NATIONAL SCIENCE & ENGINEERING WEEK

# Change Champions

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
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# About this pack:

This activity pack is intended to be potential source of ideas for school or home activities for National Science and Engineering Week. All activities are related to the theme of the Week in 2009 - 'Change'. This is a broad theme and can include many topics in a wide variety of science and engineering subjects. For example, activities in this pack cover a real mixture of topics including; physical processes of weather, erosion, movement, energy and sound (and the impact on engineering), the chemical processes of dissolving, colour change and change of state and the biological processes of growth and degradation.

## CREST ★ Awards

All activities can count towards a CREST★ Investigator award if you would like to accredit the children's work. There are 5 Star and 5 SuperStar activities in the pack – one for each day of National Science and Engineering Week (although of course you can pick and choose what you would like to do).

For the CREST ★ activities (aimed at 5-7 year olds) children discuss, solve problems and share experiences. In CREST SuperStar activities (aimed at 7-11 year olds) children work independently, discuss ideas and how to test them, solve simple problems and decide how to share results.

The pack is split into two sections one with the 5 CREST Star accredited activities, one with the 5 CREST SuperStar accredited activities; indicated by the logos on those activity pages.

Star SuperStar

## Older children

This pack is developed for 5-11 year olds. However, for older children there is a section which gives ideas that could be used to develop the activity further. See section 'For older children'.

## How to use this pack

This pack includes pages for teachers to help explain the activity to the children and organiser's notes. Some activities take a while to set up and some take more than a week to complete. Make sure you read the activity pack well in advance of National Science and Engineering Week (6-15th March 2009) in order to ensure the activities can be done during that time.

## The Story so far…

To connect all the different activities together you can ask the children to become 'Change Champions'. The children will then be set a series of science missions to investigate things that change. There is a suggested story below to fit in with this idea:

*It's National Science and Engineering Week and millions of people across the country are having fun learning new things about science; come and join in! The theme for the Week is 'change' and everyone is learning about things that change. Change is important; imagine one day waking up and nothing changed anymore. The weather didn't change, cars didn't move, water didn't turn to ice, plants didn't grow, you didn't grow older… The world would be a very strange place! As part of National Science and Engineering Week – you have been set a science mission. You need to find out about all the things that change. Is there anything that doesn't change? Can you tell us?*

# Mission 1:
## Chocolate chewing

The first thing you could investigate on your science mission is a physical change. Are you hungry because this is a yummy change? Get prepared to eat some chocolate.


This change is all about what happens when you put chocolate in your mouth. It melts and eventually disappears because it dissolves in your saliva until nothing is left. Chocolate powder will also dissolve into water or milk too – this makes hot chocolate.

Scientists call this dissolving a 'physical change'. When you eat a chocolate bar you are dissolving a solute (the chocolate), into a solvent (your saliva) to create a solution (chocolate mix in your stomach).

This challenge is all about dissolving. Can you make chocolate dissolve faster or slower in your mouth? How could you do this? What is happening?

### Talk about:

1. How does chocolate melt in your mouth?
2. What is dissolving?
3. How could you make chocolate dissolve faster or slower in your mouth?

### Here are some ideas to get you started:

1. You have been given some chocolate by your teacher. How long will it take for the chocolate to dissolve if you:
    a. Just place the chocolate in your mouth and do nothing. Don't move your tongue and don't chew?
    b. Put the chocolate in your mouth and move your tongue around but don't chew?
    c. Put the chocolate in your mouth and chew?
2. When and how and what will you measure to test this?
3. How will you make sure your tests are fair?

### Sharing your ideas:

After the experiment what did you find? Which method made the chocolate dissolve the quickest? Which the slowest? Can you explain why?

### Here are some extra challenges:

1. What happens when you dissolve chocolate powder to make a chocolate drink? Does the powder dissolve quicker when you a) stir it b) when you don't stir c) when the milk/water is hot d) when the milk/water is cold e) when you stir AND the water is hot?

# Chocolate Chewing: 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 the children understand their science mission – to investigate how things change.
4. Give the children time to think about dissolving and what it is. What won't dissolve?
5. Give them the equipment needed to time how quickly the chocolate dissolves in their mouth.
6. Get the children to predict/guess which method will make the chocolate dissolve the quickest.

## Background:

1. The chocolate that was chewed will dissolve quickest. The piece that the children just placed in their mouth will dissolve the slowest.
2. This is because moving chocolate around in your mouth exposed more of the surface area to the solvent (the saliva) than when the chocolate was just sitting still in the children's mouth. Just like with hot chocolate mix. If you stir the powder it dissolves quicker.
3. You could also get the children experimenting with hot chocolate. You could see which dissolves first – one where the water/milk is warm or one where the water is cold. You could also get them to stir or not stir the hot chocolate.

## Suggested Materials:

1. Chocolate pieces
2. Your mouth
3. A clock or watch
4. Paper
5. Pencil

## Safety points:

Make sure chocolate is prepared in a clean environment.

## For older children:

You may want to explore the science behind chocolate. There is a great source of information on the Exploratorium website, go to http://www.exploratorium.edu/exploring/exploring_chocolate/.

## Mission 2:
### Mould garden

The second thing to investigate on your science mission is a biological change - how things grow. This is a change that happens to plants, animals and microorganisms – all living things grow!

Have you ever seen mould growing on rotten food? It might be disgusting but mould is a type of organism called a fungus. This fungus likes to feed on the same food you do. It uses the energy it gets from food to grow.

This challenge is all about growth. Can you grow your own mould garden? Can you describe how mould grows?

### Talk about:

1. What happens when things grow?
2. What do you think will happen when mould grows on left over food?

### Your challenge:

Create a mould garden and record how mould grows.

### Here are some ideas to get you started:

1. What food might you collect to grow mould on?
2. You will need to grow your mould in a closed container. Where will you put this container?
3. When and how and what will you measure to record how your mould is growing? Maybe you'd like to answer some of these questions:
    a. What food started getting mouldy first?
    b. What colour is the mould? How many different colours do you see?
    c. What texture is the mould - flat, fuzzy, bumpy?
    d. Does all the food in your mould garden get mouldy?
    e. Does mould spread from one piece of food to another?

Now you can start creating your mould garden. Get your left-over food and with the help of your teacher create your garden. Leave this garden to grow over 2 weeks and record what happens.

### Sharing your ideas:

After the experiment what did you find? What happened to the left-over food over time?

### Here are some extra challenges:

1. Take pictures or draw your mould garden as it grows. Does all the mould look the same? Does the mould grow differently on different food? Create a poster or display describing how a mould garden grows.

