NATIONAL SCIENCE & ENGINEERING WEEK

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Ticket to ride

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:
These activities are all about **transportation** – the movement of people and goods from one location to another on **land or water**, or through **air**. It is intended to be a source of ideas for school or home activities. Dip into these activities and discover a bit more about the process of moving, over land, through water or through air…

CREST ★ Awards
All activities can count towards a CREST★ Investigator award if you would like to accredit the children's work.

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 CREST Star accredited and CREST SuperStar accredited activities; indicated by the logos on those pages.

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.

How to use this pack
This pack includes pages for teachers to help explain the activity to the children and organiser's notes. Make sure you read the activity pack well in advance of National Science & Engineering Week (6-15th March 2009) in order to ensure the activities can be done during that time.

Activities:

LAND:
SLIPPERY SLOPE (Crest star)
HUMAN TRANSPSPORTER (Crest star)
ROLLING ALONG (Crest Superstar)
WHEEL POWER (Crest Superstar)

WATER:
PADDLE RACER (Crest star)
LOADING CARGO (Crest Superstar)

AIR:
MAKE A CRATER (Crest star)
WHAT'S IN A SHAPE (Crest star)
SEND A MESSAGE (Crest Superstar)

Slippery Slope

Your challenge: To investigate sliding!

Talk about

- Have you ever slipped on a patch of ice, or a wet floor, or a banana skin?!
- If you had a sledge, would it be easier to pull your sledge over ice, or grass, up a hill, or down a hill, with someone on the sledge, or with it empty?
- What affects how objects slide and how could you test these?

Here are some ideas to get you started

1. You have been given a test surface and some objects to slide on it. Which ones slide best and why is this?

2. As a group, can you come up with a fair test for deciding which object is the best slider? Try your test out.

3. Now choose just one of the objects and, using your fair test, investigate what happens when you make changes to the test surface. You might try rubbing on some silicone floor polish or adding a layer of another material on top of your surface or ...something else.

Sharing your ideas

Talk about what you found with the rest of your group.

Here are some extra things that you can do

1. Moving quickly is important in many sports and sometimes this is all to do with improving sliding. Think of as many examples as you can of sports in which it's important to improve sliding to help you to win!

2. Sometimes it's important for things NOT to slide – can you think of some examples? Can you find the best surface for an object of your choice not to slide?

Slippery Slope

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Give the children time to discuss what things affects sliding?
4. In small groups, give the children a test surface (see suggestions in material list) and a selection of objects. Can they predict which objects will slide best? Give them a short time to test out their predictions.
5. Discuss the results together, so what affects sliding – the size of object, shape, material, amount of force applied? Or…
6. As a group, try to devise a fair means of comparing how objects slide. One simple way might be to lift one end of the surface until sliding starts – can the amount of incline be simply estimated? (A ruler held up against a wall might make a useful reference point.) Another method might be to give the objects a shove (as in the game shove-halfpenny) and see how far they move (but are the 'shoves' all the same size?!) Is it enough to do any test just once? (Are the results identical every time?) If not just once, how many times?
7. Finish by encouraging the children in small groups to investigate different test surfaces.

Background

Friction is the resistance encountered when surfaces in contact slide against each other. Smooth or even surfaces produce *less* friction; rough or uneven surfaces create *more* friction. The lower the friction the more easily objects will slide. Smoothing out surfaces can help to reduce friction – polish, wax, water, grease, and soap, all these substances can be used as lubricants to fill bumps in the surfaces so that the friction is reduced.

There are lots of examples in sport where we reduce friction to move faster e.g. wax on the bottom of skis, polish on bowling alleys, flowing water down swimming pool chutes, sweeping brooms in curling, grease on a bicycle chain…

Sometimes it is important to hinder sliding e.g. studs on football boots, grit on roads, tyres with deep tread on vehicles, chalk on hands for rock climbing…

Suggested materials

- Test surface e.g. tin tray or baking tin, plastic chopping board, wooden board, piece of correx
- A selection of test objects e.g. matchbox, eraser, stone, piece of wood, ice cube, 2 pence coin
- Ruler
- Silicone furniture polish and cloth
- To investigate different surfaces a selection of: pieces of sand paper, felt, polystyrene sheet, sugar paper, shiny card, cling film

For older children: Have a look at the soles on the bottom of everyone's shoes. How do the designs differ? How would you go about designing and testing a new sole for an 'ultra-grippy' walking shoe? How could you model and test these designs?

Human Transporter

Your challenge
To compare different ways of carrying heavy books and decide which you think is best.

Talk about

- How do we carry things? Such as: books to school, shopping from the supermarket, swimming costume to the pool, lunch up a mountain, valuables around the beach, food in a café, clothes and belongings on holiday?
- How do you decide which method of carrying to use?

