Renewable Energy

http://www.sustainableenergy.qld.edu.au/html/what.html
http://www.qse.org.au/education/community_ed.jsp
http://www.climatechange.gov.au/education/index.html
http://www.hydro.com.au/Home/Education/
http://www.csiro.au/csiro/channel/pchdo.html
http://www.environment.gov.au/settlements/renewable/
http://www.environment.gov.au/programs/greenvouchers/index.html
http://www.csiro.au/science/RenewableEnergy.html
http://www.teachsustainability.com.au/resources/our-energy-future-renewable-energy-proposal/view
http://www.esded.com.au/
http://www1.eere.energy.gov/education/
http://www.teachers.ash.org.au/jmresources/energy/renewable.html
http://www.depweb.state.pa.us/justforkids/cwp/view.asp?a=3&q=472538
http://www.energy.com.au/energy/ea.nsf/Content/Kids+Renewable+energy
http://earthsci.org/education/teacher/basicgeol/alt_energy/alt_energy.html
http://www.bom.gov.au
http://www.csiro.au/csiro/channel/pchdo.html