# Mould garden: Organiser's notes

## What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list and make sure you make time to prepare the mould garden. You will need to give the children time over the next 2 weeks to come back and observe the mould growth. Maybe start this a week before National Science and Engineering Week so that the children can finish the activity during the Week. You could get them to take pictures for a display during the Week as well.
3. Make sure the children understand their science mission – to investigate change.
4. Give the children time to think about growth. How do things grow? Encourage them to predict what will happen when mould grows.
5. Give them the equipment needed and help the children make a mould garden.
    a. If the food is small - a grape or one section of an orange - use the whole thing. Cut bigger foods like bread or cheese into 1-inch sections.
    b. Dip each piece of food into some water and put it into your container. If you use a big jar, lay it on its side.
    c. Try to spread the pieces out so that they are close to each other - not all in a heap.
    d. Put the lid on the container.
    e. Tape around the edge of the lid to seal it.
    f. Put the container in a place where no one will knock it over or throw it away.
    g. Label it "Mould Garden"
6. Allow the children to look at the mould garden every day if possible. For the first 2 or 3 days, you probably won't see much. You can watch how the mould spreads and how things rot for about 2 weeks. After that not much more will happen.
7. This Is Important! - Don't allow the children to use anything with meat or fish in it. After a couple of days it will smell very bad! Also do NOT allow them to open the container once the mould garden has been made. (see background and safety section)

## Background:

1. That fuzzy stuff growing on the food in the mould garden is mould, a kind of fungus. Mushrooms are one kind of fungus; moulds are another.
2. Unlike plants, moulds don't grow from seeds. They grow from tiny spores that float around in the air. When some of these spores fall onto a piece of damp food, they grow into mould.
3. Green plants are green because they contain a chemical compound called chlorophyll. Chlorophyll makes it possible for green plants to capture the energy of sunlight and use it to make food (sugars and starches) from air and water. Unlike green plants, mould and other fungi have no chlorophyll and can't make their own food. The mould that grows in the mould terrarium feeds on the bread, cheese, and other foods (just like we do). The mould feeds itself by producing chemicals that make the food break down and start to rot. As the food rots, the mould grows.
4. It can be annoying to find mouldy food in your refrigerator but in nature, mould is a very useful thing. Mould helps food rot, which is a disgusting but necessary thing. In a natural environment, rotting things return to the soil, providing nutrients for other plants. Mould is a natural recycler.
5. When most foods get mouldy, it means they aren't good to eat anymore. But some cheeses are eaten only after they become mouldy! Blue cheese gets its flavour from the veins of blue-green mould in it. When a blue cheese is formed into a wheel, holes are poked through it with thin skewers. Air gets into these holes and a very special kind of mould grows there as the cheese ripens.
6. There are thousands of different kinds of moulds. One mould that grows on lemons looks like a blue-green powder. A mould that grows on strawberries is a greyish-white fuzz. A common

mould that grows on bread looks like white cottony fuzz at first. If you watch that mould for a few days, it will turn black. The tiny black dots are its spores, which can grow to produce more mould.

7. If you used foods that contain preservatives, mould may not have grown very well on them. If you want to experiment more with mould, you can make one mould garden using food with preservatives (like a packaged cupcake) and another using food that doesn't have preservatives (like a slice of homemade cake). Which one grows more mould? You can also experiment with natural preservatives like vinegar and salt.

### Suggested materials:

1. A clear container with a lid. You'll need to throw away the container at the end. Big glass jars and clear plastic containers work great.
2. Adhesive tape
3. Water
4. Some leftover food (you can use whatever is in your refrigerator), such as bread, fruit (like oranges, lemons, or grapes), vegetables (like broccoli or green pepper) cheese or cake. Do not use meat or fish.

### Safety:

1. After 2 weeks throw your mould garden straight into the bin. Don't reuse the container. Don't even open the lid! Mould is not a good thing for some people to smell or breathe.
2. Do not use meat or fish in the mould garden

## For older children:

You may want to add to this activity for older children. It might be interesting to look at mould in more detail. Questions worth exploring may be – What does mould actually look like at the molecular level? What would you see under a microscope? How does mould reproduce? How does it break down food? Is mould classified as a plant? Is it a simple organism?

To inspire children's interest you may want to use this article published in *The Independent* to get a discussion going:

Bread mould is almost as complex as humans

By John von Radowitz
Thursday, 24 April 2003 Next time you pick up a loaf covered in bread mould think twice before throwing it into the dustbin. After all, this is an organism that can sense the time of day and react to different colours, new research reported yesterday has revealed.

Researchers at the Whitehead Institute Centre for Genome Research in Cambridge, Massachusetts, have worked out the genetic blueprint of Neurospora crassa – better known as bread mould. The mould's genes indicated it had a biological clock and could sense the time of day, react to blue and red light and was able to defend itself against invading viruses, a report in the journal Nature said.

Commenting on the work in Nature, Jonathan Arnold and Nelson Hilton from the University of Georgia in Athens, US, said that "the number of genes is not so different from humans" adding that "we are truly not that far genetic complexity from the common bread mould".

Bread mould, first identified in 1843 as a contaminant of bakeries in Paris, helped pave the way for modern genetics and molecular biology.

(Adapted from resources from the Exploratorium: http://www.exploratorium.edu/)

## Mission 3:
### Making Music

The third thing you could investigate on your science mission is another type of physical change - sound. Sound changes all the time – What is the highest or lowest note you can make?

What you are doing is changing the pitch of sound. We change sounds all the time so that we can talk to one another and to make music. There are lots of different musical instruments that make lots of different sounds using different materials.

This challenge is all about changing sound. Can you make your own musical instrument and use it to make different notes? Or make loud or quiet sounds?

### Talk about:

1. What is sound?
2. What materials can be used to make sounds?

Can you make your own musical instrument? What materials are best to use?

### Here are some ideas to get you started:

1. You have been given some materials which you can use to make your own musical instrument. What do you plan to make? Be as imaginative as you can!
2. What materials are best to use?
3. Can you make a musical instrument that can make different notes?
4. How will you test how well your musical instruments work?

Now you can begin making your musical instrument. Which instrument can change the pitch of sound the best? Which instrument makes the loudest noise?

### Sharing your ideas:

What did you find? Which musical instrument is your favourite?

### Here are some extra challenges:

1. Can you use your musical instruments to make a song?

## Making Music: Organiser's notes

### What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list. You can give the children a range of materials so that they can make a range of different musical instruments. You could get them to take pictures for a display and record the sounds the instruments make.
3. Make sure the children understand their science mission – to investigate change.
4. Give the children time to think about how to change the pitch and volume of sound. How is sound made?
5. Encourage them to talk about the different characteristics of materials and how they can be used to make sounds.
6. Musical instruments the children could make include:
    a. Shakers (margarine pots with rice, gravel or sand)
    b. Scrapers (plastic bottles with ridges, dowel rods, glass paper)
    c. Drums (food containers, biscuit tins, material to stretch over the top of the containers)
    d. String instruments (food containers, elastic bands, string).
7. Give them the equipment needed and help the children if needed to make their instruments. Try and get them to be as imaginative as possible – what crazy instruments can they come up with?
8. Get them to test the musical instruments. Which ones make the loudest/quietest noise? Which instruments allow the children to change the pitch of the sounds?

### Background:

1. Sound is a series of compression waves that moves through air or other materials. These sound waves are created by the vibration of an object, like an elastic band or material stretched over a pot.
2. Your eardrum vibrates from sound waves – sending a message to the brain. We then hear the sound.
3. Whenever an object in air vibrates, it causes compression waves in the air. These waves move away from the object as sound.
4. The back and forth movement of a loudspeaker cone, guitar string or drum result in compression waves of sound. When you speak, your vocal cords also vibrate, creating sound.
5. Skiffle is a type of folk music with jazz, blues and country influences, usually using homemade or improvised instruments such as the washboard, tea chest bass, kazoo, cigar-box fiddle, musical saw, comb and paper, and so forth, as well as more conventional instruments such as acoustic guitar and banjo. Skiffle has influenced modern day rock and roll.