Here are some ideas to get you started

1. Discuss how you could carry books home from the library and what you might use.
2. How could you compare different carrying methods using some heavy books? How will you make your comparisons fair? Can you score the different methods? How will you record this?

Sharing your ideas
Take it in turns to present to the group your best and worst way of carrying books. Remember, not everyone's recommendations will necessarily be the same!

Here are some extra things that you can do

Design a new bag for carrying library books. Draw a picture of your design and label all its best features.

Human Transporter

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Give the children time to talk about how we carry things.
4. Either as one large group, or sub-divided into smaller groups, ask the children to select a number of different methods of carrying books and devise a means of comparing these. To make the tests fair the distance carried, the number of books and the person carrying them should all be kept the same. The 'human transporter' may tire, so adequate rest periods may need to be built in between tests. Methods could simply be ranked in order of 'ease', awarded a certain number of happy faces or given a score out of 10.

Background

Choosing the best strategy for carrying loads depends very much on what the load is, where you are, the convenience factor and to a certain extent - fashion! There is no doubt that we don't always use the most efficient methods – backpack slung over one shoulder rather than two, loaded shopping bag over one arm, heavy rucksack slung too low – all potentially bad for our posture and backs. Perhaps it wouldn't be a bad idea if we all learnt to carry loads on the tops of our heads! The purpose behind this investigation is to get children thinking about carrying, whether it is possible to rank different methods or whether it's simply a matter of taste. When we decide that this is the 'best' method, what is it 'best' for; our backs, our street credibility, our convenience, or something else? Secondary pupils in particular often carry lots of books in their school bags so developing good carrying techniques is an important issue.

Suggested materials

- A variety of different bags: e.g. selection of carrier bags, back pack, framed rucksack, sports bag, bum bag
- Tea tray
- Wheeled shopping trolley (if you have one!)
- Some large books

For older children

- By means of a questionnaire, determine the range of weight pupils carry to school and the sorts of bag they use. Your questionnaire might also cover reasons for choice of school bag (e.g. cost, practicality, fashionability?)
- Carry out some research into good and bad ways of carrying loads in regard to posture and back strain.
- Draw a poster to illustrate your recommendations on the 'do's' and 'don'ts' of carrying.

Rolling Along

Moving heavy objects is hard work but there are ways of making it easier, especially if you apply a bit of scientific know how to the problem!

Talk about

- Have you ever helped to move a piece of heavy furniture? Was it easy? What's the heaviest object that you have ever helped to move?
- Have you ever visited a stone circle? The stones are often huge – how do you think the stones got there? (many came from miles away).

Your challenge

To develop some sort of device to actually measure the force required to move a heavy load *with* and *without* rollers? Try pushing a heavy book along a table top. Now lay some pencils down on the table, place the book on top of the pencils and try again. Notice any difference?

Here are some ideas to get you started

1. What sort of force do you need to move a book along a table?
2. How could you simply measure this force? Could you use elastic bands, weights, something else?
3. Think about the pieces of equipment that you might need and check with your teacher if these are available. It could be helpful to draw a picture of how your force-ometer might work.
4. Now construct, test and maybe then improve your device! Do the rollers make a difference to the amount of force required?

Sharing your ideas

Demonstrate your force-ometer to the other members of the group.

Here are some extra things that you can do

1. Use your force-ometer to compare the force required to move your load up and down slopes.
2. Try different diameter rollers – felt tips for example instead of pencils.
3. Does the surface you are moving the load across make a difference?

Rolling Along

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Encourage the children to talk about their experience of moving heavy loads and techniques/equipment we use to make this easier.
4. Give everyone the opportunity to push the book along the table with and without pencils underneath it and then let them think about ways of how they might measure the force required in both situations. The force we are using to move the book is either a **pull** or a **push.**
5. There are many different approaches to making a simple force-ometer. A simple **pull**-ometer can be constructed with an elastic band and a ruler – measure how far the band stretches before the book starts to move (tie a piece of string around the book, attach the elastic band to the string). An alternative **pull**-ometer could be devised using weights dangled on a string over a table top, how much weight does it take to start the book moving? A **push**-ometer requires a bit more thought – perhaps a pneumatic device using syringes, or measure the size of weight required colliding with the book to start it moving.

Background

Friction is the resistance encountered when surfaces in contact slide against each other. Rollers help reduce this friction by reducing the amount of surface in contact at any one time and by smoothing the surface.

Many industrial machines use rollers to move items along the production line.

Suggested materials

- Heavy books (to move!)
- Good supply of round pencils
- String
- Rulers
- Elastic bands
- Pencils and paper
- Weights

For older children

- Could you devise both a **pull**-ometer *and* a **push**-ometer? Which do you think is most accurate?
- Find some examples of where we use rollers today to help move things? e.g. at airports.
- Another way of making it easy to move things is to use wheels. What are the advantages and disadvantages of wheels over rollers?

