NATIONAL SCIENCE & ENGINEERING WEEK

Move it!

BRITISH SCIENCE ASSOCIATION

Part of the British Science Association's National Science & Engineering Week Activity Pack Series.

For further information visit
www.nsew.org.uk

BIS
Department for Business Innovation and Skills

National Science & Engineering Week is funded by the Department for Business, Innovation and Skills

Move it! About this pack:

This activity pack contains a range of different activities on the theme of motion for National Science & Engineering Week.

Activities are aimed at 5-11 year olds but may be suitable for a range of age-groups. They are intended to act as a stimulus for your own National Science & Engineering Week activities and can be tailored to the ability of the group.

The “Move it!” activities have all been designed for use in discrete 20–60 minute class or science club sessions. Activities 1-12 are short, fun experiments that can be done as filler activities or a range of round-robin sessions. They use resources that can be sourced cheaply and easily. Successful completion of each of activities 14 and 15 can count towards a CREST ★ Investigator award. There is one Star and one SuperStar activity in the pack.

In Star activities (usually for 5–7 year olds) children discuss, solve problems and share experiences. In SuperStar activities (usually for 7–11 year olds) children work independently, discuss ideas and how to test them, solve simple problems and decide how to share results. Extra suggestions are also given for each activity for older or more advanced children.

More information about CREST ★ Investigators from the British Science Association can be found at www.britishscienceassociation.org.

For more activities around the theme of motion, see the Ticket to Ride pack from www.nsew.org.uk

Activity 1: Melt! Boil!

Model a solid, liquid and gas

You will need:

- nine people
- a large open area, such as the school playground.

What you do:

1. Stand close to one another in a square, three people by three people, so you are just touching. If you keep perfectly still, you are representing a solid at absolute zero.
2. Now move so you are all about a 50 cm away from each other. You are now nearly – but not quite – representing particles in a solid at room temperature. You can make this model more accurate by moving from side to side and backwards and forwards, gently bumping into one another, but always keeping the overall square shape.
3. Now imagine someone turns on a heater. Can you feel yourself getting warm? Start jiggling faster. When someone shouts “melt!” start moving randomly so you are still about 50 cm away from one another, but no longer in your fixed square pattern. You are now representing particles in a liquid.
4. Someone’s turning the heater up! Start moving faster. When someone shouts “boil!” begin to break away from one another and fill the whole area that you’re in. Your movement should be fast and random. You are now representing particles in a gas.

What’s happening?

You are modelling a solid, liquid and gas. Scientific models such as this are very important – they help us to imagine what is happening in the world around us. Here, you are using people to represent particles: you are showing how the arrangement of particles changes between a solid, liquid and gas.

You could try:

Think about some other theories that you get taught in science lessons. Can you think of any other scientific models that you could try out?

Activity 2: Auto-inflate

Blowing up a balloon with yeast

You will need:

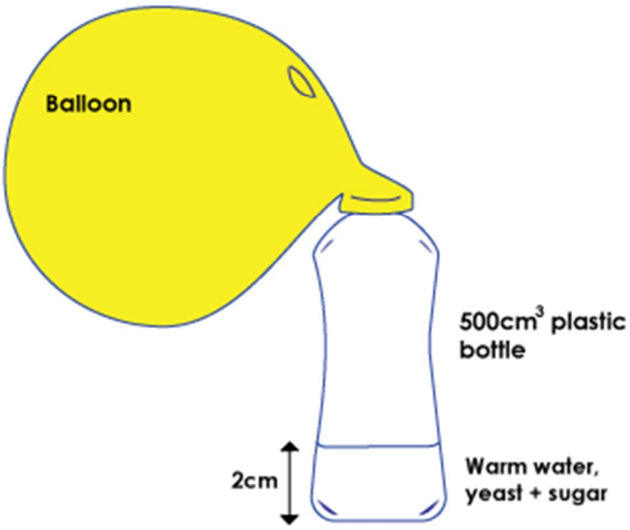
- about two teaspoons of baker's yeast
- one half-litre clear plastic bottle
- two teaspoons of sugar
- some warm water
- one balloon.

What you do:

1. Pour some warm water into the bottle – about 2 cm deep.
2. Add the yeast and give it a little swirl to help the yeast dissolve.
3. Add the sugar and give it another swirl.
4. Place the opening of the balloon over the top of the bottle.
5. Put the bottle–balloon contraption in a warm place for about half an hour – by a radiator would be good. Watch the balloon slowly inflate!

What's happening?

A chemical reaction takes place in the bottle, which releases a gas, carbon dioxide. The carbon dioxide (CO_2) pushes the air from the bottle into the balloon.



You could try:

See what happens if you change one or more of the variables. For example: use more yeast, use honey instead of sugar, leave the bottle in a cool place, use cold water instead of warm, and so on.

