NATIONAL SCIENCE & ENGINEERING WEEK

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Domestic science

Part of the British Science Association's National Science & Engineering Week activity pack series. **www.nsew.org.uk**

BIS | Department for Business Innovation & Skills

BRITISH SCIENCE ASSOCIATION

About this pack:

Background

This year's activity pack investigates the science in your life. There are activities about the food you eat, the way you wash, your belongings and your surroundings. It will even try to explain some everyday mysteries—like how does the rug get across the room by itself? Follow our exploration of science in the home, through the kitchen, bathroom, living room and garden.

The first section contains details on how to carry out the activities. The second section has background notes on the science behind the activities.

Educational links

All activities in this pack contribute towards Key Stage 1 Investigation and Skills in science, Skills in designing and making and Skills in social subjects in the 5-14 Guidelines. We recommend that you consult the National Curriculum on the website (www.nc.uk.net), and the 5-14 Guidelines (www.ltscotland.org.uk/5to14).

Science safety

Many of these activities involve using heat and/or potentially dangerous objects and ingredients. Please read each activity carefully, and take appropriate measures to ensure the safety and enjoyment of all participants.

Acknowledgements

Activity 8 was donated by the Schools & Home energy Education Project. For more information see: www.pluggingintothesun.org.uk
Activity 10 was donated by The Making Place, London. To find out more about their activities see: www.themakingplace.co.uk
Activity 20 was donated by Eureka! the Museum for children in Halifax. To find out more about their activities see: www.eureka.org.uk
Activity 21 is adapted from the book 'Nature Detectives: Environmental Science for primary children' (Max de Boo, Association for Science Education and The Woodland Trust). www.woodland-trust.org.uk

Section A: Kitchen science

Breakfast boogie.

You will need: puffed rice breakfast cereal, Perspex (or glass) sheet, woolen cloth or towel.

Pour a few handfuls of breakfast cereal onto a flat surface. Place a few small boxes or similar around the edges as supports and lay the Perspex over the top. Use the cloth to rub the Perspex as if you are polishing it. What happens to the cereal? Can you explain what you see?

Challenge: What happens when you use a mixture of different cereals?

Eat your greens.

You will need: saucepan, water, 2/3 small pieces of fresh broccoli (or another green vegetable), baking soda, a cooking hob, a timer.

Half fill the saucepan with water and place it on the heat. When the water starts to boil add the broccoli and start the timer. Watch the broccoli carefully and record what happens to its colour. After a few seconds, put the lid on the pot. Boil the broccoli for 15 minutes. Then remove it and place it on a plate. What has happened to the colour? Does the broccoli taste good?

Challenge: What happens if you add baking soda to the water?
Challenge: How can you have bright green and firm broccoli?

Micromagic.

You will need: 3 identical glasses (microwave safe), water, cooking oil, microwave oven.

Put 3 cm of (room temperature) water into a glass and put it in the microwave for 15 seconds. Carefully remove the glass and feel the outside. What has happened?

Now do the same with a clean glass but use oil instead of water. What has happened to this glass? When both glasses have cooled to room temperature, put them back into the microwave with the third (empty) glass for 15 seconds. What is different about the 3 glasses?

Challenge: Can you explain how microwaves work and predict the effects on other liquids?

Colourful cabbage.

You will need: red cabbage, pan, water, strainer, bowl, hot plate, paper towel—cut into strips selection of liquids, (including vinegar and baking soda solution).

Break the cabbage leaves into small pieces and heat in a pan of water for 15 minutes. Strain the leaves over a bowl (what colour is the cabbage now?). Soak the strips of paper towel in the cabbage water then spread them out and leave them to dry. When dry, dip one into the vinegar and one into the baking soda solution. What happens? Can you explain why the two liquids behave differently?

Challenge: How many different colors can you make the paper turn?

Bread.

You will need: 700g strong bread flour, 1 tablespoon salt, 1 teaspoon dried yeast, 1 teaspoon caster sugar, 425 ml warm water, bowl, wooden spoon, flat, clean work surface, extra flour for dusting, oil, plastic food wrap, 900g (2lb) loaf tin (or two 450g tins), oven at 230°C (GM8/450°F), wire rack.