Wheel Power

Your challenge
You have a really heavy load to shift but you have discovered a wheel! (just the <u>one</u> wheel). Can you use it to devise some form of vehicle to move the load? Model and test your design using the materials provided.

Talk about

- Do wheels make it easier to move things? Why is this?
- Do you know of any one-wheeled vehicles?

Here are some ideas to get you started

1. What are the basic parts that your vehicle will need?
2. How will you attach the wheel to the vehicle so that the wheel can still turn?
3. Draw a plan of how your vehicle will look and so that you can identify what pieces of equipment you will need.
4. Construct your vehicle, test and then modify if necessary.

Sharing your ideas

Demonstrate your vehicle to the rest of the group. Whose design do you think is best and why?

Here are some extra things that you can do

1. Have a competition to see whose one-wheeled vehicle can carry the heaviest load.
2. What size of wheel is best? How could you test this?

Wheel Power

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Talk with the children about wheeled vehicles. Do they know of any with just one wheel? (The wheelbarrow is one with which they should all be familiar.)
4. Some children may never closely have looked at how a wheel works. The wheel needs an axle (or spindle) to ensure that it turns. There are two approaches to wheel and axle: a) the axle can either be **fixed** to the frame and the wheel spins freely on the axle (in which case the hole in the centre of the wheel should be large enough to allow the wheel to spin freely) or b) the axle spins **free** of the frame but the wheel is fixed to the axle (the hole in the middle of the wheel should be small enough to ensure a snug fit to the axle). In this case some mechanism is needed to attach the axle/wheel to the frame using for example a drinking straw - the axle and fixed wheel spin together inside the straw, the straw is fixed to the frame.
5. Aside from the **wheel & axle** the children are going to need some sort of **frame** for their vehicle. The frame incorporates the wheel and axle and carries the load and could have built in handles to push it along. All the parts need to be fixed together – elastic bands, blu-tak and string are good for temporary solutions, tape and glue provide a more permanent solution.
6. The 'heavy load' needs to be decided upon, nothing too heavy (at least initially), this could be anything from a bag of marbles to a packet of lentils and should be the same for everyone.

Background

A wheel makes it easier to move loads because it reduces the friction encountered between the moving surfaces. The wheelbarrow in fact combines the advantages of both a *wheel* and a *lever*. The load is centered just behind the wheel and that way, you have to lift only a small part of the load. If the load is placed too far back in the wheelbarrow it becomes far more difficult to move – interfering with the leverage.

Suggested materials
Some or all of the following:

- Assorted wheels (budget option - cotton reels, cardboard wheels cut from cereal packet)
- Wood dowel/plant sticks (of suitable diameter to either fit loosely inside the centre hole of the wheel for fixed axles, or snugly into the hole for free spinning axles)
- Drinking straws
- Lollipop sticks/craft sticks
- String
- Assorted plastic cartons, foam trays, yoghurt pots etc.
- For 'fixing' – selection of: blu-tak, elastic bands, tape, glue

For older children

- Find out about the history of wheelbarrows.
- A wheelbarrow is a 'second class lever'. What does this mean?
- Where is the best place to put a heavy load on a wheelbarrow? Could you design a test to determine this?

Paddle Racer

Your challenge
To design and test a paddleboat made from an empty carton and powered by an elastic band.

Talk about

- Has anyone ever been rowing or canoeing or been in a peddalo? All these craft have some form of paddle - how do they work?

Here are some ideas to get you started

1. Your teacher will show you how to make a simple paddleboat using empty fruit juice or milk cartons.
2. Make yourself a paddleboat and test it out.
3. Can you make your paddleboat travel forwards *and* backwards?
4. How could you make your paddleboat travel faster or further? What bits of the paddleboat might you change in order to do this? How will you test whether your change made a real difference?

Sharing your ideas
Have a mini regatta! Demonstrate your paddleboat to the rest of the group.

Here are some extra things that you can do

1. Can you develop a design for a paddleboat with two paddles?
2. Measure out a small quantity of water and load this into your juice/milk carton. Does the paddleboat still work? Have a competition to see who can add the most water to their carton and still get the paddleboat to travel a set distance.