### Suggested materials:

1. margarine pots
2. rice/gravel/sand
3. plastic bottles with ridges
4. rods
5. food containers
6. biscuit tines
7. material
8. elastic bands
9. string

## For older children:

You may want to add to this activity and investigate sound further.

You could use diagrams of a sound wave and explain how a different sound is a different shaped wave. For example you could get the children to try and match the shape of the wave drawing with a corresponding sound i.e. high note is a higher frequency wave. Another good way of demonstrating sound is using a Slinky. Stretch the Slinky out on the floor or a table to about three to four meters with a partner firmly holding the other end. One of you represents the sound source and the other represents the sound receiver (the ear). With a push, the coils compress against each other. The compression travels to the other end of the Slinky as a wave. This compression and expansion of the slinky can represent the air molecules being compressed in a sound wave.

You could potentially get older children to create a 'science show' for younger children. This would use their creative skills as well as test their knowledge. They could use slinkies, drawings, musical instruments and their favourite songs to demonstrate the science of sound.

You could also get children to create their own skiffle or jug band music and dress up in 1950-1960's style dress. How did the original skiffle and jug band music players make their instruments and how do they produce different sounds?

# Mission 4:
## Memory masters

The fourth thing you could investigate on your science mission is another biological change - your memory. You learn new things and make new memories all the time. Every day you remember new things and every time you do your brain has changed just a little bit! Every time you learn something you are changing yourself!

This challenge is all about memory. Can you test your memory and see what is easy to remember and what is harder?

### Talk about:

1. What is memory?
2. What is hard to remember and what is easier? Can you think of some examples?

### Here are some ideas to get you started:

1. Your teacher will explain some games to you. These games are a fun way to see what is easy to remember and what is harder. Which game to do you think will be the easiest? Which will be hardest?
2. How can you test your memory?

Now you can start to play your memory games. Which game is the easiest?

### Sharing your ideas:

What did you find? Have you changed your brain and made a memory?

### Here are some extra challenges:

Try doing exactly the same games tomorrow. Do you think you might be quicker at them tomorrow than you were today? Why is this?

# Memory Masters: Organisers Notes

## What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list.
3. Make sure the children understand their science mission – to investigate change.
4. You need to explain each of the games to the children and get them to try and predict what will be harder to remember and what will be easier. This is not a competition between the children, this is about them deciding together which they think is hard and which they think is easy to remember. It should allow the children to realise that things that are visual or mean something to them are easier to remember than things that are neither of these.
    a. Game 1: This game is a demonstration of what should be easier to remember – visual things. Have everyone sit in a circle. One person is chosen to leave the room (they'll need an adult to help). Before that person leaves the room everyone has 1 minute to try and remember what they are wearing/look like. That person then changes as much as they can about their appearance. You can have fun with this - for example they could put on a large colourful hat, tie their sweater around their leg, put a sock in their hand and put on a different jumper. They then re-enter the room and stand in the middle of the circle while the rest of the group takes turns guessing what's different for a few minutes. Did the class miss anything? Overall was it quite easy?
    b. Game 2: This is a demonstration of what is really hard to remember. There are very few people in the world who can remember this. Here is a very long number – 4589339923249835934523342584567. Get one person to read out each of these numbers in a series. Can anyone repeat it and get it right? Numbers are VERY hard for our brains to remember because they are not very visual and a number doesn't mean as much to us.
    c. Game 3: Remembering a story. Choose quite a short and simple story to tell the children. Get them to listen carefully. Ask them at the end to tell you what happened. How easy was it for them to remember? Did they miss anything?

## Background:

1. Memory is our ability to store, retain, and subsequently retrieve information. Everyone can remember things – from what they ate for breakfast, to what their bedroom looks like, to what they learnt at school.
2. Our brain is better at remembering visual and spatial things that mean something to us more than anything else. For example – do you ever forget what your bedroom looks like? Or where the kitchen is?
3. Memory lets us learn new things and means that we get better at things if we practice them.
4. There are different types of memory, short-term and long-term.
5. Short-term memory is supported by temporary patterns of neural activity in the brain and long-term memories are created by permanent changes in neural connections.
6. One of the important things about sleep is that it allows memories to be formed properly. You tend to forget more things if you don't get enough sleep.

## Suggested materials:

1. Some dressing up clothes. Big bright colours preferable
2. A book with a short and simple story

## For older children:

You may want to develop this activity for older children.

For National Science and Engineering Week 2008, Teachers TV teamed up with the British Science Association to bring schools the opportunity to take part in a significant nationwide experiment. This investigated, via an on-line test and survey, how diet and exercise can influence memory and concentration. More than 78,000 children at 682 schools took part in March 2008 in what was the largest ever experiment of its kind. If you didn't take part in 2008, why not use the online resources at www.teachers.tv/experiment to get your school to find out how ready to learn your children are and how you can improve this.

You could also investigate what the children find hard to remember. What sort of information is difficult to learn? Why do they think this is? You could work with the children to come up with imaginative ways of remembering hard facts. There are many techniques that can be used to help memorise things. What methods do the children think work best and why? Can they come up with their own methods? Testing out techniques like this may help them in exams.

# Mission 5:

## Multi-coloured meal

The fifth thing you could investigate on your science mission is colour change. There are many different colours all around you all of the time. Imagine if there were no colours – how boring the world would look!

What colours are found in the natural world? What are the most common colours and which are the rarest?

This challenge is all about investigating colour. Your mission is to make the most colourful collection of things you can. This could be the most colourful meal or maybe the most colourful sandwich (of course – your challenge isn't to make it taste nice!).

### Talk about:

1. What is colour?
2. What are the most and least common colours in nature?

### Here are some ideas to get you started:

1. You need to collect things from nature that are different colours. Your teacher will help you decide what to collect.
2. What colours do you think are common and which do you think are rare?
3. How could you record your observations?

Now you can start collecting things from nature.

### Sharing your ideas:

What did you find? What colour is most common in nature?

### Here are some extra challenges:

Do colours change in nature? What colours do you see in a garden in the winter and what do you see in summer? Can you make a winter and summer picture to show what colours you might see?

## Multicoloured meal: 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 the children understand their science mission – to investigate change.
4. Decide whether you would like the children to collect different coloured food to make a meal or sandwich or if you would prefer them to spot different coloured things on a nature walk. A nature walk might be less expensive if you don't want the children to buy/collect food items.

### Background:

1. There are two reasons why we see colours. Firstly it is caused by light interacting with the world around us. Secondly it is a result of the way our eyes detect light and how our brains interpret what we see.
2. The colour of an object depends on both the physics of the object in its environment and the characteristics of the perceiving eye and brain. Physically, objects can be said to have the color of the light leaving their surfaces.
3. Animals and plants are different colours for a number of reasons. For example, most plants are green because of their contain chlorophyll used to make energy from sunlight and plants have flowers with bright colours to attract insects. Animals also use colour to hide or camouflage themselves, for display or to warn others of danger. For example:
    a. peacocks use bright colours for display
    b. ladybirds use red and black spots to warn off those that might want to eat them (ladybirds don't taste nice)
    c. wasps use black and yellow markings to warn of others of their sting
    d. snakes use their markings to camouflage themselves in the grass

### Suggested materials:

1. A selection of different coloured food

### For older children:

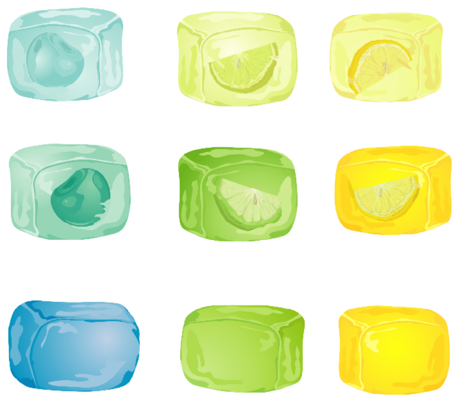
You may want to develop this activity for older children.