Activity 3: Falling raindrops

Imagine you're a rain drop

You will need:

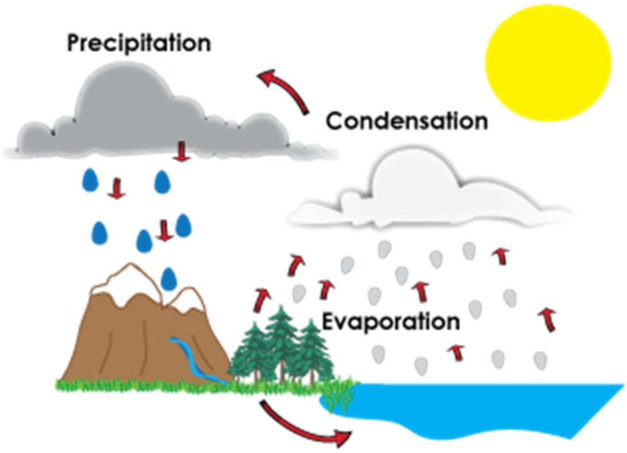
- some books and/or the internet for research
- a pen and paper, or a computer word processor.

What you do:

1. Do some research in books or on the internet (or ask your teacher!) to find out about the water cycle.
2. Imagine you are a water droplet. Describe the journey you would take from falling as a drop of rain, through all aspects of the water cycle and ending up back in a cloud.

What's happening?

You are using your writing skills to explain the water cycle. There is only a limited amount of water on Earth, and it goes around and around in a cycle. Explaining this as a descriptive story will help you to understand the process.



The Water Cycle

You could try:

You could try completing the same research/writing task, but find out and write about the carbon cycle.

Activity 4: Windy wonder

Investigate Bernoulli's principle

You will need:

- an electric hairdryer with circular nozzle
- a balloon
- a table tennis ball.

What you do:

1. Blow up the balloon and tie a knot in the end to keep the air in. Let go. It drops to the floor.
2. Turn on the hairdryer and point the nozzle directly up at the ceiling. Place the balloon above the nozzle and let go. You should be able to keep the balloon in the air.
3. Try doing the same thing again but, this time, slowly move the nozzle so it's pointed upwards at an angle. The balloon should follow the stream of air. Try moving the hairdryer back upright again, making the balloon follow the air stream.
4. Repeat the experiment with a table tennis ball instead of a balloon. See if you can make both the balloon and the table tennis float at the same time (using one hairdryer!)

What's happening?

This is a demonstration of something called *Bernoulli's Principle.* Daniel Bernoulli was a Dutch-Swiss mathematician born in 1700. He discovered that, the faster air flows over the surface of something, the less the air pushes on that surface (and so the lower its pressure). It's the reason we've managed to make aeroplanes fly.

You could try:

Make an airfoil (aeroplane wing) out of a piece of paper to see Bernoulli's principle in action.

Here's an example:

>> http://www.tryscience.org/experiments/experiments_wingit_athome.html

Activity 5: Moon in motion

Model the phases of the moon

You will need:

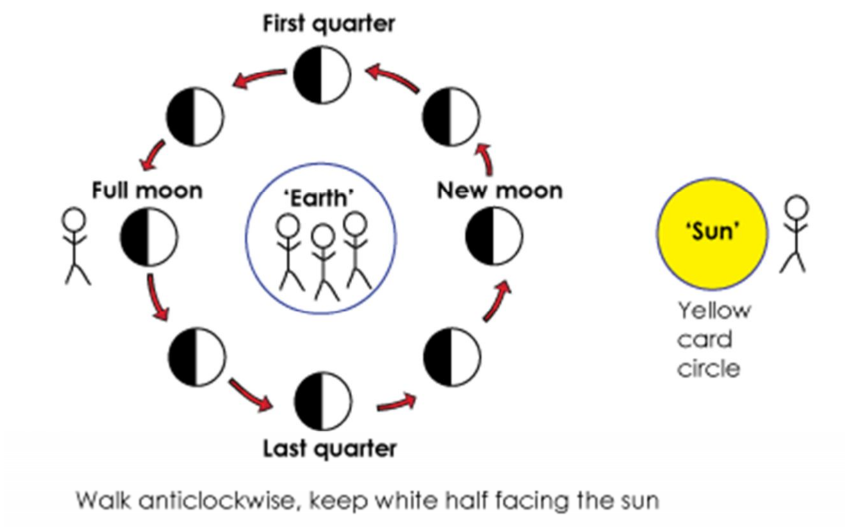
- a large ball (football or larger) with one half painted white and the other half painted black, to represent the Moon
- a large, yellow cardboard circle to represent the Sun
- a group of friends to represent the Earth.

What you do:

1. One person holds the ball ('the Moon'). Another holds the yellow circle ('the Sun').
2. The rest of the group ('the Earth') should stand together in a huddle between the Moon and the Sun.
3. The person holding the Moon walks anti-clockwise around the Earth, making sure the white half always faces the Sun.

What's happening?

The group representing the Earth will notice that they can see different amounts of white when the Moon moves around the Earth – when they're facing in the opposite direction to the Sun, the Moon appears white. When they are facing towards the Sun, the Moon appears dark. That's because the Moon reflects the Sun's rays – the half facing the Sun looks white because it is illuminated. The amount of illuminated Moon we can see depends on the Moon's position as it orbits the Earth.



You could try:

Find out more about the Moon's orbit. How would you change your model to make it more accurate?