Paddle Racer

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Talk with the children about their experience of oars and paddles.
4. Demonstrate how to make a simple paddleboat (see diagrams). You will need a suitable area of water for testing – a paddling pool is ideal. **SAFETY: Children should always be supervised working with water. Paddling pools should be emptied as soon as they have finished using them. Any spilt water should be quickly mopped up where it might present a slip hazard.**
5. Allow the children to make and test out their paddleboats and then collect the group together to see what they have found. Can they make their boats travel backwards and forwards? (This depends on the direction the paddles are wound). Do they notice what happens to the elastic bands as they wind up the paddles? (The bands become twisted and tight – the energy used in winding becomes stored as potential energy in the bands. The elastic band should be slack before starting to wind otherwise the paddle boat cannot be 'powered up' very much).
6. Have a discussion about what could be altered to improve their boats. Are they looking to improve the distance travelled or the speed of the boat? Suggestions might include; number of winds, number of elastic bands, paddle at the front or back, shape and size of the paddle. How will they carry out a fair test to investigate some of these suggestions? Emphasise that only one thing should be altered at a time.
7. Finish off with a boat regatta to demonstrate everyone's boats.

Background

So how does a paddleboat work? It can all be explained by Newton's third law of motion - for every action, there is an equal and opposite reaction. The paddle pushes the water (action), the water resists (reaction) and the boat moves forward. The boat moves in the opposite direction to the paddle. The energy to move the paddle comes from the energy stored in the elastic band. As the elastic band unwinds the energy stored within is transferred to drive the boat forward.

If the children experiment with doubling, tripling, and even quadrupling the elastic bands they will find that with a single elastic band, they can give the paddle lots of winds. Using several bands (making a thicker and thicker band) it isn't possible to wind up the paddle as much. A boat with a single thin band will go a long distance at a fairly slow speed, a boat with multiple bands a short distance but at a much faster speed.

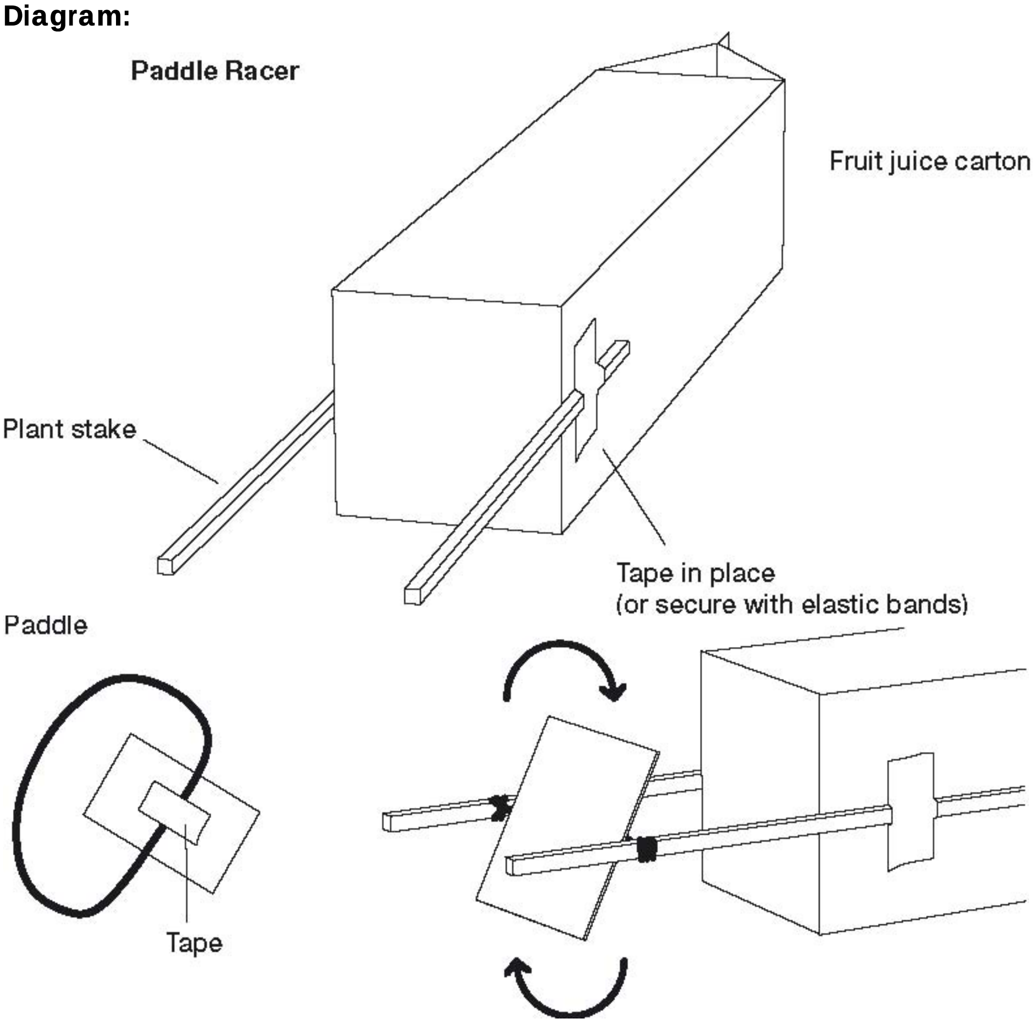
Suggested materials

- Empty 1 litre fruit juice cartons or/ empty plastic milk bottles. Smaller (500ml or less) cartons are useful for boat making if the water testing area is fairly limited.
- Elastic bands - the bands should be sufficiently long that, unstretched, they are approximately the same width as the cartons. Plenty of thin elastic bands of identical size are useful for fair testing – these can be doubled up or tripled up to make 'thicker' bands.
- Testing area – paddling pool filled with water or similar!
- Material for making paddles – old plastic butter cartons or similar.
- Plant stakes or chopsticks!
- Tape

