NATIONAL SCIENCE & ENGINEERING WEEK

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# Super Science

Symbol supported science activities

## Organisers' notes

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

# Acknowledgements

This pack contains activities adapted from British Science Association STEM enrichment resources.

Widgit Software have translated existing activities from National Science & Engineering Week and CREST Star Investigator activity packs to symbol-supported activity cards and accompanying notes for teachers working with SEN groups.

For a range of other symbol supported resources visit **www.widgit.com**.



Successful completion of each of Investigations 1 and 2 (pages 15- 16) and the two group activities (pages 17- 18) can count towards a CREST Star Investigator award. There are two Star activities 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. Modifications and extra suggestions are also given for each activity for completing them with SEN groups.

If you enjoyed these activities and would like to do more then why not register for CREST★Investigators and receive a pack of further activities and investigations? CREST★Investigators is a brand new, UK-wide award scheme that enables children to solve scientific problems through practical investigation.

For more information on how to register and receive your pack, visit **www.britishscienceassociation.org/web/ccaf/CRESTStarInvestigators/** or call **020 7019 4943**.

# About this pack

This pack is designed for children who have difficulty following instructions given purely in text. They may also have difficulty in remembering a series of verbal instructions. The pupil materials are therefore supported with symbols and photographs. This widens access to important science learning.

The pack contains activities and investigations adapted from existing STEM enrichment resources provided by the British Science Association for its National Science & Engineering Week  and Crest Star Investigator award programmes. The Super Science activities have all been designed for use in discrete 20–60 minute class or science club sessions. They have been created to support activities during National Science & Engineering Week although the activities can be used any time.

Each experiment, investigation or group activity has teacher guidelines and pupil instructions. In many cases there are ideas for extra activities, but the teacher will need to be responsive to individual needs. In some cases these "extras" are too difficult, whilst in others the teacher may want to add something of their own.

Generally it is assumed that children will be working in twos or threes. Most experiments are not suitable for more than three – except the group activity. Parents working at home with a single child will want to take part – albeit at a distance – with what the child is doing.

These notes consist of what the teacher needs to do, guidance on the preparation and sourcing of materials and some of the basic science involved. In trying to explain the science there has often been a need for simplification, but nothing has been said that is contradictory to what might be learned at a later stage. The extra note on materials in the teacher sections contain explanations of the precise details where these are needed.

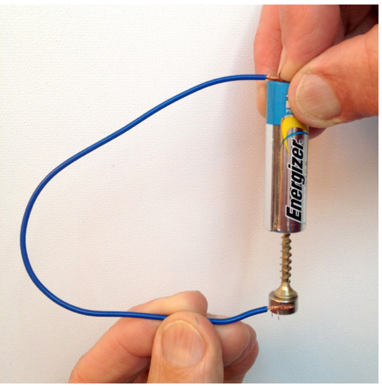
There are also some notes on more general applications of the principles involved in each experiment. These can easily be supplemented by searching for subject support materials online. This should enable the teacher to put the experiment in a wider context. It is up to the teacher whether this might form the background to a discussion before the experiment – to give a focus, or after to show the importance of the experiment. It is possible to do both and it will vary from experiment to experiment.

## Educational Links

The activities and challenges within this pack can be used to complement, or contribute to, the Science and Art & Design sections of the National Curricula in England, Wales and Northern Ireland, and the Scottish 5-14 Guidelines in Environmental Studies and Expressive Arts. 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**).

# Contents

# Activity 1: Spinning screws




## Materials

- magnet – see below
- screw
- battery
- wire

Magnets for "Spinning screws" (and "Invisible treacle") can be obtained from a variety of sources including Amazon. They are cylindrical magnets 10 or 12mm diameter. An AA battery works well and the wire can be stripped from any piece of cable. It does not matter if it is insulated or not, but if it is, then 1cm at each end should be bared.

## What to do

This is easy to try yourself using the student instruction sheet. Try the extension activity. This is to find how the effectiveness varies when the wire is touched under the magnet. (For example it will not work if you touch the very centre of the underneath of the magnet). It is easier to do this if the magnets are 12mm diameter. You need to decide if the children have the co-ordination to manage this. You could also try putting the screw through a small strip of paper so the paper looks like wings and be sure you have the right bits of paper, scissors etc. ready.