Use a sieve to put the flour, salt, yeast and sugar into a bowl. Make a small depression in the centre of the mixture and add the water. Use a wooden spoon to mix the ingredients together. What happens to the mixture? (When it becomes difficult to use the spoon, you can use your hands).

Transfer the dough to the work surface (you may need to lightly flour the surface if the dough is sticky). Knead the dough for approximately 3 minutes. Return the dough to the bowl. Lightly oil one side of the plastic wrap and cover the bowl with the oiled side facing the dough. Leave for approximately 2 hours. What has happened to the dough? Can you explain why the dough has risen?

Knock the air out of the dough and knead for 2 minutes. Pat the dough into a rectangular shape, fold the ends into the centre so that one end slightly overlaps the other. Cover with plastic wrap again and leave for about 1 hour.

What has happened to the dough now? Place the loaf on the centre shelf of the pre-heated oven for 40 minutes. When you remove it from the tin tap the base of the loaf—it should sound hollow. If you like very crusty bread you can return it to the oven without its tin for 5 more minutes.

Challenge: What could you change to make bread with a soft crust?

Honeycomb toffee.

You will need: 4 desert spoons granulated sugar, 2 desert spoons syrup, 1/4 teaspoon bicarbonate of soda, and saucepan.

Measure the sugar and syrup into a pan and stir over a medium heat. What happens to the sugar? When the sugar has completely dissolved, bring the mixture to the boil and let it bubble until the mixture turns dark brown. Why has the colour changed? Add ¼ teaspoon of bicarbonate of soda. What happens to the mixture? Allow to froth while stirring out any lumps. Pour onto a baking tray and allow to cool. What happens to the mixture as it cools down?

Challenge: What other sweets could you make by altering the properties of sugar?
Challenge: Design a gift box for your toffee.

Dressing the salad.

You will need: 4 containers with lids (e.g. jam jars), olive oil, vinegar, pepper, stopwatch/timer.

Half-fill one container with olive oil and another with vinegar. Record what they look like. Pour 2 tablespoons of oil and 2 tablespoons of vinegar into each of the third and fourth containers. Shake one of these for 5 seconds and the other for 60 seconds. Record what happens to the liquids. How long does it takes for each one to separate?

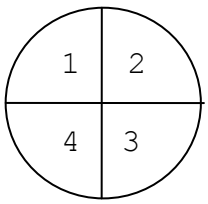
Add pepper to one of these containers. Shake both containers for 30 seconds. How long do they take to separate now? Why do you think the 2 mixtures behave differently?

Challenge: How can you alter the proportions of the ingredients to make a delicious but more stable salad dressing?
Challenge: Can you find 3 everyday examples of emulsions?

Section B: Bathroom Science

How clean are your hands?

You will need: 2 sterile dishes, (Petri dishes are ideal but you could use any shallow container sterilized in hot water, a pressure cooker or an oven), nutrient agar, (alternatively you can use unflavoured gelatine available from supermarkets and pharmacies), soap, water.



Fill the sterile containers with nutrient agar (or gelatine) and leave to set. Divide each container into 4 numbered quarters (see diagram). Label one container "Water," and the other "Soap."

Touch section 1 of the dish labelled Water with your fingers. Wash your hands well in water but without using soap. Shake off excess water (do not dry your fingers with a towel) and while still wet touch section 2. Wash again and touch section 3. Wash a final time and touch section 4.

Touch section 1 of Soap with your fingers. Wash your hands well in water and soap. Shake off excess water (do not dry your fingers with a towel) and while still wet touch section 2, wash again and touch section 3, and wash a final time and touch section 4.

Leave the plates in a warm place for 48 hours. Look carefully at each of the quadrants. What is different about them?

Challenge: What happens when you use different soaps i.e. antibacterial vs. moisturising, bar vs. pump bottle?
Challenge: What happens if you use hot water?

Testing tissues.

You will need: variety of paper tissues, weights, water.

Fix a sheet of tissue in place (e.g. stretch a sheet across a gap between 2 tables and weigh down at each end). Gradually add weights to the span. What happens to the tissue?

Challenge: What is the strongest tissue you can find?
Challenge: How does the strength of different tissues change when wet?

Flushed.

You will need: toilet, water, glasses, a bucket (approximately 7l).

