

Helping Your Child with *Forces, Springs and Magnets*

Introduction

In these sections of the National Curriculum for Science children learn a number of basic ideas about forces. This is one of the more difficult areas and is learned in stages over several years. The ideas may seem obvious to us but some of them are counter-intuitive: children have to work hard to grasp them and even adults make mistakes. Activities that demonstrate or reinforce these ideas will help children develop the mental agility to cope with them and others in the future. If children get

the wrong ideas at this stage it is very difficult for them to 'un-learn' things later on.

This sheet points out mental blocks that children sometimes have when learning about forces. There are also activities, opportunities for you to talk about things children notice around them at home or when out with the family. This will reinforce what they do at school and help them realise how their science lessons relate to everyday life.

KS1 Year 1: Pushes and Pulls

Useful Vocabulary

Twist, spin, slide, swing, swerve, hop, jump, turn, fast, slow, push, pull, faster, slower, further.

Basic Ideas

- Children need to be fluent in describing the many ways that things move. Some children think that movement only means 'from place to place'.
Activity: Talk about the words we use to describe movement.
- Something only starts or stops moving because we push or pull it ('we are applying a force' but we don't need this vocabulary yet). Children need to realise there is cause and effect here. They should be encouraged to use the word 'because' correctly in this context.

Later on children will learn that something keeps on going at the same speed in a straight line until a force changes its speed or direction.

Intuitively they will think that things only move because a force is applied and that things will stop moving if no force is applied. This is, after all, what we see in the world around us. The key is to realise that there is a force of friction slowing things down. Children will learn about friction in Year 4.

Note: Children should not say that things move because we push or pull them. More correctly they should say that things start or stop or speed up or slow down because we push or pull them.

Activity: Talk about why the leaves move on a tree. Many children at this age think that the moving leaves are causing the wind rather than that the leaves are moving because the wind is pushing them.

Year 2: Forces and Movement

Useful Vocabulary

Direction, distance, force, fast, faster, fastest, slow, slower, slowest.

Basic Ideas

- A push or pull can make an object speed up or slow down — push harder and the object's speed changes more rapidly.
Note: Many children think that that when you push harder the object simply goes at a higher constant speed.

- A push or pull can make an object change direction
- A push or pull can make an object change shape, e.g. modelling clay

In school children will make things move and compare they way they move. The priority here is that they experience how objects react to being pushed or pulled in as many different ways as possible. This will help them understand the work they do later. Any activity that gets them pushing, pulling or rolling things down a slope gets them familiar with how things react to a force.

KS2 Year 3: Magnets and Springs

Useful Vocabulary

Magnets, magnetic, non-magnetic, repel, attract, repulsion, attraction, names of common metals such as copper, aluminium, iron, steel.

Basic Ideas

- Magnets exert a push or pull.
- Magnets attract or repel another magnet. Children do not need the idea of North Pole and South Pole of a magnet yet.
- Magnets attract magnetic metals but have no effect on non-magnetic materials
Some children think that magnets attract all metals. In fact only iron, steel, nickel and cobalt are magnetic.

Activity: Use a fridge magnet to test a range of metal objects: radiators, cutlery, tins, saucepans, jewellery, to see which ones are attracted to the magnet. Children should be able to say why there is a difference and classify the objects into groups.



Iron filings reveal magnetic field lines

Activity: Use two fridge magnets held against each other to see how they react. Why is this different from using metal objects?

Activity: Find as many magnets around the house as possible, for example: handbag clips, door closures, screw drivers, toys.

- Springs exert a push when you compress them and a pull when you stretch them.
Activity: Find things around the house which use springs, e.g. stapler, pens, beds, chairs, catapults, kitchen scales, etc.

Activity: Make a wind-up 'car' using a cotton reel, drinking straw and elastic band (see demo) and test how it goes when you wind it with a different number of turns.

Year 4: Friction

Useful Vocabulary

Friction, air resistance, water resistance, force meter, surface area, forcemeter, newton.