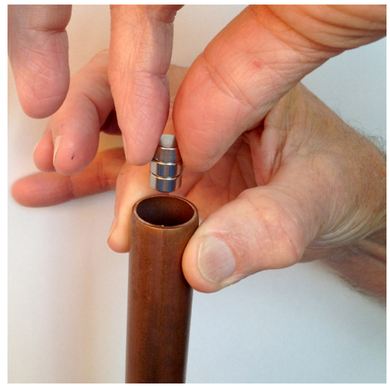
## The science for teachers

When the wire touches the edge of the magnet a current flows from the edge, radially through the magnet to the screw base and then through the screw, the battery and back through the wire. When a current flows at an angle to a magnetic field a force is produced at right angles to both. This causes the spinning. If the current is in the same direction as the magnetic field then no force is produced. This is why touching the bottom centre of the magnet does not work.

## Background

An electric current flowing in a magnetic field and producing motion is used in electric motors from Scalextric upwards to large electric trains. An experiment frequently done in secondary schools is to make a motor using this principle. So many pupils will learn more about this later.

# Activity 2: Invisible treacle



## Materials

- 22mm copper tube, 60cm long
- 4 cylindrical magnets
- small object that can fall through the tube

Magnets for "Invisible treacle" (and "Spinning screws") can be obtained from a variety of sources including Amazon. They are cylindrical magnets 10 or 12mm diameter.

The copper tube should be 22mm copper. It can be bought from a plumbers' merchant or DIY but you may be able to beg an off cut or at least get one cheaply. You need about 60cm length.

## What to do

This is easy to try yourself using the student instruction. Guide the children to hold the tube loosely so that it hangs vertically. Make sure they can look down the tube as the magnet falls. If the floor is dark put some white paper down so they can see the magnet in the tube more easily.

The extension activity is very easy except for separating the magnets and putting them together again. It can hurt if a bit of a fold of flesh gets caught as you put them together. You may want to do this yourself.

## The science for teachers

The effect here is caused by the opposite of activity 1: spinning screws. When there is relative motion between a magnetic field and an electrical conductor, there is an induced current in the conductor. As the magnet falls, the induced current circulates round the edge of the copper in the vicinity of the magnet. These currents themselves produce a magnetic field which repels that of the magnet and slows the magnet down.

## Background

The principle of electromagnetic induction in this experiment is used in induction motors, dynamos, magnetic braking and many other applications. When the moving magnetic field is itself created by an alternating current the applications are much wider and include transformers and aerials - just two of very many examples.

# Activity 3: Kelly wobbles

## Materials

- table tennis ball cut in half
- plasticine to fill the ball
- 3 pea sized pieces of plasticine
- cocktail stick

There are suggestions elsewhere to try this experiment by rolling the plasticine into a ball and then cutting it in half. This is hard for some students as if the ball is not exactly round the experiment does not perform well. So the advice is to use the half table tennis ball – or improvise something similar. The half table tennis ball is just an ordinary table tennis ball cut in half with a sharp Stanley knife. Care is needed – this is not a job for the children.

## What to do

Make the three pea sized pieces of plasticine so that if two are rolled together to make a larger "head" then the Kelly still bobs up when pushed right over - When all three are rolled together it stays tipped over. When the pupils try with two peas the speed of wobble is a lot slower. You may need to draw attention to this. If possible have two side by side to show.

For the extension activity have handy some materials the children can use to decorate their Kelly. These need to be very light. Try the experiment again cutting the cocktail stick in half so as to make a shorter Kelly.

## Science for teachers

The plasticine in the base provides a low centre of gravity. For the Kelly to topple the centre of gravity must be above the flat plane of the plasticine. The more weight on top, the more the centre of gravity is raised, and so it will topple when displaced by a smaller angle. The slowness with a larger head is quite different from an ordinary pendulum as there the speed does not depend on the weight of the bob.

## Background

The stability of transport is one important example, for example double-decker buses, boats (although that is more complicated because of the water) and high sided lorries. The centre of gravity needs to be low in all of these. In certain sports the body shape is adjusted to give a low centre of gravity to improve stability.

# Activity 4: Drop it in

## Materials

- plastic beaker
- piece of card that easily covers beaker
- various objects - some heavy, some light, some rough, some smooth (must all fit in the beaker)

Make sure the card separating the object on the top with the beaker below is not too smooth. Otherwise it will be too easy to get all objects to fall in. Test all objects first and find some that show variations in behaviour. Weight and smoothness are factors.

## What to do

Try the experiment with the materials you provide and check that the extension activity is reasonable with these materials.