Activity 6: Spinning screws

Make an electric motor

You will need:

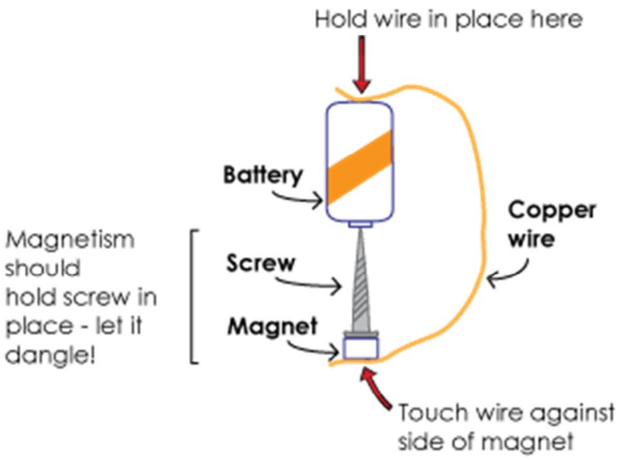
- small disc magnet
- about 10 cm of copper wire
- a 1.5 V battery (C type)
- a magnetic screw (a drywall screw should work).

What you do:

1. Bend the copper wire into a C-shape.
2. Place the flat end of the screw on the magnet.
3. Hold the battery vertically. Place the sharp end of the screw against the positive end of the battery, so it dangles down (it should stay in place because the screw is magnetic).
4. Hold one end of the copper wire against the negative end of the battery.
5. Gently touch the other end of the copper wire to the flat end of the screw.
6. Watch it spin!

What's happening?

You have made a 'homopolar' motor. It was invented in 1821 by Michael Faraday. It works because the current flows from the battery down through the screw, through the magnet, through the wire and back to the other end of the battery. An electric current is a flow of electrons. The electrons are affected by the magnetic field, causing the screw to spin around.



You could try:

Seeing what happens if you turn the battery round, or use a different sized-battery or magnet.

Activity 7: Hover balloon

Make a balloon-driven hovercraft

You will need:

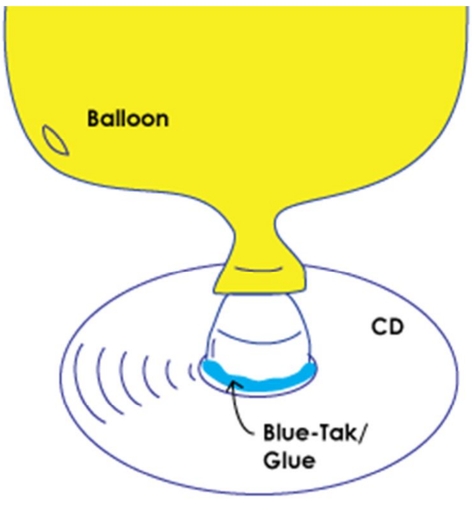
- CD (it might get ruined, so don't use your favourite!)
- bottle–top with a push/pull closure – like those on some sports drinks or water bottles
- *Blu-tack* or glue
- balloon.

What you do:

1. Make sure that the bottle-top is open. Make a ring using the *Blu-tack* and use it to make an airtight join between the bottle-top and the CD (keep the shiny side facing down). You could glue the bottle–top if you prefer.
2. Put the CD hovercraft onto a large, smooth surface.
3. Blow up a balloon and pinch the end so that the air doesn't come out.
4. Stretch the balloon's opening over the bottle-top.
5. Now let go of the balloon and give your hovercraft a gentle nudge.

What's happening?

Air escaping from the balloon lifts the CD, creating a cushion between the CD and the table top. The CD floats on the cushion of air. It moves easily when you push it because there's hardly any friction between the CD and the table. Without the cushion of air there is more friction, and it doesn't move so easily.



You could try:

Try using different materials to make your hovercraft. What happens if you try it on different surfaces? What about using different-sized balloons?

Activity 8: Whizzy washing-up liquid

Make a soap-powered boat

You will need:

- piece of card
- scissors (be careful with the scissors)
- ruler
- washing-up liquid
- sink or bath full of water.

What you do:

1. Measure and cut out a piece of card about 10 cm x 5 cm. This is your boat.
2. At one end of the boat, fold the two corners in to make a point – this is the front.
3. At the back, in the centre, cut out a small slot – this is the boat's engine.
4. Place the boat on the water. Add a few drops of washing-up liquid to the engine. Watch your boat go!

What's happening?

Water has a 'skin', called surface tension. It's strong enough for the cardboard boat to lie on top. The tension pulls the boat equally in all directions, so it doesn't move.

Detergent breaks down the skin. If there is detergent at the back of the boat and none at the front, the water pulls the card more at the front than at the back: the boat moves.

You could try:

Make a more sophisticated model boat. Can you create an engine that releases washing-up liquid drop by drop, so that it keeps moving?

Activity 9: Rocket blasters

Baking powder rockets

You will need:

- plastic case for camera film (or a small plastic pot with tight-fitting lid – but not a screw lid
- vinegar
- baking powder (bicarbonate of soda)
- safety goggles.