For older children

Find out about the history and development of paddle steamers. Can you design a motorised paddleboat – using a small electric motor, battery and paddles?

Diagram:



Loading Cargo

SuperStar

If you are loading cargo (into a rucksack, onto a boat, onto a plane etc.) it's important to balance the load. If the load isn't balanced properly, not only is there danger of tipping over, it impairs movement.

Your challenge
To investigate the balancing point of a given object.

Talk about

- Have you ever travelled on a large vehicle ferry? How are the vehicles loaded? Why do you think it matters which vehicles go on first or where they are put on the car deck?
- What is a 'keel' on a boat and what purpose does it serve?
- What is 'symmetry' and do you know the difference between vertical and horizontal symmetry. Can you give some examples of both using different letters of the alphabet?

Here are some ideas to get you started

1. Trace around the boat shape provided and cut out the same shape in card. Punch a hole (see diagram) and attach a piece of string to hang up the shape somewhere convenient (wall hook, display board etc.). Add a 'plumb line' as shown (string hanging down from the boat with a weight attached to the bottom). The boat shape is **vertically symmetrically.** You could draw your own shape but make sure that it is vertically symmetrical too. The plumb line should hang down through the centre of the boat.
2. Take some 'cargo' and attach to the boat using blu-tak or masking tape. Investigate what happens to the boat when you move the cargo away from the vertical centre point. Can you think of some way of recording what happens?
3. Draw and trace around the shape representing the 'keel'. Attach the keel to the bottom of you boat using tape. What happens now as you move the cargo about the boat?
4. What happens if you add weight to the bottom of the keel or have two keels (like a catamaran)?

Sharing your ideas
Keep a pictorial record of what happens to your boat, with and without cargo, with and without a keel or keels. Did everyone's investigation give the same results?

Here are some extra things that you can do

1. Can you design your very own keel shape to minimise the boat 'listing'? Carry out a series of measurements to prove that the new keel works better than the first.

Loading Cargo

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Talk with the children about their different experiences of travelling on large car ferries and the importance of balancing the load.
4. The boat shape given is vertically symmetrical i.e. a vertical line drawn down the centre would cut the boat into two mirror images. Examples of letters from the alphabet, which are vertically symmetrical are 'A', 'H', and 'M', letters that are horizontally symmetrical include 'B', 'D' and 'E'. Can the children suggest any other examples of letters with vertical and horizontal symmetry?
5. Ask the children to cut out a cardboard boat shape (either working individually or in small groups). Help the children to attach a hanging line and a plumb line to each boat shape and find somewhere suitable to hang it.
6. Provide some 'cargo' and allow the children time to investigate what happens when they move the cargo further away from the central line. How will they record their observations? (A series of vertical lines marked on the cardboard shape will come in useful here). Continue on to experiment with attaching a keel, weighted keel and then two weighted keels.