## Science for teachers

When the card is snatched there is a force of friction between the card and the object on top which tries to pull the object with the card. For objects with a rough surface and which are light this force can be sufficient to pull the object to the side before the card is removed. With heavier objects that have a higher inertia the force is less likely to be enough to accelerate the object to the side sufficiently – unless the object has a very rough base. (Note for experts: We really ought to be talking about mass here and not weight, but at this level that would be too hard).

## Background

Talk about the fact that things easily "stay put" – it is hard to get them going. A train needs a very powerful motor to start, but the engine can be cut back when the train reaches a steady speed.

# Activity 5: Rain maker

## Materials

- some soil
- large clear container, big enough to make a small landscape with the soil
- small container to hold water
- cling film
- sticky tape

Make sure that the cling film is wide enough to cover the larger container. Otherwise two sheets will be needed and it will be hard to avoid holes.

## What to do

Make sure the children get the idea of putting sticky tape all round the edge to hold the cling film down. Once the model is made it needs to be kept warm to start the evaporation of the water so that the condensation appears on the cling film. This can take anything from a few hours to days depending on the temperature.

If you try the extension activity with really dry soil you will need somewhere to keep the model and be sure the children have the patience to wait.

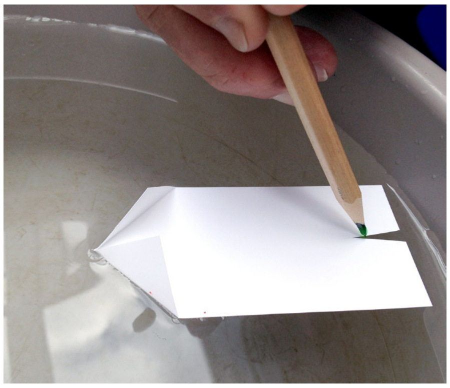
## Science for teachers

This is a model of the water cycle. The pupil notes include a symbol explanation of the water cycle.

## Background

You can look up further details on the internet.
Try www.wikipedia.org/wiki/Water_cycle.

# Activity 6: Whizzy washing up liquid



## Materials

- some pieces of card
- scissors
- pencil
- washing-up liquid in a small pot
- the children will also need access to a sink or other container in which to float their boats

Make sure the card you use is reasonably water resistant so it doesn't get too soggy too quickly. The pieces should be 10cm x 5cm or similar. Just the tiniest drop of washing liquid works fine.

## What to do

Try the experiment. For the extension activity find a longer trough so the boat will travel some distance, or do the experiment outside in a paddling pool. Experiment with how far the boat goes depending on the shape of the front and how much washing up liquid is used. Check this yourself first.

## Science for teachers

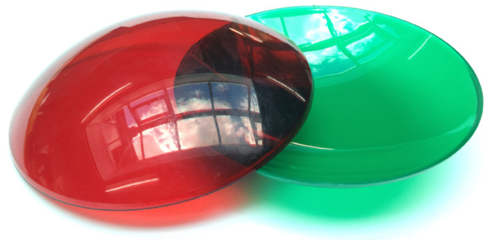
Water behaves as if its surface has a skin - it doesn't - but it behaves as if it does. It is hard to explain this correctly in the pupil materials which are necessarily simplified. The surface of the water is therefore "stretched". This is called surface tension. The effect of washing up liquid is to lower the surface tension. So the tension at the rear of the boat is lowered so allowing it to be pulled forward.

## Background

The surface tension of water allows some insects to float, e.g. a water boatman. The surface tension also pulls raindrops into spheres – they only look like tear drops when they fall on a window pane.

Reducing the surface tension allows water to "wet" a surface more easily. This is one of the reasons why washing-up liquid works. Surface tension also causes water to rise up in tissues and filter papers (capillarity) – something used in activity 8 later.

# Activity 7: Light entertainment



## Materials

- 2 torches that are roughly equally bright
- 1 piece of red filter
- 1 piece of green filter
- white sheet of paper
- blu-tac or similar
- sticky tape

It is important to try this first to make sure your filters show the red and green lights do actually make yellow. These can be obtained from Amazon by searching for "coloured filters" . The coloured filter gels PAR36 work best.

## What to do

Try the experiment. Even if the torches are the same brightness the amount of light absorbed by each filter can be different. You may need to encourage the children to hold the torches at different distances to make a better yellow colour.

For the extension activity instead of using the filters on the front of a torch look through the two filters placed on top of one another. The filters suggested do not give total black but greatly reduce any light coming through the two together.