What you do:

1. Make sure that you do this experiment outside in a wide open space. Wear safety goggles.
2. Take the lid off the plastic pot. Fill it with baking powder.
3. Add about two teaspoons of vinegar. Put the lid back on.
4. Quickly, but carefully, turn the plastic pot upside-down, place it on the ground and stand well back.
5. After a few seconds, watch your rocket fly!

What's happening?

You have created an 'acid-base' reaction. The baking powder (a base) reacts with the vinegar (an acid) and makes carbon dioxide (a gas). The carbon dioxide builds the pressure within the plastic case until eventually its lid pops and it flies into the air!

You could try:

Instead of making a rocket, you can make an exploding bag – add baking powder, vinegar and warm water to a 'zip-lock' sandwich bag and seal it. Shake and stand back!

Activity 10: Shake it

Can you move the marble through the salt?

You will need:

- plastic test tube with screw lid or bung, or similar
- salt
- a marble.

What you do:

1. Pour salt into the test tube until it's about three-quarters full. Add the marble and put on the lid.
2. Now try moving the marble from one end of the test tube to the other, through the salt.
3. Here's how you do it: turn the tube upside down so the marble is at the bottom.
4. Now shake the test tube up and down … the marble will rise up through the salt.

What's happening?

There is more friction against the salt crystals than the glass marble because they are smaller. So, the salt slows down more quickly than the marble. At each shake, some salt settles under the marble. Eventually the salt pushes the marble to the top of the tube.

You could try:

Try using something other than a marble, or something other than salt.

Activity 11: Water rising

Capillary action in action

You will need:

- Part 1:
  - two 100 cm^3 beakers (or glass tumblers)
  - two sheets of paper towel.
- Part 2:
  - two 100 cm^3 beakers
  - a white carnation
  - food colouring (any colour)
  - sharp craft knife [be careful].

What you do:

1. Part 1:
   a. Twist the two pieces of paper towel together, so that it looks a bit like a small rope.
   b. Pour water into one of the beakers to about three-quarters full. Place it next to the empty beaker.
   c. Bend the paper 'rope' and place one end in the water, and the other in the empty beaker.
   d. Sit back and – patiently – watch as the water moves through the paper into the empty beaker. It will stop when both beakers contain the same amount of water.
2. Part 2:
   a. Three-quarters fill both beakers with water.
   b. Add a few drops of food colouring to one of them.
   c. Using the knife, split the stem of the white carnation from the bottom to about half way up the stem.
   d. Place one half of the split stem in the plain water, and the other half in the water and food colouring mix.
   e. Leave it overnight and check out the results.

What's happening?

In a plant stem there are long narrow tubes that transport water and food to the flowers. When this water evaporates from the flowers (the same as when we sweat), more water rises up the tubes.

There's two reasons why the water rises: suction (like sucking water through a straw) – water lost from the flower leaves a space in the tube which pulls on the water below – and capillary action – the tubes are very narrow and the water particles want to stick together, so the water climbs the tube.

Each tube is connected to one part of the flower, so you can see where the water is going.

You could try:

See capillary action in action with a celery stalk – chop the end off the celery and place it in a mixture of water and food colouring. Within a day you should be able to see the food colouring work its way up the stalk and into the leaves.

Activity 12: Super spinners

Make a paper helicopter

You will need:

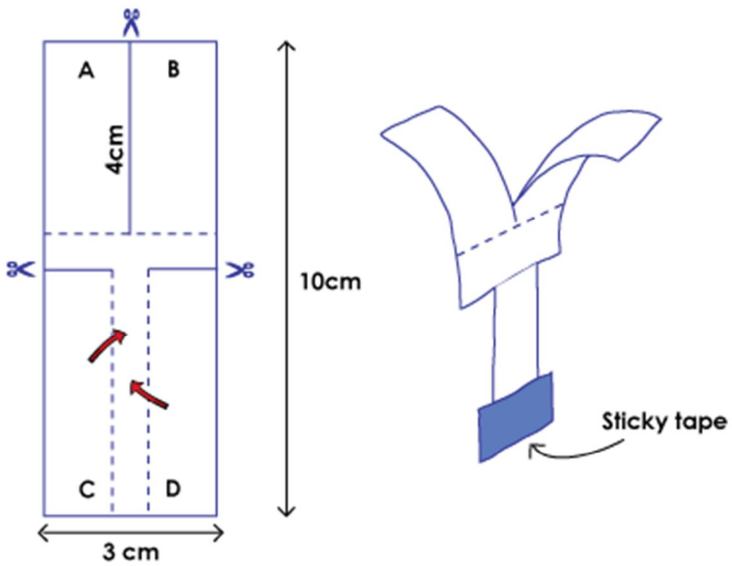
- paper
- scissors [be careful]
- ruler
- sticky tape.

What you do:

1. Cut out a strip of paper, 3 cm x 10 cm. Measure and draw lines on it, as in the diagram. Cut along the solid lines.
2. Fold section A along the horizontal dotted line towards you, so it's at a right angle.
3. Fold section B along the horizontal dotted line away from you, so it's at a right angle.
4. Now fold along sections C and D towards you, all the way back.
5. Wind some sticky tape around the bottom – about three winds – to add a bit of weight and keep it held together.
6. Drop you helicopter from as high a point as you can. You might want to try standing on a chair [be careful!] or drop it over some stair banisters.