For example you could investigate how colour can affect mood. Do different colours make you feel different things? Why is art an emotional thing? Could colour have something to do with this? You could bring this science activity into the art lesson.

Alternatively you could get children to test whether everyone gets an emotional reaction to colour. Does everyone feel the same way about the same colours? What does colour mean in nature? Do animals and plants use colour for a reason? What are these reasons?

There is also a challenge pack called Colour Chaos available to freely download on our website (www.nsew.org.uk). This contains many more activities specifically exploring colour.

# Mission 1:
## Crazy Cubes



The first thing you could investigate on your science mission is how water changes. You know it can change from ice, to water, to steam and back again. Scientists call this a physical change.

If water couldn't change there would never be any clouds, it would never rain or snow, there would be no rivers and there would be no ice at the north and South Pole – and that's just some examples!

You have been given six ice cubes by your teacher to investigate what makes water change. But something is strange about these ice cubes. One is black, one white, one red, one blue, one green and one yellow. Your teacher says that when these ice cubes melt, some melt slower than others. Your teacher says they are crazy ice cubes and you should investigate!

### Talk about:

1. When an ice cube gets warm what happens?
2. Do you know what a solid, a liquid and a gas are?
3. What might be making these coloured ice cubes melt strangely? (Clue: Do you get warmer on a hot sunny day in black clothes or white ones?)

### Your challenge:

Can you test these crazy coloured ice cubes? Can you time how long each is taking to melt?

### Here are some ideas to get you started:

1. How will you test how long it is taking for these ice cubes to melt?
2. What materials do you need?
3. When and how and what will you measure to test these ice cubes?
4. How will you make sure your tests are fair?

Now you can start investigating your ice cubes. Get your materials ready and compare how quickly they melt.

### Sharing your ideas:

After the experiment what did you find? Which ice cube melted the fastest? Which the slowest? Can you explain why?

### Here are some extra challenges:

1. What else might slow or speed up the time it takes for an ice cube to melt? Clue: what does the council put on the roads when it's cold and about to snow?

# Crazy cubes: Organiser's notes

## What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list and make sure you make time to prepare the ice cubes. See background for information.
3. Make sure the children understand their science mission – to investigate change.
4. Give the children time to think about water and how it changes state. Encourage them to think about how temperature makes it change. If water didn't change what might our planet be like?
5. Give them the equipment needed to time how quickly their coloured ice cubes are melting. Make sure they put the ice cubes somewhere so that each cube gets the same about of light/heat from the sun/lamp.
6. Get the children to predict/guess which ice cubes they think will melt the slowest/fastest.
7. Encourage them to discuss why different coloured ice cubes would melt slower/faster. Talk about how colours absorb light.
8. To make the white ice cube add milk to the water. For the black one mix up all the other colour food dyes, (it won't be quite black but it will be close) or use Coca Cola.
9. You can make the children prepare the ice cubes the day before if you wish.
10. You can also put normal ice cubes on coloured card rather than using coloured food dye to colour the ice cubes themselves.
11. Make sure the ice cubes are placed somewhere they are receiving the same amount of light from the sun/lamp etc.

## Background:

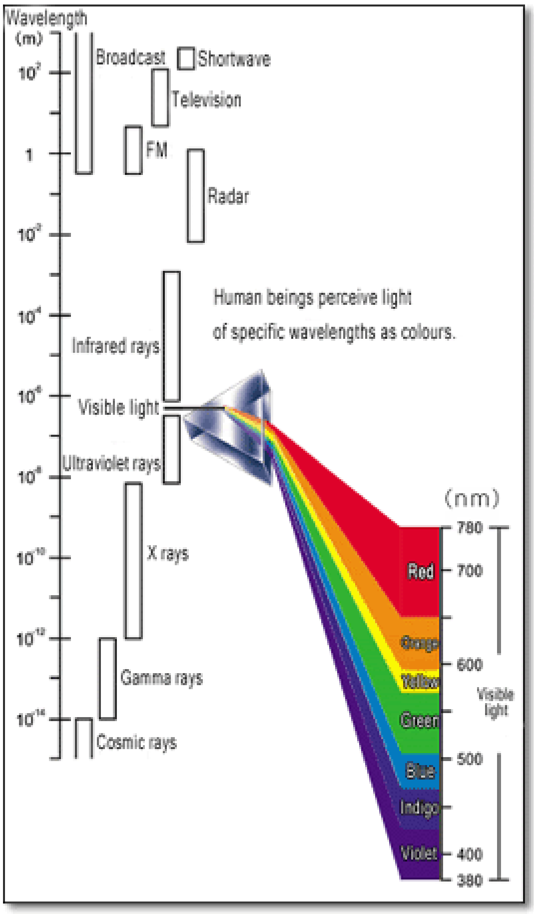
1. This experiment demonstrates that different colours absorb light/heat differently. Don't you get hotter on a sunny day in black clothes? This is because the colour black absorbs more light making the clothes get warmer. Black is the most efficient 'solar heat collector'. The white ice cube will melt the slowest since it reflects most of the light. The other colours absorb all the light except for the one they reflect. This is the colour they appear to us.
2. If sunlight passes through a prism, a band of colours like a rainbow are produced. This was discovered by Isaac Newton. The band of colours is called the colour spectrum.
3. In terms of physics, light is a type of electromagnetic wave. The distance from trough to trough (or from peak to peak) of these waves is called the wavelength. The colours we perceive differ depending on the wavelength of the light we are seeing.
4. The reason human beings can see the colour spectrum is that certain specific wavelengths of light stimulate the retinas of our eyes, causing us to perceive colours. We perceive the light with the longest wavelengths as red and that with the shortest wavelengths as violet. The range of wavelengths the human eye is capable of perceiving is referred to as "visible light".

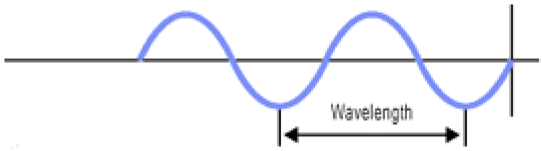
## Suggested materials:

1. Coloured food dyes: yellow, green, blue, red
2. Milk
3. Coca Cola (or use all food dyes together to make black)
4. White paper or card to place ice cubes on
5. Timer

For older children:

You could look further into the properties of light. How does our brain let us see light? It recognizes different wavelengths of light and then perceives this as colour. Can the children draw accurate scaled-up diagrams of what each colour looks like in terms of the shape of its wave? Or alternatively can they match the wavelength with the correct colour? For example red would be a wave with a wavelength of 780 nm and violet would be a wave with a wavelength of 380 nm. Your brain can tell these apart easily – but can the children?