Pour 2 glasses of water into the toilet. Wait a few seconds. What has happened? Has the water level changed? Pour in another 2 glasses of water. Has anything happened now? Now get a full bucket of water and use the glass to empty it into the toilet 1 glass at a time. What happens?

Now refill the bucket and pour all the water into the toilet. What happens? If the amount of water is the same, why does it behave differently when you pour it in all in one go?

Challenge: What is the minimum amount of water needed for the toilet to flush?

Hot water.

You will need: cardboard box (at least 45 x 30cm and no higher than 10cm), 3m of flexible plastic tubing, (2mm thick and 1.2 cm diameter), matt black paint, a paint brush, 2 6l buckets with lids, (you could make cardboard lids), 2 thermometers, food colouring, aluminium foil, clear plastic or Perspex sheets (the same size or larger than the box), newspaper, extra cardboard, tape.

Make 2 holes (the same diameter as the tubing) in the box at opposite ends of one side. Glue aluminium foil inside the box and paint the outside black.

Push the tubing through one hole. Curl it around the bottom of the box and poke the end out of the other hole. Leave equal amounts of tubing sticking out of each hole. Paint the tubing inside the box black.

Tape the sheet of clear plastic onto the top of the box. Make sure it is airtight.

Tape newspaper around the outside of the buckets to insulate them. Make 2 holes (the same diameter as the tubing) in the lid of one of the buckets (this is your experiment bucket the other is the control). Fill both buckets with water and replace the lids.

Push one end of the tubing from the box into the experiment bucket until it reaches the bottom of the bucket. Push the other end into the bucket so that it is in the water but near the top of the bucket (you may need to cut off some excess tubing).

Prop the box up at a slant so that it is facing the sunlight. Place the experiment bucket on some support (books/box) so that the bottom of the bucket is higher than the top of the box. Arrange the control bucket at the same level.

Take the end of the tube near the top of the bucket and suck on it to fill it with water. Push the tube back into the water making sure that there is no air in the tube. Your solar heater is now ready.

Leave the solar heater and control bucket in the sun for 1-2 hours and measure the temperature of the water periodically, as well as the temperature inside the heater.

Challenge: Can you make the water hotter?

Money laundering.

You will need: dull or dirty copper coins, white vinegar, 1 teaspoon salt, glass bowl, paper towels.

Pour the vinegar into the bowl. Add the salt and stir until it dissolves. Drop the pennies into the bowl. What happens?

Rinse the pennies well under running water. Place them on a paper towel to dry. How have the pennies changed?

Challenge: What happens if you don't rinse the pennies?
Challenge: What happens if you use different types of coins?

Living room science

Creeping carpets.

You will need: room with a carpet, small rug, tape.

Place the rug in the middle of the carpet. Cut 4 small pieces of tape and place one on the carpet under each corner of the rug to mark its current position. Walk backwards and forwards across the rug, several times. Check where the rug is in relation to the tape. Has the rug moved?

Challenge: Does the rug behave differently on different carpets?

Taste buds.

You will need: 9 containers (test tubes/small jars), water, sugar, (salt), eye dropper, measuring spoons.

Label the containers 1 – 9. Put the same amount of water in each. Leave Container 1 with no sugar, add ¼ tsp to Container 2, add an extra ¼ tsp to each tube so that tube 9 ends up with 2 tsp of sugar. Stir each tube to make sure the sugar is dissolved. Use an eyedropper to put a few drops from one of the containers onto your tongue. What does it taste like?

Rinse out the dropper with pure water and try another container. Can you tell the difference? (Remember to rinse out the dropper between each test with pure water).

Challenge: If you repeat the experiment using salt is it easier/more difficult to tell the difference?

Electrical circuits.

You will need: wire, battery, led lights, switches or thumb tacks and paperclips.

Make a simple electrical circuit to turn a light on and off. If you add another bulb to the circuit what happens when you turn the switch on and off?

Challenge: Can you build a circuit so that you can operate the 2 bulbs independently?

Garden science

As old as the trees.

You will need: tape measure, tree.

Trees grow a new ring under the bark each year. You can count these rings to find out how old they are. Can you work out how old a tree is without cutting it down? (See explanatory notes).

Challenge: Can you find a tree (or a branch) that is the same age as you?

Sun dials.