What's happening?

When the paper helicopter falls to the ground, air pushes up against its blades. They bend ever so slightly. The air then pushes upwards on a slanted blade and some of that thrust becomes a sideways (or horizontal) push. It doesn't just move sideways, though, because there are two blades which have equal forces acting on them in opposite directions.



You could try:

Try altering your design – what happens if you use different paper or card, or make it bigger or smaller, for example? How slowly can you make the helicopter fall to the ground?

Activity 13 (group activity): Balloon racers

Make a vehicle powered by a balloon

You will need:

- one balloon per group (but have some spares in case they burst!)
- materials for making a model vehicle, such as: *Lego*, *K'nex*, *Meccano*, or similar (including wheels!); different types of paper/card; lolly sticks; food trays and other packaging; plastic bottles; straws
- tools for cutting and joining materials, such as: scissors and craft knives [CARE]; sticky tape; masking tape; staples; different types of glue.

What to do:

The challenge is to make a vehicle powered by a single balloon. Who can make it travel furthest in a straight line?

Make sure that each group has the same type and size of balloon, to ensure a fair competition.

Remember, this challenge is about is about distance not speed.

Build your racer from the construction and modelling materials provided. It doesn't matter if different groups use different materials – however, if you would like it to be a fair test then everybody should use exactly the same equipment. The choice is yours!

Key questions to think about:

1. How will the balloon attach to your machine?
2. How and when will you inflate the balloon?
3. How will your machine move?
4. How will you make sure your machine travels in a straight line?

Background information

This group activity – as well as being fun – is a good demonstration of Newton's Third Law of Motion (law of reciprocal actions). It states: "Whenever a particle A exerts a force on another particle B, B simultaneously exerts a force on A with the same magnitude in the opposite direction. The strong form of the law further postulates that these two forces act along the same line."

In other words, every action has an equal and opposite reaction: the air escaping from the balloon is the action, and the car's propulsion across the room in the opposite direction is the reaction.

Background notes

For each activity, read through the pupil instructions to familiarise yourself with the method. Make sure the pupils understand what they are going to do.

Check the 'you will need' list and make sure that everything that pupils need is available. Extra materials may be needed if trial runs or repeats are necessary.

Give pupils all the equipment they need and make them aware of any health and safety issues; a risk assessment should always be carried out before starting any practical work.

Read through the notes below for some background information on the science behind each activity.

Curriculum links

Working through this activity pack touches on many areas of the 5-11 curricula, but activities can also be adapted for KS3. Some of the supportive background notes in this section go into topic details which are covered at secondary level and have been included to provide the teacher with further background should it be required. Activities are intended as a stimulus and can therefore be adapted based on the ability of the group.

England KS1 and KS2 (purple indicates KS2 only)

- ★ Sc1 Scientific enquiry (Ideas and evidence in science; Investigative skills)
- ★ Sc2 Life processes and living things (Life processes; Green plants; Living things in their environment)
- ★ Sc3 Materials and their properties (Grouping and classifying materials; Changing materials; Separating mixtures of materials)
- ★ Sc4 Physical processes (Electricity; Forces and motion; Light and sound; The Earth and beyond)

Northern Ireland KS1 and KS2

- ★ 3.4 The world around us (Interdependence; Place; Movement and energy; Change over time)

Scotland (Experiences and outcomes for levels 1–2)

- ★ Planet Earth (Biodiversity and interdependence; Energy sources and sustainability; Processes of the planet; Space)
- ★ Forces, electricity and waves (Forces; Electricity; Vibrations and waves)
- ★ Materials (Properties and uses of substances; Chemical changes)

Wales KS1 and KS2 (purple indicates KS2 only)

- ★ Scientific Enquiry (The Nature of Science; Communication in Science)
- ★ Life Processes and Living Things (Life Processes)
- ★ Materials and their Properties (Grouping Materials; Changing Materials)
- ★ Physical Processes (Electricity; Forces and Motion)

Activity 1:

Pupils are likely to be familiar with 'scale models' of large objects such as model cars, planes, boats and buildings.

Scientific models are very important in science. Most scientific models are precise mathematical descriptions, but simpler ones are also are also used to help imagine what is happening. Models help in making sense of the world around us. Models help us picture objects, from the very large (e.g. habitats or the solar system) to the really tiny (e.g. atoms or cells). Models also help us understand changes, for example, erosion, energy transfer and changes of state.

The particle model of matter and changes of state is one important example. Using people to represent particles, the arrangement of particles in solids, liquids and gases can be visualised. It is a very simple model, but can be the starting point for the development of more sophisticated models as pupils continue their scientific education.

Activity 2

Changing sugar into ethanol and carbon dioxide is the essential process in bread-making and in beer and wine making. However, the change is extremely slow unless yeast is added. Yeast catalyses the reaction, in other words makes it go faster. At the end of the reaction, yeast is still there. The word equation for the reaction is simply: sugar → ethanol + carbon dioxide. Warming the reaction mixture also makes it go faster, though if the temperature gets too high, the yeast no longer works.