Light has the characteristics of a wave. The distance from trough to trough (or from peak to peak) of the wave is called the wavelength.

## Mission 2:
### Stormy structures

The next thing you could investigate on your science mission is a physical change – the weather. The weather here changes a lot! Rainy, windy, sunny, snowy, cloudy, hot or cold!

Our homes keep us dry, warm and safe but sometimes in strong storms buildings can collapse! Engineers spend a lot of time designing buildings and bridges so that they can withstand the weather. To do this, they use physics and maths to make sure buildings are strong and stable.

Can you make a structure that can withstand the weather or even a storm?

### Talk about:

1. Different weather conditions
2. How do you make strong buildings - what shapes and materials do engineers use?

### Your challenge:

Can you make strong structures out of simple materials? Are some shapes easier to knock over than others?

### Here are some ideas to get you started:

1. You have been given some materials to make different shaped structures. Your teacher will show you how to test your structures under some 'weather' conditions. This will test how strong your structures are. What shapes will you make?
2. What materials do you need?
3. <u>When</u> and <u>how</u> and <u>what</u> will you measure to see how strong your structures are?
4. How will you make sure your tests are fair?

Now you can start building and investigating your structures. Get your materials ready and compare how strong they are.

### Sharing your ideas:

After the experiment what did you find? Which structure was the best? You could also display your structures in class for the whole week.

### Here are some extra challenges:

Make a poster about your stormy structures. Can you spot triangle shapes used in other buildings or bridges? Take photos of what you see.

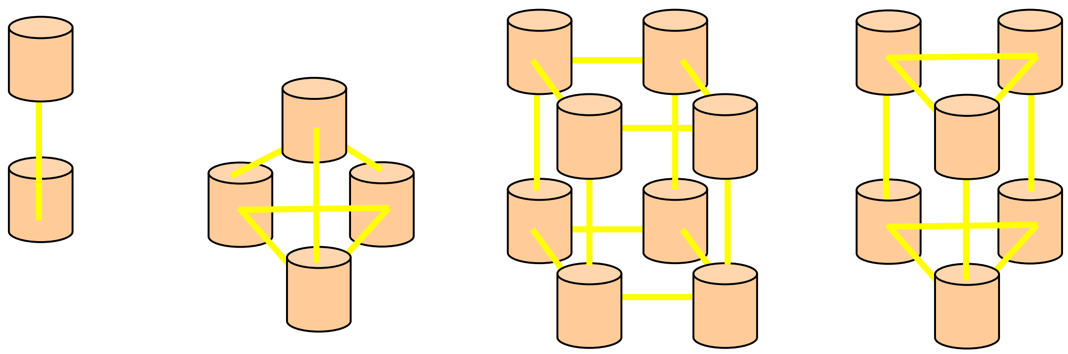
# Stormy structures: Organiser's notes

## What do I do?

1. Read the 'Mission' sheet to familiarise yourself with the activity.
2. Check the resources list.
3. Make sure the children understand their science mission – to investigate change.
4. Give the children time to think about buildings and how they need to be built to withstand the weather.
5. Give them the equipment needed. You could either allow them to build freely, or alternatively suggest shapes to use. Note: the bigger the children make the structures the more dramatic the destruction will be.
6. Get the children to predict/guess which structures will be destroyed/damaged by the 'weather' and which will remain standing. If a camera is available – before and after pictures could be taken and the children could produce displays. You could also give prizes to those children who built the strongest structures.
7. Encourage them to discuss why different structures might be stronger than others. Which were the best?

## Suggested structures:

These are some suggested structures. The ones using triangles are more stable.



1) Simple 2) Triangles 3) Squares 4) Triangles and squares

## Background:

1. To test the structures against the 'weather' you can recreate weather like conditions of wind and earthquakes (you could also demonstrate rain if you wanted by using a watering can – but this may be a bit messy). Place the structure to be tested in a container. You could then use a hairdryer or a strong fan to see if you can knock down the structure with 'wind'. To test the structures under earthquake conditions you can then tip and shake the container and see if that will knock it down. Also put the structures under compression and tension. Compression and tension would be felt more strongly by the structure during an earthquake but also on a day to day basis.
2. Within structures parts are always pulling and pushing on each other. Structures remain standing because some parts are being pulled or stretched and other parts are being pushed or squashed. The parts that are being pulled are in tension. The parts that are being squashed are in compression.
3. A good way to understand the forces acting on structures is to imagine yourself in an object's place. For example, if you're a brick and someone piles more bricks on you, you'll feel squashed, so you're in compression. If you're a long steel cable attached to a couple of

towers and someone hangs a bridge from you, you'll feel stretched, so you're in tension. Some materials - like bricks - don't squash easily; they are strong in compression. Others - like steel cables or rubber bands - don't break when you stretch them; they are strong under tension. Still others - like steel bars or spaghetti - are strong under both compression and tension.

4. Squares collapse easily under compression. Four pieces of spaghetti joined in a square tend to collapse by giving way at their joints, their weakest points. With a spaghetti triangle, the only way to change the angles of the triangle is by shortening one of the sides. So to make the triangle collapse you would have to push hard enough to break one of the pieces of spaghetti. Therefore pasta and marshmallow structures with triangles are stronger.

### Suggested materials:

1. A bag of marshmallows (or blu-tac if you want to test the structure against 'rain').
2. A box of spaghetti

### Safety points:

If you use water to simulate rain – mop up any spillages.

## For older children:

You may want to develop this activity for older children. We all take buildings for granted but it is essential for architects to understand physics in order to make strong and stable structures. What would we do without somewhere safe to live?

A good website for topical engineering/architecture information and classroom activities is http://architecture.about.com

You may also want to visit the engineering section of the National Science and Engineering Week website (http://www.nsew.org.uk). This section is full of useful information, including how to invite an engineering ambassador to your school.

# Mission 3:
## Ripen it!

The next thing you could investigate on your science mission is another change to do with food!

Have you ever noticed that food such as fruit bought from the shop will ripen over time? It may even go rotten and start to smell if you forget about it. Why does this happen?

### Your challenge:

Can you test what will affect how quickly a banana will ripen? Do you think you can slow down or speed up how quickly the banana changes?

### Talk about:

1. How can you tell an unripe banana from a ripe or a rotten one?
2. Can you slow down how quickly a banana ripens or goes rotten? What might help?
3. What different types of packaging are there? How could you test which might be best for a banana?

### Here are some ideas to get you started:

1. What types packaging are you going to test? You can test other things too to see if they help.
2. How long will you need to do your experiment? (You may need to leave the bananas for a week in order to see the effects of your experiment).
3. <u>When</u> and <u>how</u> and <u>what</u> will you measure? Think about colour, texture, taste and smell.
4. How will you make sure your tests are fair?

Now you can start investigating banana ripening. Get your materials ready and start your experiment.

### Sharing your ideas:

After the experiment what did you find? What's the best way to store bananas – and stop the rot?