You will need: measuring tape, chalk (or other marking tool).

Stand outside in the morning and look to see where your shadow is. Mark on the ground where you are standing and ask someone else to mark around the shadow of your head. In the afternoon, go and stand in exactly the same place and ask someone to mark where the shadow of your head is now. What has happened to your shadow? Can you explain why this has happened?

Challenge: Can you design an accurate sun dial for National Science & Engineering Week?

Absorbed in flowers.

You will need: white flowers (e.g. carnations), glasses, water, food colouring.

Put five drops of food colouring in a glass of water and stir. Place a flower in the glass. What do you think will happen? Leave for 6 hours or overnight. What has happened to the flower and why?

Challenge: What happens if you use warm water?

Hanging out.

You will need: clothes line, clothes pegs, selection of clothes,(e.g. 2 each of t-shirts, socks), washing bowl, water, hair dryer, watch/timer.

Soak the clothes in water and wring them out. Hang the clothes on the clothes line so that you have 1 set at one end of the line and 1 set at the other. Use the hair dryer to blow hot air at 1 of the sets. What do you think will happen? Time how long it takes for each set of clothes to dry.

Challenge: Investigate which types of materials dry the fastest?

Air pressure.

You will need: peeled hard-boiled egg, glass bottle with a wide opening, (the opening should be a little smaller than the width of the egg), matches.

Place the egg on top of the bottle and demonstrate that it will not fit through the opening. Light two matches. Lift the egg and drop the burning matches into the bottle. Immediately replace the egg. Watch what happens next.

Challenge: Can you think of other 'magic' tricks that use science in this way?

Long-term Projects

Spring into science with the Woodland Trust

Join in and record the first signs of spring. By recording when buds first burst, flowers bloom and when tadpoles first appear we can further our understanding of the changing seasons. You could investigate the trees that line the road, the plants on the school field or the pond in your garden or local park.

To find out more go to the woodland trust website www.naturedetectives.org.uk/

Preservation's what you need.

Find out about the many different ways to make food last longer and how they work. You could even try some of them yourself e.g. dried fruit/pasta, refrigeration, pickled onions, salted fish, frozen peas, chutney. Which methods do you prefer? Are there any that you wouldn't want to use?—if so why?

Recycling.

Consider what you/your household/your street throw away each week. Find out what happens to this rubbish. How much of it is recycled? How much of it could be recycled or reused

Consider the ways in which rubbish and recycling affects you, your surroundings and society

Hold a discussion to allow people to discuss what they think about rubbish disposal and recycling and what if anything they think should be done in the future. You could invite waste experts from the local council and recycling charities.

Background notes

Kitchen science

Breakfast boogie.

Everything is made of tiny particles. Some of these particles are positive and some are negative and opposites attract, like metal to a magnet. When you rub the Perspex/glass sheet the negative particles in the Perspex get excited. When the positive particles in the cereal feel all that negative excitement they just have to get up there and join in. It's as if a magnet was pulling them. The force that is pulling them up there is not magnetism; it is called electrostatic force. Once they get there they stop being so excited and so another force, gravity, pulls them back down again. As soon as they are back down, they start wanting to get back up… and so on and so on.

Heavier cereals are more susceptible to gravity and so tend to be less mobile in this experiment.

Eat your greens.

When the broccoli is first added to the water, the hot water causes tiny air bubbles between the plant cells to expand and escape showing the chlorophyll—so the broccoli looks bright green. Cooking the broccoli makes it easy for the chlorophyll to lose magnesium, which is replaced by hydrogen from natural acids in the plant. This chemical change causes the colour change to a duller green.

The baking soda neutralises the acids, causing the colour to stay bright green—but it also weakens the cell walls, making the broccoli soft and mushy.

To keep the broccoli green and firm—make sure that the water is boiling before you add the broccoli. Add the broccoli a piece at a time to stop the water cooling (the boiling destroys the enzymes that make the chlorophyll break down). Don't put the lid on the pot. That lets the acids boil away instead of having them condense and drip back into the water.

Micromagic.