Basic Ideas

- Friction is a force that opposes motion (usually slowing things down). It originates from surfaces in contact, e.g. bicycle brakes.

Activity: Look at the soles of school shoes compared with trainers and football boots and note the difference.

Activity: If a child slips while climbing a slope for example, talk about what is happening and what could be done about it.

Activity: If it snows, investigate how well different surfaces slide down an icy slope, e.g. sledge compared to serving tray.

- Friction is useful when we need to slow down and essential for walking and for wheels to propel things, but is not useful when it makes things wear out.

Note: The fashion for wooden floors has increased the number of falls in the home as people walk round in stockinged feet and slip — this is where more friction would be useful!



Note: We are required to have at least 2 mm tread-depth on tyres not to increase friction but to squirt water out from under our wheels in the rain. In dry conditions smooth tyres give more grip (which is why Formula 1 teams use the smoothest tyres allowed by the race rules).

- To measure a force we use the forcemeter which gives readings in

newtons. An apple held in your hand pushes onto your hand with a force of about 1 newton. A person with a mass of 70 kg will push down on the floor with a force of 700 N. Children should always use newtons to measure forces.

Note: Later on in Year 6 they will have to talk about mass in kg. In Science, weight is a force so it is measured in newtons.

- Water resistance is a type of friction. It slows things down as they fall through the water. More streamlined objects can go through water more easily (e.g. sharks).

Activity: Make shapes from modelling clay and drop them into water to see how they fall.

Note: Competitive swimmers now use costumes with lengthwise ribs to mimic shark skin. This gives less water resistance than a smooth costume or even bare skin!

- Air resistance stops things falling as quickly as they would otherwise. Note: Children will always say that heavier objects fall more quickly than lighter objects. They think this is because the object is heavier but forget that air resistance is making the difference.

If there were no air then *all* objects, whatever their mass and shape, would fall at the same rate.

Astronaut David Scott verified this by dropping a hammer and a feather on the moon on August 1971!



Activity: Drop different objects then say why they fall at different rates. Try two pieces of paper, one flat and one screwed up into a ball. Same weight but different effects. This is where Forces gets more challenging!

Year 6: Balanced and Unbalanced Forces

Useful Vocabulary

Weight, gravity, upthrust, balance, newton, forcemeter.

Basic Ideas

- Gravity pulls things down towards the centre of the Earth. Weight is the downwards pull of the Earth on something.
- If an object is stationary its because the forces on it are balanced (they cancel out). An example is hanging something on an elastic band. The band stretches. The pull of the elastic band as it tries to contract balances the pull of gravity on the object.

- Hanging a heavier object on an elastic band makes it stretch further.

Activity: Observe that the washing line gets longer if you put heavier washing on it.

- When you submerge an object then the water pushes up on it (called upthrust or buoyancy).

Activity: Note how much easier it is to lift someone in a swimming pool than on dry land.

- When an object floats it is because the water is pushing up on it.

Activity: Try to push a float underwater at the swimming pool.

- Air resistance is like water resistance (but less). Something falling through the air tends to be slowed down by the air. The bigger its surface area, the more the slowing effect.

Activity: At an air show, ask how parachutes can get us to the ground safely.



The vertical motion of a balloon is governed by the balance (or not) of its weight and upthrust

Note: Cartoons give children an odd view of how gravity works. Characters often don't fall until they notice that they have run off the end of the cliff!

Children have an intuitive understanding of balanced forces. They have been on see-saws where they have been unbalanced by a heavier child or balanced when they can't move.

Web Resources

There is an enormous amount of material on the web. The site name may help give you an indication of the quality of the information. Sites ending in ac.uk are usually UK universities, edu are American (US) universities, while gov.uk, gov and mil are government or military organisations. You can find all sorts of things with a query to a search engine, but here are some to get you started:

<http://www.hep.phys.soton.ac.uk/hycc/>

<http://www.phys.soton.ac.uk/>

<http://www.chem.soton.ac.uk/>

<http://www.ecs.soton.ac.uk/>

http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo_15_feather_drop.html

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Dropping a hammer and a feather on the moon