## Science for teachers

When red and green lights are shone together on a screen what is reflected into our eyes is a combination of red and green light. This is called colour addition and the composite effect of our eye is to see yellow. A red filter absorbs all colours except red, a green filter all except green. So if we put the two on top of one another most colours are absorbed and little light gets through. This is called colour subtraction. Note: Not all yellows are made up red and green. Sodium street lamps are pure yellow. The effect in this experiment is physiological.

## Background

Filters are used in theatres to get different lighting effects often overlapping the colours. You could also talk about the red and green filters used for the old 3D films. If you can obtain a 3D book with red and green spectacles, see if you can get the children to explain how they work.

# Activity 8: Colour split

## Materials

- felt tips of different colours
- rectangular small container
- paper tissues

There are a variety of ways of doing this experiment but the one here is very quick to give results and they are all on one piece of paper. It is best to use non-primary colours for the felt tips as well as primary, as these show the composite colours used in making the felt tip's colour. It complements the last experiment well by showing that composite colours can be split up. The container needs to be rectangular so it can take a tissue lengthwise see the picture in the pupil instructions. Paper handkerchiefs which are a bit stiffer may be better than tissues.

## What to do

Try the experiment with your felt tips and select some that show splitting of colours and some that do not. For the extension activity suggest that pupils visit a DIY shop to see if anyone is mixing paints and see if they can get the assistant to show the colours put in to make the composite paint colour.

## Science for teachers

Pigments reflect certain colours. So a paint with a number of pigments will reflect a range of colours. This is not too dissimilar to the colour addition in Experiment 7.

## Background

This relates to paint pigments and dyes for clothes.

# Activity 9: Noisy cutlery

## Materials

- piece of string about as long as your arm
- metal fork
- metal spoon
- plastic fork
- plastic spoon
- sticky tape

You need some twine, some white thin string and rather thicker strong string.

## What to do

Try the experiment. The effect is very dramatic with a fork, less so with a spoon and very poor for plastic cutlery.

Try the extension activity with your strings to make sure there is a significant difference.

## Science for teachers

Sound travels much better through a solid than through air. So the vibrations of the object are heard much better when the string is there to take the sound to the ears. Different materials will allow sound through differently. The metal fork is best as the prongs can more easily vibrate as they are thin. Plastic materials do not vibrate well at the frequencies of the sound.

## Background

Sound also travels much better in liquids than a gas. Both solids and liquids are denser than air. Whales can be heard over long distances. Sonar used in WW2 was used to find submarines. Echoes of sound travel faster and further in water. Seismic waves from earthquakes are waves in the earth. Some are like sound waves (compression) others are not (transverse).

# Activity 10: Make a skiffle bass

## Materials

- cardboard or wooden box without a lid
- washer or bead
- different threads e.g. twine, light string, heavier string
- piece of wood about 0.5m long with a hole at one end

In the pupil notes the photograph shows an inverted wooden A4 paper tray as the resonator, but the experiment will work quite well with a cardboard box the size of a shoe box. Make sure the washer or bead has a large enough hole to thread the thickest string through. It is best to make the hole in the box beforehand, as if cardboard is used it is easy to make the hole too big. It is also necessary to make a hole in the end of the wooden stick (60cm long and about 1cm x 1cm) to tie the string through. The string lengths can be about 1 metre and shortened to the required length when it is tied to the top of the stick.

## What to do

Try the experiment. If the pupil has difficulty, be sure you can show how to hold the box down and how to hold the stick to alter the tension. This experiment will illustrate the relationship between the tension in a string and the note it produces.

The extension activity also makes it possible to show the effect of the length of the string and its weight for a given length. Try the effect of shortening the string and changing the string for one of a different weight. Try this first so you can give advice.

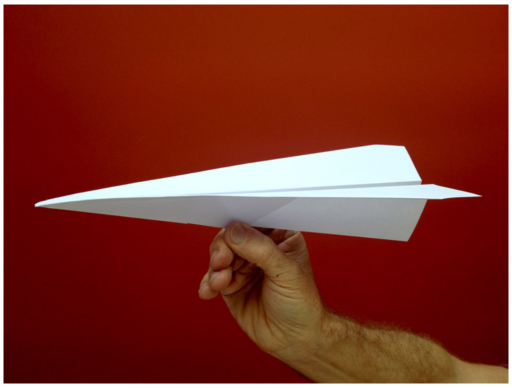
## Science for teachers

The pitch of a vibrating string depends on three factors, the tension (the square root), the length ( inversely proportional) and the mass per unit length of the string (the inverse square root).