The glass of water heated up well, but the other two did not. Inside the microwave is a tube called a magnetron which broadcasts microwave radiation. All food contains water molecules which are polar i.e. they have one positively charged end and one negatively charged like a magnet. The microwaves approach the water molecules in the food and pull the positive end one way and the negative end in the opposite direction. As the wave passes, the pulls are reversed. This causes the water molecule to vibrate back and forth rapidly. This vibration "heats" up the molecule which then passes some of the vibration to surrounding molecules, making them hot too.

Oil is not a polar molecule, which is why oil and water do not mix easily. (Polar molecules stick to other polar molecules, but not to nonpolar ones). Because the oil is nonpolar, it is not heated by the microwaves. That is why we cannot fry food in a microwave. The empty glass did not get hot because there was no water and therefore no polar molecules to be vibrated by the microwaves.

Colourful cabbage.
Red cabbage contains a water-soluble pigment called flavin. The colour of the juice changes in response to changes in its hydrogen ion concentration. Acids donate hydrogen ions in an aqueous solution turning the colour to red. Alkalines accept hydrogen ions turning the colour to a greenish-yellow.

Bread.
Using strong bread flour rather than normal flour gives a more elastic dough as the flour contains more gluten.

Yeast is a live fungus. When you add warm water to the mixture the dormant dried yeast is reactivated and starts to feed on the sugar. This process creates the by-product of carbon dioxide. Kneading the dough causes the gluten in the flour to become more and more stretchy. This stretchy gluten traps the carbon dioxide bubbles and this causes the dough to rise

Honeycomb toffee.
You can explore the changing properties of materials caused by heating and cooling. Heating the syrup and the sugar together causes the sugar to dissolve into the syrup mixture. As the mixture comes to the boil it starts to oxidize causing the colour change. When the bicarbonate of soda is added the mixture starts to froth. This is because gas is being created and released forming bubbles within the toffee mixture. As the toffee sets the bubbles leave pockets of air inside the toffee, creating the honeycomb texture. When you pour the mixture into the tray it begins to cool. As it cools it begins to harden and form the solid (and brittle) toffee.

Emulsions.
An emulsion forms when two ingredients that do not mix (e.g. oil and water) are held together by an emulsifying agent. In the case of the salad dressing the addition of pepper can help to stabilize the oil and vinegar. Adding an egg to the oil and vinegar would significantly improve its stability.

Other everyday emulsions include: paint, mayonnaise.

Bathroom science
How clean are your hands?
Although you can't see them with the naked eye bacteria are everywhere, on and around us. This experiment shows how bacteria live on our skin and especially on our hands (because they are in contact with many surfaces and environments where bacteria thrive, e.g. door handles, money, etc). Washing your hands with normal soap can get rid of bacteria on your hands because soap binds to dirt and other microorganisms. Antibacterial soap, on the other hand, is better at eliminating bacteria because it contains a chemical that kills bacteria by poisoning them or by breaking their cell walls.

Testing tissues.
Paper towels are generally stronger when they are dry. How strong they are compared to each other depends on how the fibres are woven together as well as the number of layers in the tissue (some tissues are 2-ply and have 2 layers, others are 3-ply or even 4-ply). Which brands did you find were the strongest? Why not write to the manufacturers asking them how the tissues were made and why they are so strong?

Toilets.
You should find that pouring in 7.5l in one go causes the bowl to flush. That is, almost all of the water is sucked out of the bowl, the bowl makes the recognizable "flush" sound and all of the water goes down the pipe. You have poured enough water into the bowl fast enough to fill the siphon tube. Once the tube was filled, the rest was automatic. The siphon sucked the water out of the bowl and down the sewer pipe. As soon as the bowl emptied, air entered the siphon tube, producing that distinctive gurgling sound and stopping the siphoning process.

Hot water.
This activity builds a thermo-siphoning solar water heater using sunlight to heat water. It takes approximately 2 hours (which can be broken into separate sessions) to build the water heater and approximately 3 hours of sunshine to heat the water. Further information can be found at: www.pluggingintothesun.org.uk/solarthermal.htm

The differences in the water temperature before and after it passes through the heater create the pressure differences which allow the siphon to work. The hot water rises up the tubing from the heater back into the bucket. Cold water from the bucket is sucked in by the low pressure in the tubing to replace the hot water. The process is continuous creating a constant flow of cold water into the heater and hot water back into the bucket.