Carbon dioxide is released and pushes the air in the bottle into the balloon (carbon dioxide displaces the air). Further carbon dioxide is produced and fills the balloon. Pupils might find it interesting to compare what happens when two balloons of similar size, one filled with air and the other with carbon dioxide, are dropped from the same height. The one with carbon dioxide has greater mass (carbon dioxide is denser than air) and falls to the ground more quickly.

Activity 3

The earth has a limited amount of water – it keeps going around and around in the Water Cycle. This cycle is made up of a few main parts: evaporation (and transpiration); condensation; precipitation; collection.

Other essential ideas are that ice melts to form water and water evaporates to form water vapour (even though it cannot be seen and some pupils might think it has 'disappeared'). The warmer it is, the faster these changes happen. More difficult, perhaps, is the idea that when the reverse changes happen, the surrounding air gets warmer.

There are three states of matter – solid, liquid and gas. Water can exist in each of these, as ice, water and water vapour. Changing from solid to liquid and liquid to gas requires energy. This energy has to be transferred from somewhere. The Sun stores energy which is carried to Earth by light (electromagnetic radiation). When a puddle dries, for example, energy carried from the Sun is transferred to water, making water particles move faster and faster until they escape from the liquid. Water evaporates. The reverse change, water vapour to water releases energy which is transferred to the surroundings.

Activity 4

This is a demonstration of *Bernoulli's Principle.* Bernoulli discovered that the faster air flows over the surface of something, the less the air pushes on that surface (and so the lower its pressure). So, the air from the hairdryer flows around the outside of the balloon (or table tennis ball) evenly around each side. Gravity pulls the ball downwards while the pressure below the ball from the moving air forces it upwards. This means that all the forces acting on the ball are balanced and the ball hovers in mid-air.

When you move the hairdryer the balloon will follow the stream of air because the fast moving air around the sides of the ball is at a lower pressure than the surrounding air.

Bernoulli's principle is key to how aeroplanes fly – air rushing over the top of the wings exerts less pressure than air from under the wings.

Activity 5

The Moon reflects the Sun's rays, which is why the half facing the Sun is always white – it is illuminated. The amount of illuminated moon that we can see depends on the Moon's position as it orbits the Earth. The different phases are called:

- New Moon (when it appears dark)
- Waxing Crescent (when less than half of the right-hand-side is illuminated)
- First Quarter (when the whole right half is illuminated)
- Waxing Gibbous (when more than half of the right-hand-side is illuminated)
- Full Moon (when the whole moon is illuminated)
- Waning Gibbous (when more than half of the left-hand-side is illuminated)
- Last Quarter (when the whole left half is illuminated)
- Waning Crescent (when less than half of the left-hand-side is illuminated).

Did you know: the phrase "once in a blue moon" refers to when two full moons occur in the same month.

Activity 6

An electric circuit is made when one end of the copper wire touches the screw head and the other end touches the magnet. Electrons move through the circuit, produce an electric current. They move from the battery back into the battery. It is usual to say that electricity flows from the positive terminal to the negative terminal, but this was before scientists found out how to find the direction of flow of electrons. This is called conventional current. It is known now that electrons move from the negative electrode to the positive electrode. However, to avoid confusion conventional current is always used.

Because of the arrangement of the copper wire and the disc magnet, electric current flows from its centre to the outer edge. A magnet attracts iron or steel objects. The region in which it can do this is called its magnetic field. The field cannot be seen, but its effects can. The magnetic field also affects moving electrons. The force felt by the electrons flowing through the disc magnet cause the magnet to spin.

Activity 7

When air escapes from the balloon, it lifts the CD and creates a cushion between the CD and the table top. The CD floats on a cushion of air. Gently push the CD and it will move along very easily, which does not happen if there is no air cushion. This is because there is no resistance due to friction between the CD and the table top. This could lead to a discussion about other ways in which friction can be reduced, for example, by having very smooth surfaces or using lubricants. The issue of too little friction might also be raised.

Activity 8

The intermolecular attractions of the molecules in the water are in equilibrium, attracting and repelling in equal measure. At the surface, where the air and water meet, water molecules at the surface experience more downward attraction towards other water molecules than upwards towards the air. This creates the surface tension of the water.

When detergent is added, nearby water molecules and detergent molecules are attracted molecules: detergent molecules spread over the surface of the water. This decreases the surface tension.

Surface tension supports the card boat on the surface of the water. It is pulled equally in every direction, and so does not move.

Placing the detergent at the back of the boat reduces the surface tension there. Because the detergent is in the notch, the only way for it to disperse is by moving out the back. The equilibrium is broken and the tension at the front 'pulls' the boat forward.

When the detergent has spread out across the surface of the water, the boat will stop moving forwards.

Activity 9

Baking powder is a mixture of flour and bicarbonate of soda. The correct chemical name for bicarbonate of soda is sodium hydrogencarbonate, but it is also called sodium bicarbonate. It may be frustrating to have so many options, but over the years scientists have tried to rationalise how chemicals are named and come up with a commonly agreed system. Another example is vinegar. Vinegar is a solution of acetic acid in water. The correct chemical name for acetic acid is ethanoic acid.