### Here are some extra challenges:

1. What about other fruit?
2. Will a very ripe banana affect how quickly other bananas in the same bag ripen?

## Ripe and rotten: Organiser's notes

### What do I do?

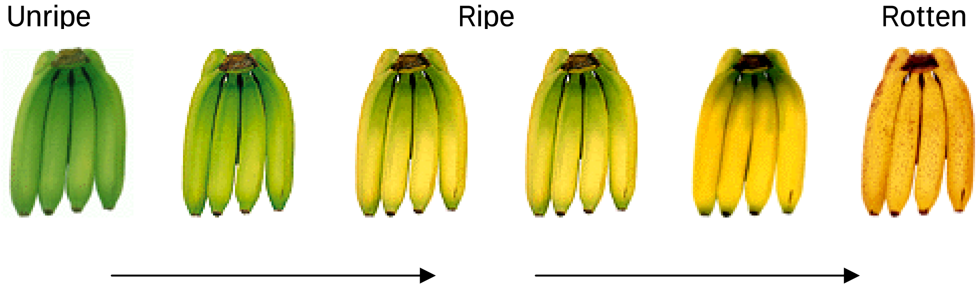
1. Familiarise yourself with the activity
2. Check that you can leave bananas to ripen over the period of a week or a few days and that the children will be able to come back and test banana ripeness.
3. Set the scene by discussing fruit and especially banana ripening. For example - have they noticed all the types of packaging used in supermarkets?
4. Give the children time to discuss their ideas about 1) what changes happen when a banana ripens 2) how long it usually takes 3) what might affect ripening 4) how they could test what type of packaging might be best for a banana
5. Gather everyone's ideas and discuss how you are going to test these and how you will record the results (you will have to leave the bananas a couple of days or a week to see the results).
6. Now let the children try out their ideas and see what they come up with
7. When they have set up their experiment make sure the bananas are left in a suitable place (temperature and moisture will affect the results as well).
8. When the children come back and collect the results talk about what they have found. The children could create displays if you want (especially if they are able to take pictures).

### Background information:

1. As fruit ripens, it produces a gas called Ethylene. Ethylene is a gas that naturally ripens fruit, but it can also over ripen fruit and cause spoilage.
2. If the fruit is not packaged properly, then the Ethylene gas can build up in the package leading to rotten fruit.
3. Packaging is not only designed to prevent damage to the fruit but also to prevent over ripening. An agricultural scientist, food scientist, packaging scientist, and material scientist all work together to design the right packaging.
4. Ripening fruit "breathes," or respires. That means that it takes up Oxygen and gives off Carbon dioxide. Oxygen is essential for the chemical reactions involved in ripening.
5. Ripening can be measured in a number of ways, including taste, colour, texture, smell and firmness. Pictures could be taken of the colour of the fruit if the children want to display their work later.
6. Paper bags tend to keep in ethylene, but they are porous enough to allow oxygen (and ethylene) to pass through. Bananas therefore tend to ripen quicker in a paper bag.
9. It's recommended to leave the fruit alone for four or five days to ripen. Do not open any of the bags during that period. On the fifth or sixth day, examine all the fruit.

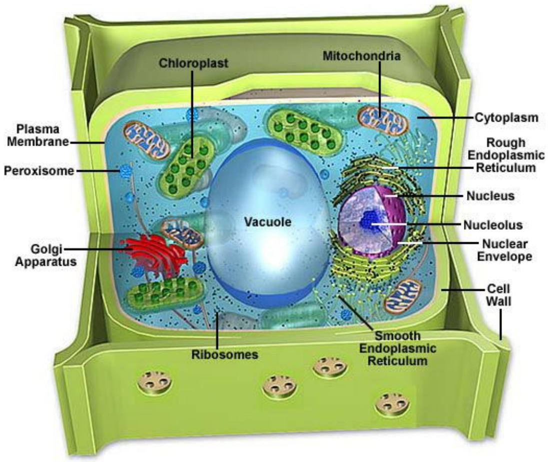
### Suggested materials per group:

1. 7 very green bananas
2. 1 very ripe banana
3. brown paper bags
4. "zipper-lock" plastic bag
5. plastic wrap
6. a marker



## For older children:

You could look into what is actually happening to the fruit when it ripens and then eventually goes rotten. Think about this on a molecular level – what's could be happening to the bananas cells? At a cellular level – ripening is associated with an increase in the activities of enzymes which breakdown the cell wall. You can see in the picture below that the cell wall of plant cells is usually thick and strong but in fruit that is ripe the walls have been broken down. When it is rotten the cells have been broken down even more. Why does fruit ripen – what is the advantage for the fruit tree?



## Mission 4:
### Move it

The next thing you could investigate on your science mission is another important physical change - movement!

How did you get to school today? How do you move from your home to school?

We move from one place to the other all the time and this is a type of change. We can also travel on machines. Machines like planes, trains, cars and bikes have been invented by scientists and engineers so we can move across great distances. These machines can take us very far, very fast.

It seems so easy to move doesn't it - but whether you walk to school or take the bus you need lots of energy to do it.

### Your challenge:

This challenge is all about movement and energy. Your task is to make a cotton reel move for as long, far and fast as possible; how many different ways can you come up with?

### Talk about:

1. Do you know what energy is?
2. How do you get something to move?

### Here are some ideas to get you started:

1. You have a cotton reel and some other materials you can use. Think about all the different ways you could make this cotton reel move.
2. What materials do you need for each method?
3. <u>When</u> and <u>how</u> and <u>what</u> will you measure to test which method is the best?
4. How will you make sure your tests are fair?

Now you can start investigating movement. Get your materials ready and compare your different methods of creating energy to make a cotton reel move.

### Sharing your ideas:

After the experiment what did you find? What method of creating energy would you recommend to move something 1) fast, 2) for a long distance or 3) for a long time? Is there one method which is best or are several methods just as good as each other?

### Here are some extra challenges:

1. Imagine you are an engineer and you have been told to make the world's fastest cotton reel for a wacky competition. What might you do? A small engine? Make it fly? Use your imagination and draw some pictures of the worlds fastest cotton reel.

# Move it! Organiser's notes

## What do I do?

1. Familiarise yourself with activity
2. Give the children time to discuss their ideas about energy and movement
3. Gather everyone's ideas and discuss how the children are going to move their cotton real. How you will record the results. Will you award prizes to the winners?
4. Now let the children try out their ideas and see what they come up with

## Background:

1. There are different types of energy (Magnetic, Kinetic, Heat, Light, Gravitational potential, Chemical, Sound, Electrical, Elastic potential, Nuclear).
2. One type of energy is found in anything that is moving (its called Kinetic energy). This includes the smallest to the largest things (i.e. atoms are moving around fast because it is hot (heat energy) to the biggest boulder rolling down a hill or an elephant pushing down trees).
3. Different types of energy can be transferred from one type to another. Energy can never be destroyed only changed.
4. You may want to do this experiment outside if you want to allow the children to create catapults. Please note the safety instructions.
5. Children could come up with a number of ways to make the cotton reel move (i.e. transferring energy to the cotton reel). For example:
    a. The energy could come from them – they could push the cotton reel. (We get our energy to move from our food).
    b. They could give the cotton reel more 'potential energy' by putting it at the top of a slope and letting it roll down.
    c. They could use the elastic band to provide energy by making a catapult.
    d. They could also twist the elastic band and make a creeping crawler. (You may want to demonstrate this at end of class. See full method of how to make one below).
    e. They could use the string to enable them to spin and throw the cotton reel further. (Weighting the cotton reel with blu-tac may make it travel further).
    f. They could make a swing by using the string. (By weighting the cotton reel with blu-tac the reel may swing for longer).
6. You could make this a hall/outside activity with competing teams. Each team should be scored on:
    a. How many ways they come up with
    b. How long they make their cotton reel move
    c. How far they make their cotton reel move
    d. How fast they make their cotton reel move
7. Of course there are lots of other options to get your cotton reel moving than the materials provided allow. Get the children thinking about other ways to create energy to move, for example where does a hot air balloon or a car get its energy from?