Background

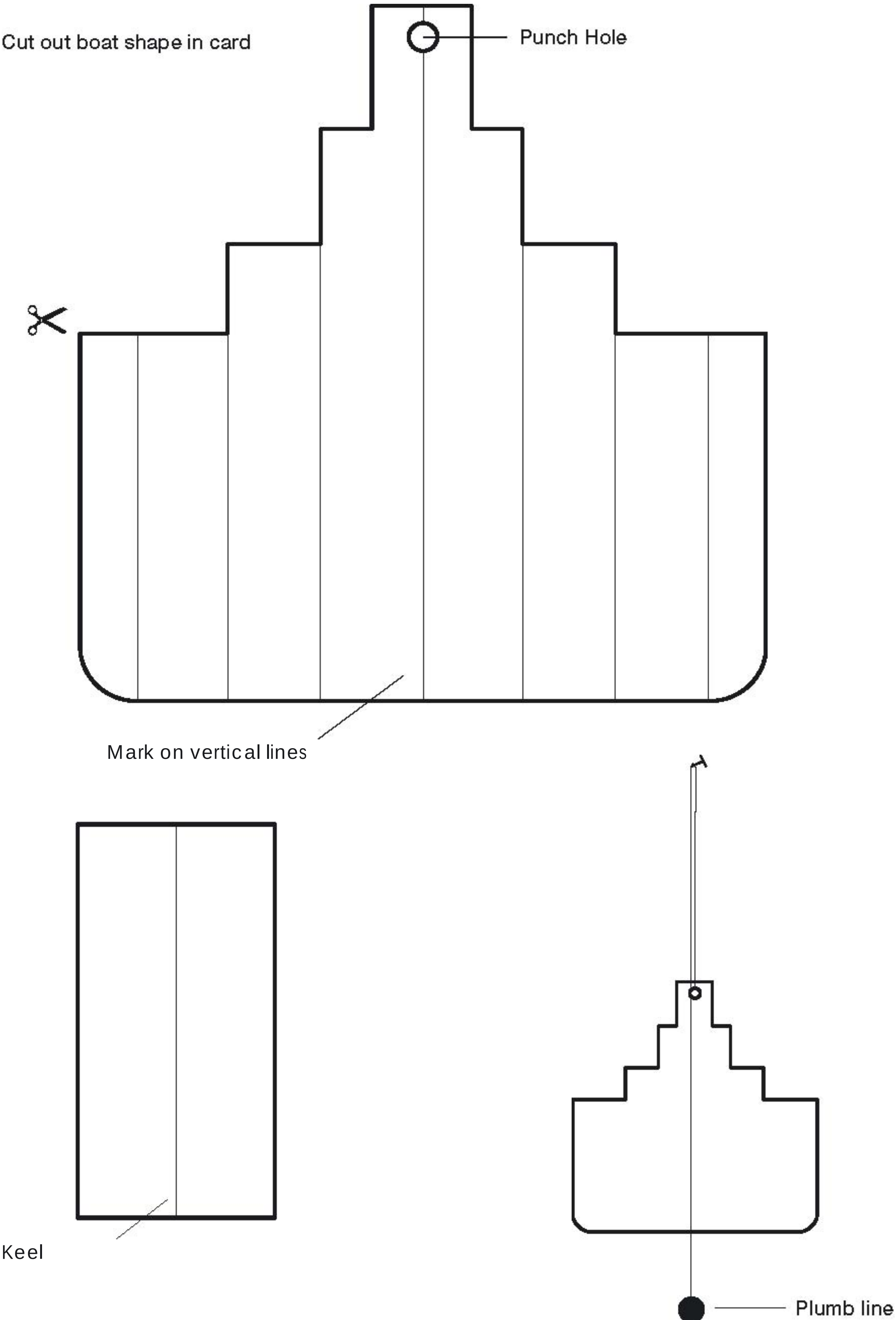
To prevent danger of tipping it is very important to load boats in a balanced way and to tie down heavy loads so that they cannot move around in high seas. The best place to put the heaviest cargo in a ship is along the centre line and as low in the water as possible. As the children move their cargo laterally, their boats will increasingly list. The listing is reduced by addition of a keel, especially a weighted keel, and further reduced using two keels. The name given to the balancing point of an object is its **centre of gravity** where the weight of the object seems to centre.

Suggested materials

- Cardboard (e.g. cereal packet card)
- Cargo - weights such as 2p pieces or similar sized washers
- Paper, pencils, rulers
- Scissors
- Blu-tak
- String
- Masking tape

For older children

- Keels don't just provide ballast to stabilize boats, they have other functions as well. Find out what these other functions are and about different types of keel.
- How would you go about finding the balancing point of a totally irregular shape? Draw and cut out some irregular shapes in card and have a go!


Cut out boat shape in card
Punch Hole
Mark on vertical lines
Keel
Plumb line

Make a Crater

Your challenge
To make some craters and investigate what controls their size. A crater is the depression made when something hard hits something softer.

Talk about

- Look at pictures of the moon's surface, it is covered with impact craters, depressions made by objects from space hitting the moon's surface at high speed. Why do you think that some craters are bigger than others?

Here are some ideas to get you started
1. You have been given some marbles and sand. Can you make a crater? How many ways can you find to make your crater larger or smaller?
2. As a group talk about what you have found and then pick one way of changing crater size to investigate further with some friends. Can you measure your craters with a ruler and show that the size really changes?

Sharing your ideas
Draw a picture to show how you made your craters

Here are some extra things that you can do
1. Try making craters using different materials in the trays; you could try sugar, flour, play dough or something else? Predict which will be best for crater-making and test this out!