When a solution of ethanoic acid is added to sodium hydrogencarbonate this reaction happens:

sodium hydrogencarbonate + ethanoic acid → sodium ethanoate + water + carbon dioxide

Sodium ethanoate stays in solution, but carbon dioxide is a gas. As more and more of it is produced the pressure builds up in the plastic film case. Eventually the pressure is so great that the plastic box is blown off its base and the rocket flies into the air.

Activity 10

When the tube is shaken, the salt and the marble move up and down. They move up at the same speed. However, after each shake, the salt crystals slow down quicker than the glass. Some salt settles under the marble. With each shake, more salt packs under the marble. Eventually all of the salt will have settled under the marble.

Salt crystals are less dense than glass and are smaller than the marble. When they rub against each other, because of their relative size and density, the salt crystals experience greater friction. Hence, they slow down quicker than the marble.

Activity 11

In transpiration, plants take up water and nutrients through their roots and the water evaporates from leaves and flowers. In a stem, the water passes along the xylem, which are narrow tubes running through the stem.

As the water evaporates, there is a pressure change and more water is then pulled up through the xylem. The water moves upwards (usually) because water molecules attract one another – cohesion – overcoming gravity. This, together with the narrowness of the tubes, brings about capillary action.

Cut flowers can access water and nutrients where the stem is cut, and pass water through in the same way.

In this demonstration, some xylem, with their ends in the coloured water, transfer the colour to those parts of the flower that they supply. The other xylem carry the clear water to other parts.

Activity 12

When the paper helicopter falls to the ground, air pushes up against its blades. They bend slightly. The air then pushes upwards on a slanted blade and some of that thrust becomes a sideways (or horizontal) push. It doesn't just move sideways, though, because there are two blades which have equal forces acting on them in opposite directions. Two opposing 'thrusts' make the helicopter spin.

Have pupils watch the direction that the helicopter spins – clockwise or anti-clockwise. Then ask them to fold the blade in the other direction, and see if the helicopter spins the other way. This activity can be adapted as a CREST ★ Investigator activity, see: http://www.britishscienceassociation.org/web/ccaf/CRESTStarInvestigators/AdditionalResources/SuperStar/Superspinners.htm

Activity 14: Sweeties have the answer

Splitting the colours from sweets

Star

Your challenge:

Sweets come in all sorts of colours and you will know from art that mixing primary colours makes lots of different secondary colours. Your mission is to find out how you can see the different colours that go into one sweet.

Talk about:

1. What colours are there in your packet of sweets?
2. Which colours would you expect to see when they have separated?
3. What other things can you find that have colour in them?

Here are some things to get you started:

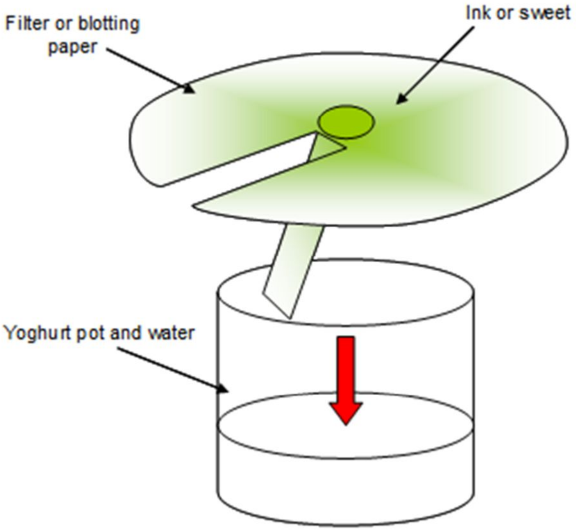
- ★ Put a small amount of water in the bottom of a plastic container.
- ★ Cut two slits into the side of your blotting paper so that there is a strip of paper which can hang into the pot of water while the rest of the paper rests on the top (see diagram).
- ★ On top of the blotting paper, place one of your sweets. Leave this for around 5–10 minutes.
- ★ Measure the distance each colour travels from the centre.

Sharing your ideas:

What happened to the colours from the sweets? Which colours travelled further from the sweets? What does this tell you about that particular colour?

Here is an extra challenge:

Try the experiment again using the colour from a felt-tip pen instead of a sweet. Does the same think happen to ink as it does to food colouring?



Sweeties have the answer: Organiser's notes

What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list.
3. Give the pupils time to think about the nature of colour and how colours can be combined/separated.
4. Ensure that pupils understand that this investigation involves observation and comparison.
5. Give them the equipment needed to analyse the dye in sweets.
6. Ask the pupils to predict/guess what will happen to the colour from the sweet as the water spreads across the paper.

Background

The suggested method is known as paper chromatography. This method and its more sophisticated variants are widely used in chemical analysis in, for example, forensic science. It is a way of 'fingerprinting' substances, by separating out its constituents.

Washable pens and sweets are used in this experiment as their pigments are water soluble. Although some inks often only appear to be made up of one colour, they are usually composed of a number of different pigments. As the water moves up and outwards onto the circle of paper, the different pigments are carried through the paper at varying speeds. Pigments which are more soluble in water move through the filter paper at a faster rate and will travel further from the centre than those which are less soluble; this should cause a series of concentric, differently coloured circles to form on the paper.