## Suggested materials:

1. Cotton reel
2. Elastic Band
3. Match Sticks/Cocktail sticks
4. Bead with large hole
5. Blu-Tack
6. String

Method to create creeping crawler:

1. Push the elastic band through the hole in the spool.
2. Break a matchstick in 2 and push one piece through the loop of elastic band to hold it in place. Fasten the stick to the spool with blu-tack.
3. At the other end of the spool, thread the elastic band through the bead and push a cocktail stick through the loop of elastic band.
4. Wind up your roller by turning the cocktail stick.

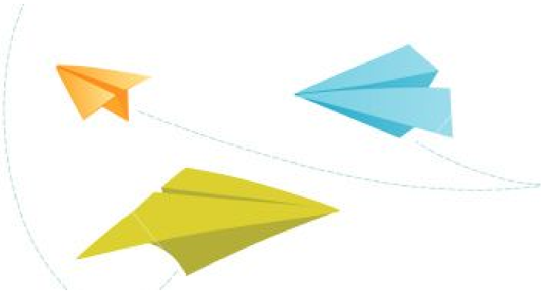
Safety: If you allow the children to make catapults – be careful to let them test them safely in an open space. Get them to test them in a direction away from people.

## For older children:

Get the children thinking about climate change and how the way we have produced energy to power the movement of things like cars and planes has led us to the problem of global warming. Think about renewable and non-renewable energy sources and investigate the carbon footprint of your school. You can do this on the website http://www.carbondetectives.org.uk/content/home/index.html for example.

# Mission 5:
## Airplane engineers

The last thing you could investigate on your science mission is flight – this invention has meant we can travel great distances in a short period of time.



### Your challenge:

This challenge is all about flight. You have been asked to help an airplane engineer investigate planes. He wants you to test what shape of paper plane will fly the best. He wants to use your results to design a new plane. He wants to know which paper plane will fly the furthest and the fastest.

How can you test different paper planes to find out which one is the best?

### Talk about:

1. Do you know how planes fly?
2. Which shape plane do you think will fly the best? Can you decide by looking at them or are you going to need some tests to tell you?

### Here are some ideas to get you started:

1. Your teacher has some instructions on how to make a variety of paper planes. Once you have made these – how are you going to test which ones are best?
2. What are you going to measure?
3. What materials do you need for each method?
4. When and how and what will you measure to test which method is the best?
5. How will you make sure your tests are fair?

Now you can start investigating flight. Get your planes ready and compare how well they fly.

### Sharing your ideas:

You could have a competition to find out which plane can fly the furthest or fastest. What were the results?

### Here are some extra challenges:

1. Can you make the paper planes you have made go even further and faster? How might you do this?

## Airplane Engineers: Organiser's notes

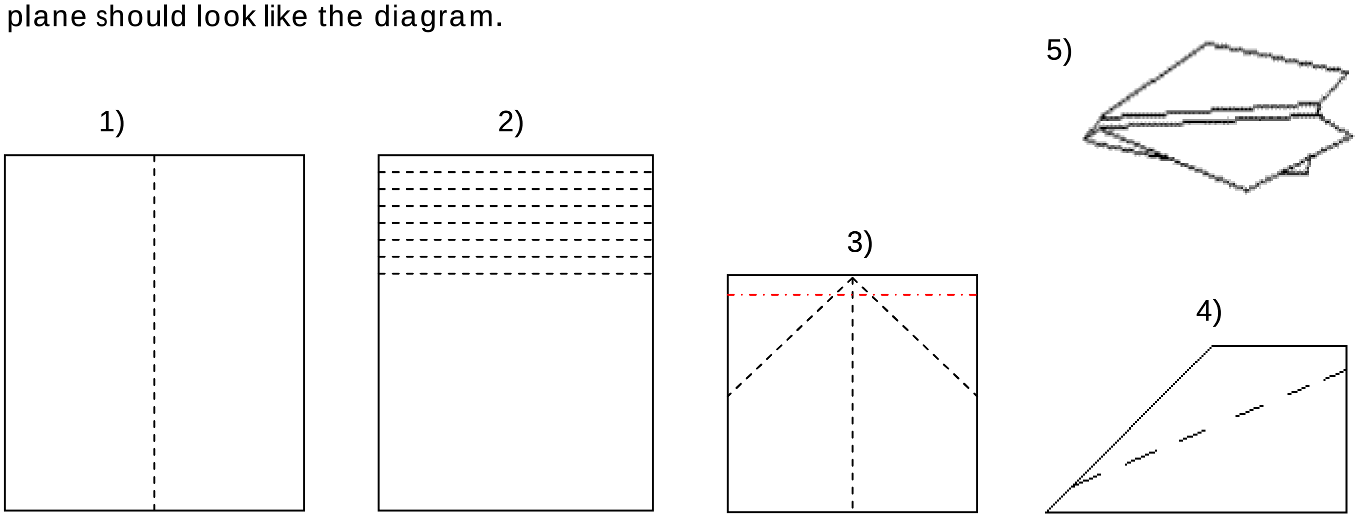
### What do I do?

1. Familiarise yourself with activity
2. Do you have enough time to get the children to make the airplanes? Alternatively you could follow the instructions and make the variety of planes for the children to test. Full instructions are below.
3. Discuss what a plane needs to fly and what might make one plane fly better than the other. Note: all the planes given will fly quite well. This exercise demonstrates some of the scientific testing an engineer would do when designing new aircraft. All will fly – but which might fly the best - only testing will show this.
4. Gather everyone's ideas and discuss how you are going to test these planes. How you will record the results? How will you launch the planes in such a way the testing is fair?
5. Now let the children try out their ideas and see what they come up with.
6. When the children come back and collect the result talk about what they have found. The children could create displays if you want (especially if they are able to take pictures/film the flight).

