Unit 6E Forces in action

ABOUT THE UNIT

In this unit children apply their knowledge of a variety of forces, including magnetic attraction, gravitational attraction and friction. Children learn about the changes in motion which occur when forces act on an object. They consolidate their understanding that forces have direction and can be measured.

Experimental and investigative work focuses on:

- making and repeating measurements
- considering patterns in results
- representing data in line graphs
- using results to draw conclusions.

Work in this unit also offers opportunities for children to use understanding about forces to explain everyday phenomena and to obtain evidence to test scientific ideas.

This unit takes approximately 9 hours.

WHERE THE UNIT FITS IN

Builds on Unit 4E 'Friction'

Children need:

- to know forces can be measured in newtons (N)
- to recognise a variety of forces and understand that forces act in particular directions.

Links with Units 5C, 5E and physical education.

VOCABULARY

In this unit children will have opportunities to use:

- words relating to forces and the measurement of forces *eg weight, gravity, upthrust, newton, forcemeter*
- near synonyms *eg still, stationary, at rest, not moving*
- generalisations about patterns in behaviour
- descriptions and explanations involving a sequence of ideas.

RESOURCES

- forcemeters (0–10N)
- objects which can be suspended from forcemeters and immersed in water
- elastic bands, magnets
- objects to be pulled by forcemeters or hung on elastic bands
- paper parachute weighted by paper clips
- weights which can be suspended from elastic bands
- metre sticks/tape measures
- plasticine, cotton wool
- secondary sources *eg CD-ROM or video showing moonwalking and with information about gravity on Earth and on the Moon*
- timers capable of reading to 0.1s
- spinners weighted with paper clips
- graphing software or spreadsheet
- simulation software illustrating the fall of a spinner

EXPECTATIONS

at the end of this unit

most children will:	identify that weight is a force and is measured in newtons; describe some situations in which there is more than one force acting on an object; draw diagrams to illustrate forces acting on an object; use a forcemeter accurately to measure forces; present measurements in simple line graphs and identify patterns in these and evaluate explanations
some children will not have made so much progress and will:	identify weight as a force; recognise that more than one force can act on an object; measure forces using a forcemeter and present measurements in tables
some children will have progressed further and will also:	describe and explain the motion of some familiar objects in terms of several forces acting on them

YEAR 6

QCA

LEARNING OBJECTIVES	POSSIBLE TEACHING ACTIVITIES
	Review children's knowledge of forces by presenting them with a range of activities *eg pulling an object with a forcemeter over different surfaces, hanging an object on an elastic band, putting two like and unlike ends of a magnet together, dropping a paper parachute* accompanied by questions *eg* *– What does the forcemeter measure?* *– How does it work?* *– What would happen if you hung a heavier object on the elastic band?* *– What would happen if you put two horseshoe magnets together?* *– What slows the parachute?* Discuss with children their answers to the questions.
CHILDREN SHOULD LEARN	
• that the Earth and objects are pulled towards each other; this gravitational attraction causes objects to have weight • to use a forcemeter carefully, interpreting the scale correctly • that weight is a force and is measured in newtons	◆ Present children with a collection of everyday objects to weigh using a forcemeter. Ask them to record the results in a table. Introduce discussion of weight and gravity by asking children what they think the readings on the forcemeter are telling them. Discuss with children their ideas about gravity and use secondary sources *eg video, CD-ROM, reference books* to find out about differences in gravitational attraction between objects and the Moon and objects and the Earth. Ask children to write a description of how it would feel to walk on the Moon. Reinforce children's ideas of gravity as a force which pulls objects towards the centre of the Earth (or Moon) and test their understanding *eg by showing them a globe with matchstick figures attached and asking them to show the direction in which gravity is acting or by showing a drawing of the Earth with clouds all around and asking which way rain will fall.* Discuss children's ideas with them.
• that several forces may act on one object • to represent the direction of forces by arrows	◆ Show children examples of objects which have clearly identifiable and familiar forces acting on them *eg an object suspended from an elastic band, an object suspended from a spring, an object resting on a strong spring, a paper clip hanging from a magnet.* Ask children to say what forces are acting on each object. Ask children to draw diagrams showing the direction of the forces with arrows and to label these.
• that when an object is submerged in water, the water provides an upward force (upthrust) on it • to make careful measurements of force using a forcemeter • to use tables to present results, identifying patterns and drawing conclusions	◆ Ask children to use a forcemeter to weigh a series of objects suspended in air and then suspended in water. At this stage do not include objects which will float. Discuss patterns in the results, relating them to the downward pull of gravity on the object and the upward upthrust of the water. Ask children to explain what they observe.
• to repeat measurements to check them • to evaluate repeated measures	◆ Ask children to compare their measurements from the previous activity with those of others and suggest why they are different. Ask children to repeat some measurements. Help children to represent as points on a graph the values obtained from a particular measurement *eg of a stone in water.* Ask them to explain to others possible reasons for differences and to say which results they have most confidence in.
• that how much an elastic band stretches depends on the force acting on it • to make careful measurements of length • to represent data in a line graph and use this to identify patterns in the data	◆ Ask children to explore what happens to the length of an elastic band when weights are suspended from it. Suggest they make measurements so that they can look for a pattern in their data. Help children to represent data collected as a line graph. Talk about the patterns in the graphs and ask children to make predictions from the graph *eg the length of the elastic band when another weight is added.* Help children test their predictions, ensuring they do not over-stretch the band.

LEARNING OUTCOMES

POINTS TO NOTE

This activity is intended to help teachers find out what children know and understand about forces from work in earlier units. Teachers will need to take this into account in their short-term planning of later work in this unit.

Children will have used forcemeters in Unit 4E 'Friction'.