Pupils will be able to see not only the different colours that are combined in an ink, but they will be able to measure the length of each colour and measure its position from the dot or the sweet. (When these measurements are written as a fraction of the distance that the water travelled, that value is unique to each dye in the mixture.) Measurements will be easier after the paper has been taken out of the water and left to dry for a few minutes.

Extra challenges: Black pens can contain a great variety of colour pigments. However, you would need to check beforehand, as many black inks are based on carbon black, which is only black.

Suggested materials

Filter paper, scissors [CARE], plastic containers dishes (like a yogurt pot or a beaker), a variety of sweets and pens (smarties and felt tips or similar, black and brown felt-tips/smarties produce the widest range of colours).

The filter paper should be cut as in the diagram above.

Safety points

Pupils may need aprons to avoid marking clothes with ink/food dye.

Provide a means to mop up any water spills.

Additional information:

For a similar activity for slightly older pupils, see the CREST ★ SuperStar Activity, Investigating Ink
http://www.britishscienceassociation.org/web/ccaf/CRESTStarInvestigators/AdditionalResources/SuperStar/Investigatingink.htm

Activity 15: Disappearing shells

Naked eggs and osmosis

Your mission is to find out if it possible to remove the shell of an egg without boiling or breaking it. Learn how to make a "naked egg". Then use your knowledge to design an investigation.

Talk about:

1. How can you take the shell off of an egg without breaking it?
2. How will you measure the egg – where will you put the tape measure?
3. What measurements and observations will you write down?

Here are some things to get you started:

- ★ How do you remove the shell from an egg without breaking it? You use vinegar to dissolve the shell: place an egg in a jar and cover it with vinegar and leave it for up to a week. The vinegar should dissolve the shell, leaving the egg inside its rubbery membrane. Try searching the internet for step-by-step instructions.
- ★ Could you put a ruler behind the egg and then read off the width or height, or some other method? Can you use the same method for the naked egg? What are the best units to use?
- ★ How will you make sure that your test is fair?
- ★ Could you use anything else to remove the shell other than vinegar, would coke work?
- ★ What is osmosis? (This is quite complicated – but it will explain why the egg becomes bigger.)

Sharing your ideas:

After the experiment what did you find?

What happened to the shell?

What happened to the egg?

Can you explain why?

Here is an extra challenge:

Investigate osmosis further:

Make and measure three 'naked' eggs using the procedure above. Place them into three different jars – one with plain water, one with water and food colouring, and one with sugar solution (water with a few spoons of sugar dissolved in it).

Leave the eggs for a few days. Take them out and carefully pat them dry. Measure them. Which ones have become bigger? Which has become smaller? Now pop them with a pin. Has the food colouring made its way into the egg?

Disappearing shells: Organiser's notes

What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list.
3. Make sure that the pupils understand their science mission – to investigate how things change.
4. Give the pupils time to think about dissolving and what it is. What won't dissolve?
5. Give them the equipment needed to measure the eggs.
6. Ask the pupils to predict/guess what will happen to the eggs.

Background

Egg shells are made of calcium carbonate. This reacts with the acetic acid in the vinegar – it breaks up into calcium and carbon dioxide. Pupils will see bubbles of carbon dioxide form on the egg and rise to the surface. The calcium floats to the top, leaving a film on the surface of the vinegar. The vinegar does not remove the egg's membrane.

If pupils measure the egg before they put it in the vinegar, and then measure the 'naked' egg when it is taken out of the vinegar, they will notice that it has become larger. This is because the water in the vinegar moves through the cell membrane. It moves by the process of osmosis – from an area of high concentration to an area of low concentration.

Extra challenges: The egg in plain water and coloured water get bigger – water passes into egg through the membrane by the process of osmosis. When popped, pupils will notice food colouring inside the egg, because it also passes through the membrane. The egg in sugar solution becomes smaller – water flows through the membrane from a higher concentration inside the egg to a lower concentration in the sugar solution outside the egg.

Suggested materials

Eggs; white vinegar (5% concentration); jars with lids; paper towels; food colouring; water; a pin; sugar; ruler; tape measure.

A suitable place to store the jars will also be required.

Safety points

Pupils should wash their hands after handling the eggs and the vinegar.

Provide a means to mop up any water and egg spills.

Ensure that the eggs are disposed of in a suitable container, at the end of the investigation.

For older pupils

Try using kettle de-scaler [CARE: CORROSIVE] to remove the egg shell. Compare the speed at which it dissolves the shell at different dilutions (for example, 1:2 (one part de-scaler to two parts water), 1:3 and 1:4).

Thank you for using Move it!

We hope you enjoyed the activities within this pack. To help us to continue to provide new activity packs, we'd like to ask you to tell us a little about what you did for National Science & Engineering Week.

Please take a few minutes to fill in this form (please complete in BLOCK CAPS only).

Name: ____________________

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Which dates did you do National Science & Engineering Week activities on?

What did you do?

Please make any comments about this activity pack, National Science & Engineering Week and/or other possible topics for future packs (feel free to continue on a separate sheet of paper).

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