Make a Crater

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Give the children time to discuss why they think some moon craters are bigger than others. If they were going to make their own craters with marbles and sand, how would they do this?
4. Allow time for the children to experiment with dropping marbles into damp sand and into dry sand and then, as a group, discuss what they observed. Did they notice how crater size was influenced by a) height of drop b) marble size and c) using damp or dry sand? N.B. Drop heights of 15 and 30 cm are sufficient to show up differences in crater size.
5. Ask the children, working in small groups, to pick one of above factors to test further. Talk about 'fair testing' and the need to only change <u>one</u> thing at a time e.g. if 'marble size' is the factor chosen then 'height of drop' and 'type of sand' should be kept the same each time. The children also need to decide how will they measure their craters. The easiest measurement to take is the crater diameter – but some children might also suggest crater depth (which of course is also likely to vary but not so easy to measure). The children should be aware of differences in results and the need to repeat their test several times.

Background

The moon's landscape is dominated by craters - which typically have raised rims. Whilst impact craters also occur on earth, the Earth's active geological processes, such as weathering, quickly destroy the impact record. Between one and three impacts, large enough to produce a 20km diameter crater, are experienced by the Earth about once every million years.

Damp and dry sand make an interesting contrast. The raised crater rim (evident in lunar craters) is best seen using soft sand, crater measurements are easier to make in damp sand.

Suggested materials

- Large trays
- Newspaper (to cover floor/table top around trays)
- Dry sand and damp sand – sufficient to cover the trays to approximately 2-3 cm in depth
- Rulers
- Marbles – large, medium and small

For older children

- Find out about other planets and moons whose surfaces are dominated by impact craters. Why do some planets have more craters than others?
- Are craters always the same shape and if not, why not? Experiment with ways in which you could change the shape of a crater using sand and marbles.

What's in a Shape?

Your challenge

To investigate 'what's in a shape?' You are going to draw and cut out a number of different shapes in paper and compare how these move through air.

Talk about

- Think about things (animals, plants, objects) that travel through the air. Do any of these have shapes in common? Do you think that some shapes might be better than others for speeding up or slowing down movement through air?

Here are some ideas to get you started

1. Take a piece of A3 paper and measure and cut out 3 rectangles – one long and thin (1 x 40cm), one short and fat (4 x 10cm) and one in between! (2 x 20cm). All have the same area, do you think that they will move through the air in the same way? How will you test this?
2. How will you make sure that your tests are fair?
3. How will you record your results?

Sharing your ideas

Talk about your results. Did everyone's results agree?

Here are some extra things that you can do

1. Choose one of your paper rectangles, make several of the same, now see if by small alterations to the shape whether you can make a difference to the flight pattern (e.g. round the rectangle corners, round opposite corners, create some zigzags, scrunch it up, or ...)
2. Try adding weight in the form of a paper clip; does this affect how your shape moves through the air? Does it matter where you attach the weight?

What's in a shape?

ORGANISER'S NOTES

What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Give the children time to think about a wide variety of things that move through air – from aeroplanes, diving gannets and arrowheads to sycamore seeds, butterflies and parachutes. Do they think that the shape of an object gives a clue as to how it will travel through the air?
4. Let the children measure and cut out their paper shapes and then discuss how they are going to test these. What will they be looking for? Time in the air, amount of fluttering or twirling, distance the paper travels sideways from launch point, some or all of these? How will they test one shape against another? Does it matter how the paper shape is launched into the air (thrown up, dropped long-end first, short-end first)? Should each test be carried out more than once? (yes!) Note: Although a stopwatch could be used to time how long the paper shapes remain in the air, because of the relatively short flight times, a more accurate method of comparing shapes is simply to drop them together in pairs and see which one lands first.
5. Let the children try out their ideas and then gather everyone together to see what they have found.

Background

Gravity is the force that pulls objects downwards toward the centre of the earth. As things move through the air they slow down (unless you keep pushing them) due to AIR RESISTANCE or drag. Air resistance is a type of force that pushes against objects and depends primarily on speed and on **shape**. A flat shape fights airflow and causes more air resistance.

Comparing these three rectangular paper shapes, the main difference in movement will be the amount of twirling. Once the paper shapes start to twirl, the flight time noticeably increases. The method of launching also has a big effect on flight pattern.

Streamlining is the term applied to the shaping of objects such as aircraft or fast cars to help them speed up and travel faster through the air. There is no doubt that there is 'lots in a shape!'

Suggested materials

- A3 paper
- Scissors
- Rulers
- Pencils
- Large open testing space – such as the hall or the gym

For older children

Does dropping paper shapes relate in any way to the movement of aeroplanes, birds and arrows through the air? What other factors need to be taken into consideration and how could you set up a more sophisticated test?

Send a Message

Imagine that you need to send an urgent message across a raging river to a rescue team on the other side. The river is too dangerous to cross, too noisy to shout across, too obscured by trees for sign language or semaphore… but you have lollipop sticks and elastic bands and a design for making a simple catapult.

Your challenge
To build yourself a simple message-sending catapult, using the design provided, and then to see if you can improve it.