CHILDREN

- identify weight as a force and the newton (N) as the unit in which it is measured
- explain why people seem lighter when walking on the Moon and need special boots *eg people weigh less on the Moon, gravity is less so people aren't pulled down so much*

Some children think that gravitational attraction only occurs on Earth.

At this stage it is sufficient for children to recognise that weight is a force, measured in newtons. There is no need to introduce the distinction between mass and weight although some teachers may wish to do so with some children.

Using reference texts drawn from other subjects is part of the range of reading required in year 6 of the National Literacy Strategy framework for teaching.

- describe the forces acting on a stationary object *eg an object resting on spring scales, a paper clip placed between two magnets*
- produce annotated drawings showing the direction in which forces are acting

Children often think gravity acts downwards rather than towards the centre of the Earth.

- record forcemeter readings for objects suspended in air and in water and identify that the reading in water is less than that in air
- explain why an object appears to weigh less when it is immersed in water than when it is in air *eg the upward push of the water cancels out some of the weight or 'pull down from gravity'*

Children sometimes think that gravity does not act through water.

Although the weight stays the same, objects appear to weigh less in water than in air because the upward push of water is greater than the upward push of air.

- recognise that measurements of the same quantity can vary
- identify some reasons for variation *eg it wasn't always easy to read the scale, sometimes the pointer isn't steady*
- state that they have more confidence in results when repeated measurements are close together

Children who have already covered Unit 6C, 'More about dissolving', will have considered how to use repeated measurements when drawing a line graph.

- make a series of measurements of the length of the elastic band with different weights attached to it
- represent data in a line graph
- identify a trend in the graph *eg the heavier the weight, the more it stretches* and use patterns to make predictions

⚠ **SAFETY** – Over-stretched elastic bands will break and may flick back painfully.

⚠ **SAFETY** – Keep feet out of the way in case the elastic band breaks and weights drop on feet *eg by putting a large box or bin underneath so that feet are automatically clear.*

Continued overleaf

LEARNING OBJECTIVES	POSSIBLE TEACHING ACTIVITIES
CHILDREN SHOULD LEARN • to distinguish between a scientific explanation for results and descriptions or other statements • to identify appropriate scientific explanations	◆ Present children with a piece of A4 paper in different states *eg flat, screwed up, folded* and with them compare how long each one takes to fall to the floor. Establish a pattern in the results *eg the larger the surface area, the longer it takes* and explain that they are now going to decide on a good scientific explanation for the pattern. Present them with a variety of explanations *eg* – *the screwed up paper fell faster than the folded sheet* – *the flat sheet was slowest* – *real parachutes are big so the person comes down slowly* – *it's because of air resistance* – *the large sheet trapped a lot of air so there was a big force of air pushing up against gravity, this kept the sheet up longer* – *air holds it up so it floats in the air* – *when there is no air a coin and a feather fall at the same rate.* Ask children to discuss these explanations with each other and identify good and bad points. Summarise with the class.
• that air resistance slows moving objects • that when an object falls, air resistance acts in the opposite direction to the weight • to check measurements by repeating them • to interpret a line graph and use it to describe the motion of spinners falling	◆ Remind children of the previous activity and of air resistance as a force and ask children to explore how spinners weighted with paper clips fall when dropped. Ask them to suggest a question/investigate a question *eg How does the number of paper clips affect the time the spinner takes to fall? or How does the height a spinner is dropped from affect the time it takes to fall?* Help children to plan a fair test and encourage them to repeat measurements. Present results on a line graph and, with the children, identify the pattern in the results. Remind them of the good and bad points in the explanations of paper falling and ask them to produce explanations of the patterns in the motion of the spinners.
	Provide children with a variety of activities, each with a question or challenge in order to consolidate their knowledge and understanding of forces *eg making a lump of plasticine float; moving a piece of iron without touching it; making an A4 sheet of paper fall as quickly as possible; making a piece of cotton wool fall as slowly as possible; explaining why most roads have rough surfaces; showing on diagrams the forces on a netball as it falls to the ground, or on an apple that floats in water; explaining a graph showing how the time taken for a parachute to fall varies with the area of the parachute.* Discuss the challenges with children and ask them to respond practically and in writing and drawing. Talk with them about their ideas.

LEARNING OUTCOMES

CHILDREN

- identify whether a statement about results is an explanation *eg this just tells you what the results are, it doesn't explain them*
- suggest improvements to explanations *eg this is good but they should have mentioned air resistance, this tries to explain but isn't clear, they need to say what floating in air means*
- use their results to plot a line graph
- recognise and describe the pattern in their results *eg the more paper clips, the quicker it fell*
- explain that air resistance pushes up on the spinner and weight pulls it down *eg the longer the wings the bigger the air resistance so it takes longer to fall*

POINTS TO NOTE

Teachers may wish to use a simplified range of statements with some children.

It is not practicable in this activity to time how long the paper takes to fall. Children can make comparisons by dropping the papers simultaneously and ranking them in order of which reaches the floor first.

SAFETY – Children should not climb onto tables etc to drop 'spinners'.

This activity offers children the opportunity to carry out a whole investigation. It may be helpful to concentrate on the aspects of investigation highlighted in the learning objectives.

When children have repeated measurements *eg for a particular length of wing*, they could either plot the mean value for the time taken to fall or all the repeated measurements (see Unit 6C 'More about dissolving').

Teachers should take care that children do not interpret the results of this work to mean that heavier objects always fall faster than light objects. In this investigation the air resistance slows the lighter object by a greater amount. If two objects of different weights are dropped when there is no air resistance they will reach the ground at the same time *eg feathers and a lump of metal dropped on the Moon.*

This work could be enhanced by the use of an ICT graphing or spreadsheet package. Simulation software could also be used to investigate the fall of spinners.

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