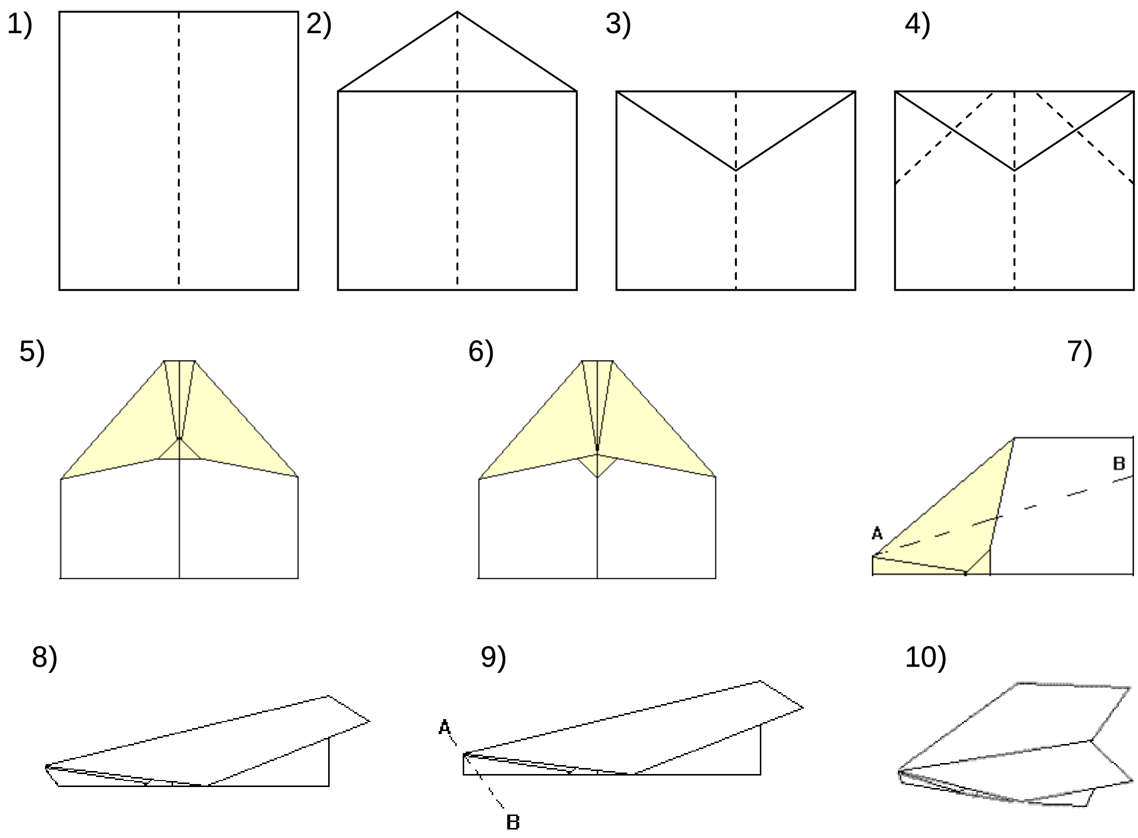
### Suggested method to make paper planes:

(Recommended that organisers familiarise themselves with the instructions before session)

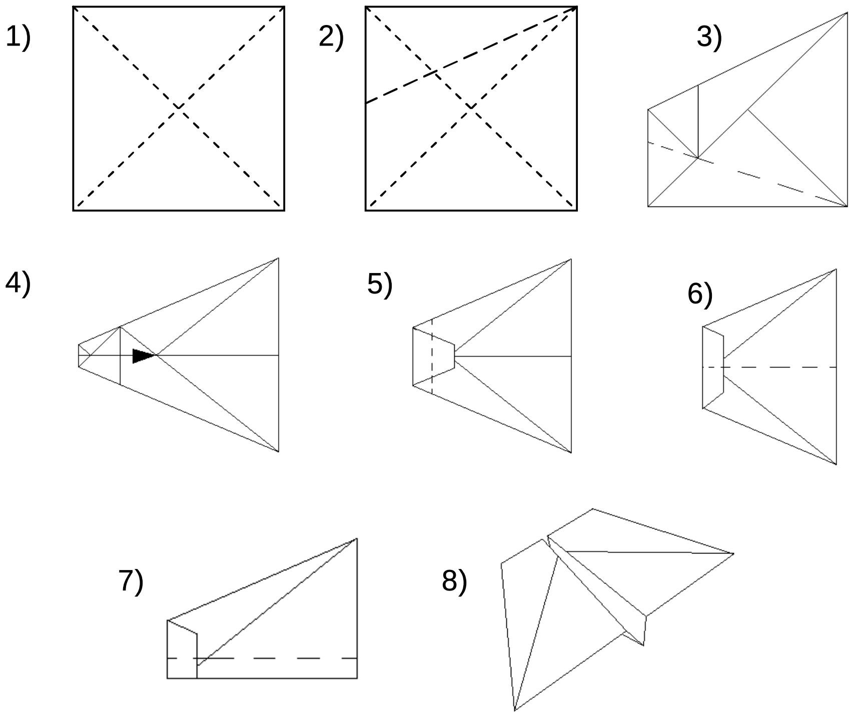
Plane Number 1: 1) First take a rectangular A4 sheet of paper and fold down the centre dotted line on opening it out again afterwards. 2) Then take the first 1 cm of the sheet and fold it up along the dotted line. Fold the flap over and over until about 3/8 of the length of the sheet is folded in this concertina fashion - this should give a heavy and thick front lip. 3) Now fold along the two dotted lines in bringing the top edges into the centre line and fold along the centre line. 4) Fold the wings down along the dotted line in one either side of the centre. 5) Now the plane should look like the diagram.




Plane Number 2: 1) Firstly fold the sheet in half along the line and then open it out again. 2) Fold the two top corners in to the centre line. 3) Then fold the top large triangle over so that the two flaps formed are now underneath the large triangle. 4) Now fold the two top corners into the centre line again in such a way that you get the form in the fifth picture. 6) Now fold the small triangle up over the two flaps. 7) Fold along the centre line so that the small triangle is on the underside of the plane on the outside along with the two flaps. Fold along the line AB on 7th picture and then turn the plane over and do the same to the other side. 8) + 9) Fold along the line labelled AB on the diagram first one way and then the other creasing really well. Tuck the triangular shaped depression in between the two wings. 10) Plane should look like this.




Plane number 3: 1) Fold the square piece of paper along the two diagonals on creasing well on both lines and opening out the paper again afterwards. 2) Now fold along the dotted line bringing the left hand edge to the diagonal centre line from top right to bottom left. Now fold along the dotted line in diagram 3 to give you diagram 4. 5) Fold the tip down on the existing crease as shown by the arrow in diagram 4. 6) Now fold the blunt nose over again along the dotted line. 7) Now fold along the centre line to give diagram 7. 8) Now fold the wings down along the dotted lines in diagram 7 to give the plane.



## Background:

This may be too advanced for some students but can be used for additional information if you'd like to add to the activity.

1. Flight requires two things: Thrust and lift. Thrust is the forward motion provided by the propeller or jet engine (or in the case of the paper airplane someone's hand). Lift has a more complicated explanation behind it:
    a. Faster-moving air has less pressure (this is often called the Bernoulli principle). The shape of wings (curved at the top) means that air flows faster on the top and the area above the wing is said to have less pressure than the area below the wing, creating lift. However, there are another set of laws called Newton's laws which also explain the lift seen. The Newtonian idea is that air flowing over the wing is ultimately deflected downward by the angle of the wing. Newton said there has to be an equal and opposite reaction, so the wing is forced upward.
2. Two forces work against flight: Drag and gravity. For drag a wing has to be designed not only to produce lift, but also to minimize the friction with passing air.

## Suggested materials:

1. Paper
2. Folding instructions
3. Somewhere good to fly the planes
4. Timer
5. Measuring tape

## For older children:

You may want to get the children to do some 'serious' aeroplane designs and test them in 'flight simulators'. Who is the next aeroplane designer for NASA?

You can use NASA's great educational website to find out – http://www.nasa.gov/audience/forstudents/5-8/features/F_Design_Plane_of_Future.html

## Thank you for using Change Champions!

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 and Engineering Week Certificate.

Organisation: ______________________________________________

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Which dates did you do National Science and 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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