Talk about

- How does a catapult work?
- Where does the energy come from?
- What safety precautions do you need when using catapults?

Here are some ideas to get you started

1. Your teacher has the design for a simple catapult and will show you how to make one. Cut out the message that you need to send across the (imaginary!) river and attach it to the catapult. Does the machine work?
2. What could you do to send your message further? Could you change the machine in some way or the way you fire it or even the way you load your message? You are allowed no more than 10 lollipop sticks per team.

Help! One of our party needs urgent medical attention. We have no means of getting across this river to the hospital. Our location is ……. And there are …..members in our party. Please send help quickly.

Sharing your ideas
Have a competition to see who can send their message the furthest!

Here are some extra things that you can do
Carry out some research to find out about trebuchets or medieval siege engines. How do these compare with your catapult?

Send a Message

ORGANISER'S NOTES
What do I do?

1. Read the challenge to familiarise yourself with the activity.
2. Check the resources list.
3. Demonstrate how to make a simple catapult (see diagrams).
4. Challenge the children in teams (or as individuals) to build themselves a catapult to this design and then test it out.
   SAFETY: Limit firing to a designated area with catapults firing away from people.
5. What could be changed to make the machines more effective? Possibilities might include: changing the length of the arms by joining two or more lollipop sticks, changing the angle of the plastic lid, changing the number or the position of sticks underneath the 'fulcrum' (point at which the arm bends), changing how the message is folded/rolled, firing technique.

Background

The catapult works because of the springiness of the lollipop sticks. The machine is powered by the energy of the person bending down the firing arm (their 'food' energy). This energy is stored in the springy lollipop stick until the catapult is released. The function of the elastic bands is primarily to keep the machine parts together. Angle of fire is important to the distance the message will travel through the air.

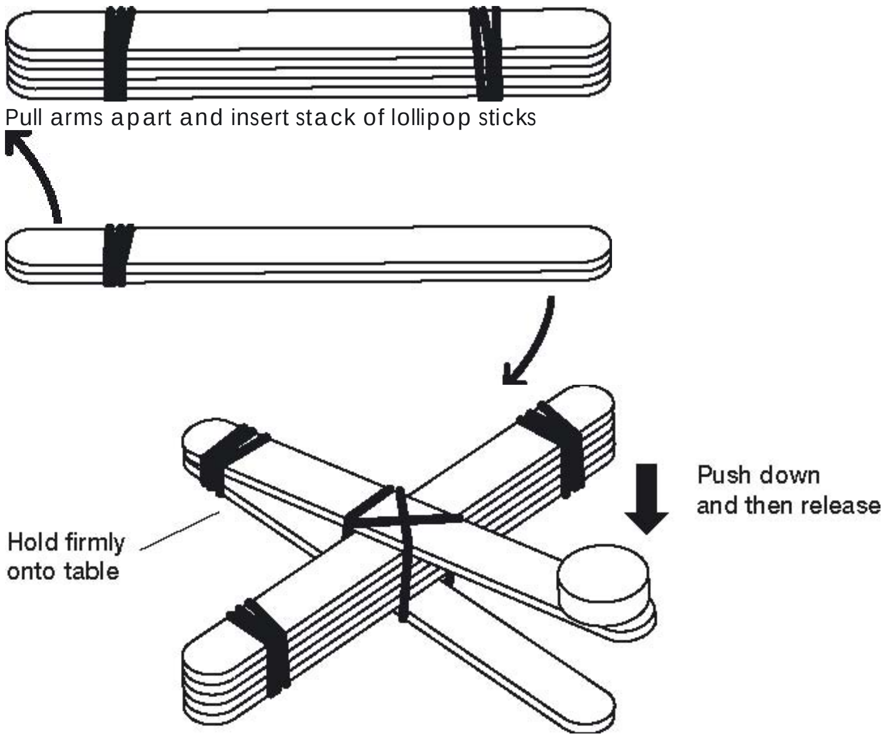
Suggested materials

- 10 lollipop sticks per team
- Small lump of blu-tak
- Assorted elastic bands
- Small plastic lids (from juice cartons, film canisters, milk bottles etc.)
- Scissors (to cut out message)

For older children

1. Take just one lollipop stick and an assortment of elastic bands and see if you can come up with an even better catapult! How far can you send your message?
2. Use your catapult to investigate effect of: size of elastic band (consider both length and width) and angle of launch on distance attained.

Catapult Instructions



Thank you for using Ticket to Ride

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

Organisation:

Address:

Postcode:

Tel:

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.

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. ☐

Please return to:
Fax: 0870 770 7102
Post: National Science & Engineering Week
FREEPOST LON 20848
London
SW7 5BR

Do you want more?

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

To start you off, all of the activities within this pack will count towards an award at either Star or SuperStar level.

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