## Background

Talk about musical instruments and the relationship between size and pitch. Look at the strings on a guitar. What are the reasons why the fat string makes the lowest notes? You could also talk about tuning by varying the tension. These principles apply to all stringed instruments – violin, viola, cello. bass, piano, etc.

# Activity 11: Aeroplane engineers



## Materials

- several A4 sheets of paper
- a flat surface to work on

## What to do

In this we suggest the "classic" paper aeroplane as the folding instructions are simple. You may want to use an alternative instead and modify the instructions accordingly. The extension activity is to use a book with suggestions for a variety of models and see which goes the furthest.

## Science for teachers

Real aeroplanes have a curved wing cross section that makes the air move faster over the wing than underneath (aerofoil). This gives lift. There is no such mechanism in this simple plane so the distance it travels is governed by how far it can go along while it is falling. It falls slowly because of air resistance, and it is streamlined so it can go quite a way horizontally. When the wings are trimmed in any way this distorts the airflow and there can be lift. Other models may have effectively aerofoils in their design and so have a lift component.

## Background

There are huge amounts on the Internet on flight and paper aeroplanes in particular. Try www.wikipedia.org/wiki/Paper_planes.

# Activity 12: Fizzics experiment

## Materials

- large balloon
- small funnel
- bottle of the fizziest drink you can find.
- short piece of string

You might want to practice this a few times because it can be difficult to get right. You should buy large round balloons. Blow them up and let them down lots of times to make them more flexible. Use a fizzy sweet drink as carbonated water is not as fizzy!

## What to do

Try the experiment to make sure your balloons and drink work. For the extension activity try different drinks. Try also warming the balloon in warm water after it has been tied.

## Science for teachers

The carbon dioxide in the drink is dissolved. When shaken or warmed the gas escapes as bubbles. If the pressure in the balloon is too high the gas will remain dissolved. This is why the balloon needs to be of a large flexible type. The key point is that gases can dissolve in liquids.

## Background

At considerable depths in the sea the pressure will dissolve gases into a deep-sea diver's blood. As the pressure is reduced, bubbles of gas form in the blood stream. This causes the bends and can cause death. So it is important to come up slowly and for there to be a decompression chamber on the boat.

# Investigation 1: Teabag trouble

## Materials

- loose tea
- 3 glasses
- 3 clothes pegs
- teaspoon
- 3 clippits, or other clips to hold material securely
- minimum of three different materials including: kitchen roll, newspaper, j-cloth, thin fabric
- datasheet for recording the results

Cut the materials to about 15cm square. Any smaller and the tea might leak.

## What to do

Try the experiment yourself. The suggested three materials do give very different strengths. You may need to help the children with the best way of clipping the tea into the teabag. An ordinary clothes peg will not hold the material sufficiently tightly to stop the tea escaping, so a stronger clip is needed. The clothes peg is to hold that clip so it is safe to dip in the hot water. The pegs are needed so children can dip the bag safely.

## Science for teachers

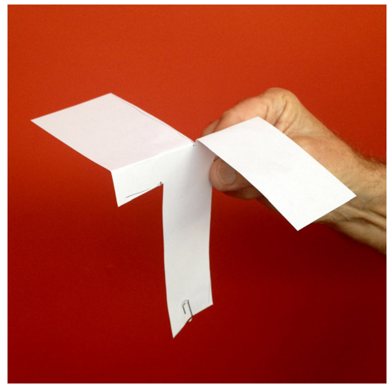
The porosity of the material will affect the rate at which the tea brews. Newspaper, for example, is not very good as it is not very porous until it disintegrates! So something that is porous and takes a while to disintegrate is best.

## Background

The first teabags were made from silk muslin in 1903 in the USA. Tea bags weren't popular in the UK until the 1950s. Now 96% of all tea sold in the UK is contained in tea bags.

Modern teabags are usually made of paper fibre and heat sealed. They come in square, rectangular, circular and pyramid shapes. The quality of the tea in the bags varies. Some can have a high quality tea dust in them. Bags with whole leaves tend to take longer to brew.

# Investigation 2:  Super spinners



## Materials

- paper clips
- scissors
- sticky tape
- sheets of paper with markings to make a tray
- sheets of paper with markings to make spinners
- more sheets of paper

Find the PDF "Super-Spinner-Template.pdf" and print out copies for the students to use. Ordinary A4 paper is fine.  There will be templates marked for the spinners. The tray is made simply by folding up 15mm around the edge of an A4 sheet.