Money laundering.
Copper pennies look dull and dirty when the copper mixes with oxygen in the air. Vinegar is an acid that makes the copper separate from the oxygen. Adding salt to the vinegar makes it a stronger solution that works faster.

Living room science
Creeping carpets.
The carpet is made of long, thin fibres when you push down on them they all bend in the same direction. When you step onto the rug you are pushing onto the fibres in the carpet below. As the fibres bend, they move the rug with them. So as you step down, the rug moves a fraction in the direction of your step. When you lift your foot, the carpet fibres bend back to their original position, but as there is no pressure on the rug, they slide back below it, leaving the rug in a new and different position. Over several repetitions this movement becomes more obvious to the naked eye. To see this process in action on a larger scale, press downwards on the bristles of a toothbrush. The bristles will all bend in the same direction and your finger will move slightly that way. Lift your finger slowly and you will feel the bristles slide back to their original position.

Taste buds.
When you eat something, your teeth chew it up into smaller pieces and then your saliva starts to dissolve it. The saliva carries dissolved molecules of food to your taste buds. You have approximately 10 000 taste buds; each one is a tiny bundle of cells on your tongue. The cells are designed to react to five basic types of molecule: salty, sweet, bitter, sour and umami – something like monosodium glutamate (MSG).

Electrical circuits.
If you place the lights next to each other they are in series and the electrical current must travel through both of them to complete a circuit and light them. If you connect them in parallel they make 2 independent circuits and the current can flow through either one or both of them to complete a circuit. Houses use parallel circuits – otherwise if one bulb fused all the lights would go out.

Garden science

As old as the trees.

Most trees increase their circumference by 2.5 cm per year, just under the bark. So, to find the approximate age of a tree measure its circumference approximately 1m above the ground and divide by 2.5.

Sun dials.

Sundials work by casting a shadow of the central stick in different positions at different times of the day. As the earth turns on its axis the sun appears to move across our sky, so that in the morning it is in the east and in the evening it is in the west. If you stood in the same spot all day you would be able to watch your shadow move around you from one side to the other. You will see that the length of the shadow changes according to the time of day—this is due to the changing angle of the sun. At midday the sun is at its highest in the sky and casts the shortest shadow. When the sun is low in the sky, at dawn and dusk, it will cast its longest shadow.

Absorbed in flowers.

The leaves and some petals of plants contain small pores (stomata). Water evaporates through these pores. As it does so, the plant draws water through its stem via its roots from the surrounding soil (or from the water in the vase). Blue or red dye is very good for highlighting the way the plant draws the water and dye up the stem. If you use warm water the flower will be warmer and so the water will evaporate from the stomata faster. This will cause the flower to draw up the water at a greater rate, effectively colouring the flower more quickly.

Hanging out.

The water droplets in the clothes were taken back into the air through evaporation. Some articles of clothing dried faster than others: small and thin articles dried faster than the thicker larger ones. Thicker material absorbs more water and so will take longer to dry than thin material. The hair dryer speeds up the process of evaporation just as it does when you dry your own hair.

Air pressure.

The matches in the bottle heat the air inside which expands. This hot air has a slightly greater pressure than the air outside the bottle. The bottled air pushes its way around the egg and some of it escapes (the egg may jump up and down as the air pushes its way up and around it). As the air in the bottle cools (this happens as soon as the matches go out or when the flame gets smaller), the now smaller quantity of air contracts so that the air in the bottle has slightly lower pressure than the air outside the bottle. This might sound odd, but the air outside the bottle pushes the egg into the bottle.

Thank you for using Domestic Science.

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. If you used this activity pack for NSEW, send in this completed form and we will send you a National Science & Engineering Week Certificate.

Organisation: _____

Address: _____

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Fax: _____

Email: _____

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).

☐ **Tick this box** to be added to our mailing list. This will keep you up to date with NSEW, including grants, resources and activities. Your contact details will not be passed onto third parties.

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CREST ★ Investigators is a UK-wide award scheme that enables students to solve scientific problems through practical investigation. The activities focus on thinking about, talking about, and doing science. The activities develop students' scientific enquiry skills in an enjoyable context with links to the National Curriculum where appropriate.

For more information on how to register and receive your Crest ★ Investigator packs, visit our website at www.britishscienceassociation.org/creststar or call 020 7019 4943.