## What to do

Follow the pupil instructions through.  Read through the pupil explanations.

## Science for teachers

The science is given in a simple form in the notes for the students. This actually has little to do with helicopters apart from something going round. So it is best not to make too much of that. The whizzers that fly by being spun by pulling a string are much more like helicopters.

## Background

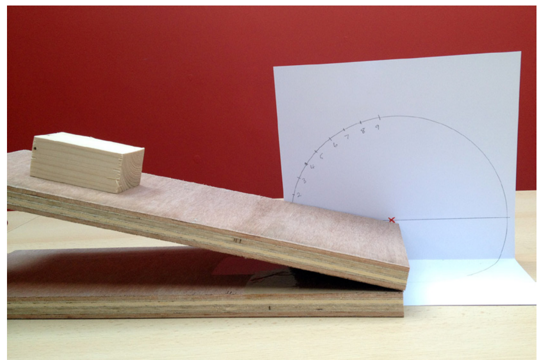
A number of plants scatter their seeds by using this motion to slow their fall to the ground e.g. The Sycamore tree. This makes it easier for the wind to blow them a distance from the parent tree. They are then more likely to have room to grow.

# Group Activities: Slippery and slipping slopes

The purpose of this activity is to look at things slipping against a slope and slopes themselves that slip. This has relevance, for example, to winter sports, hill walking, volcanic lava flows, avalanches and the terrible Aberfan disaster of 1966. The final task will be to layout the experiments in the activity and produce a poster which can be used to present the activity to other members of the class, or to friends and parents. It is hoped that the activity will encourage children to communicate effectively with one another.

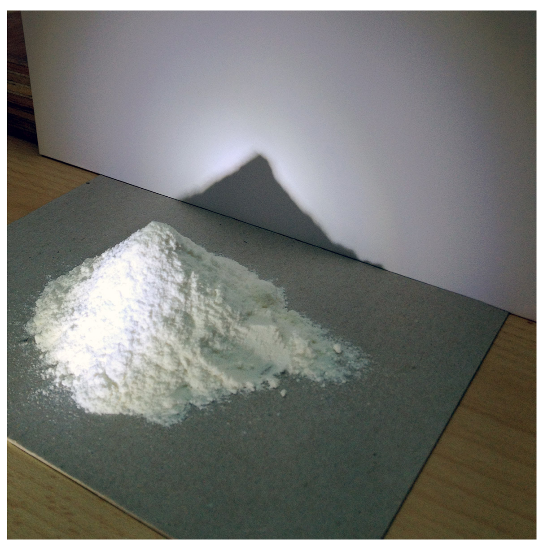
It is left to the teacher to divide the tasks among the group. At the end of the practical work those able to get information from the internet can do that while the other members of the team can help with the final display.

## Materials for Slippery slope



- piece of A4 card
- ruler
- plastic mug
- pair of compasses
- sponge backed scourer
- strong sticky tape like parcel tape
- paper back book with a shiny cover
- piece of wood about 3cm x 4.5cm x 8cm
- 2 pieces of wood about 30cm x 12cm by 1cm thick

## Materials for Slipping slopes



- couscous
- granulated sugar
- flour
- rice
- lentils or yellow split peas
- piece of A4 card
- strong torch
- sheets of paper
- small jug

# Group Activities: Slippery and slipping slopes

It is a good idea to try the tasks yourself to make sure the materials you provide are OK for the students. The piece of wood in the slippery slope experiment should have sides equally smooth. Make sure the parcel tape (or similar) is strong enough to stick the pieces of wood together for a long enough time to do the experiment.

Obtain some newspaper prints or print outs from the Internet of some of the following:

- winter sports activities
- footwear for climbing – Vibram shoes – crampons etc.
- lava flows
- winter tyres and snow chains
- advertisement for Dycem or other non-slip mat
- photos of natural disasters with sliding hills including Aberfan

## What to do

Try the experiments carefully following the pupil instructions. Allocate tasks within the group appropriately.

## Science for teachers

Slippery slope deals with friction. If the wooden block has equally smooth sides the pupils will find that the angle of slip does not depend on the area in contact. In fact if they put a weight on top it will also not affect the angle. That is something not suggested to try but you may want to.

Slipping slopes deals with the "angle of repose". The pupils will see that the grain size affects this. The friction between the grains also affects. This is why when water is present reducing the friction, landslides are likely to happen.

## Background

This will be defined by the print outs from papers and the web described in the materials section.

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