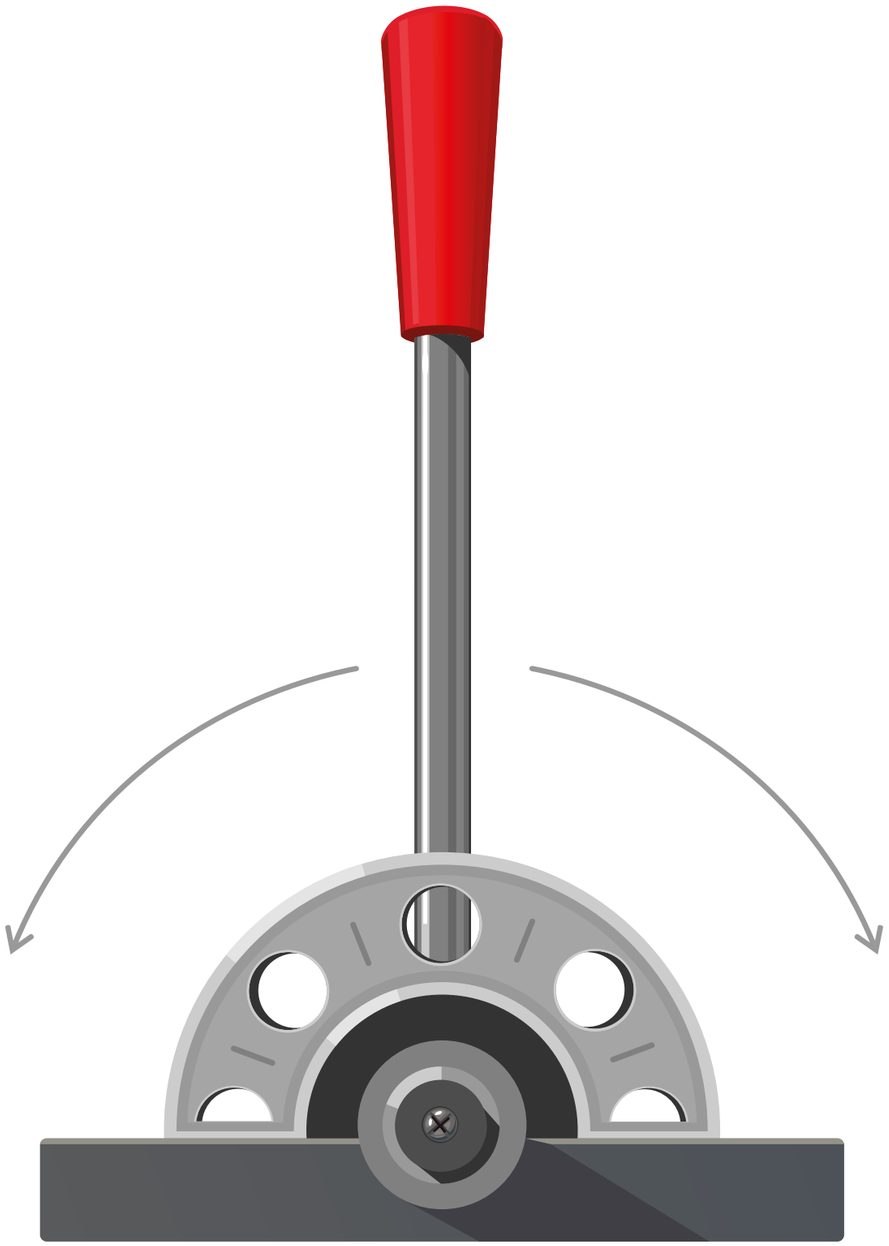


FORCES

Key concepts

- Unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.
- Air resistance, water resistance and friction act between moving surfaces.
- Air resistance, water resistance and friction slow moving objects.
- Some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

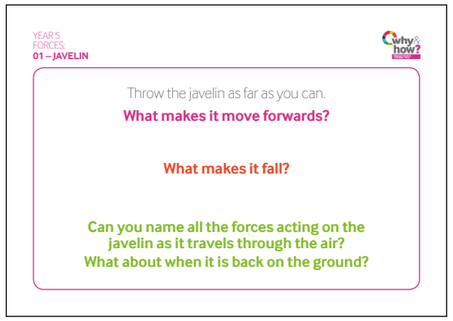
Key vocabulary:

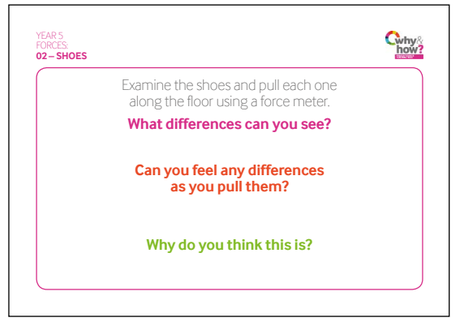
Earth	Air resistance	Mechanism
Gravity	Water resistance	Lever
Mass	Upthrust	Pulley
Weight	Friction	Gear
Force	Moving surface	Force meter
Newton		

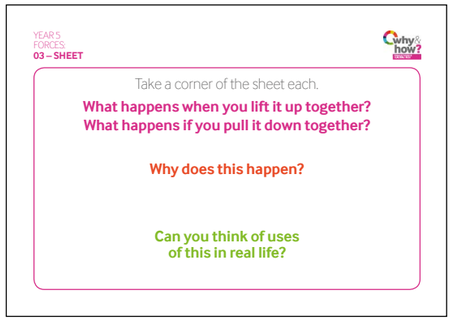
Year 5 – Forces

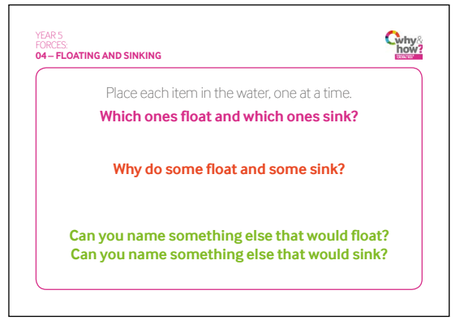
Activity	Resources required	Background knowledge	What to look out for
01	**A large space and a foam javelin.**	Forces are pushes or pulls. Javelins are propelled forwards by the push of the thrower's arm. As the javelin travels forwards through the air, air resistance is pushing back against it and gravity is pulling the javelin down. Gravity pulls the javelin to Earth even when it is on the ground.	Children may think the javelin falls because it runs out of 'push'. Do they recognise that other forces are acting? Are children using the words 'gravity' and 'air resistance'?
02	**A range of shoes with different soles.**	Friction is a force between two surfaces sliding across each other. Friction works in the opposite direction to which the object is moving, slowing the moving object down. The amount of friction depends on the surface of the objects. The rougher the surface, the more friction is produced.	Do children know how to use a force meter? Do children use the word 'friction'? Are they aware of its effects? Children may think that only rough surfaces cause friction.
03	**A small sheet or piece of fabric – at least 1 m x 1 m in size.**	Air resistance is a type of friction between air and another material. Air resistance acts against objects moving through air, including objects falling due to gravity – this is how parachutes work.	Can children explain what makes the sheet bulge? Do they use the words 'air resistance' or do they talk of trapped air?
04	**A bowl of water, a range of items – some buoyant, some not. (Take care not to create misconceptions, e.g. that all metal items provided sink)**	When an object is put into a liquid, two forces act on it. One is gravity, which pulls the object down, and the other is upthrust, which pushes the object up. The object pushes some of the water out of the way and it is this displaced water that causes upthrust. The size of the upthrust on the object will be equal to the weight of the water that has been displaced. If the downward pull of gravity is greater than the upthrust, the object will sink. If gravity and upthrust are equal, the object will float. The density of a material is how much there is of it (mass) in a particular volume of it. Lead has a high density, i.e. it is heavy for its size, whereas wood has a lower density, i.e. it is lighter for its size. When a material has a density greater than that of water, it will sink. If a material is less dense than water, it will float.	Children may confuse weight with density and say things such as 'it sinks because it is heavy'. Do they draw on any existing knowledge, e.g. that trees or branches, which, although they feel heavy, will float?
05	**A bowl of water and a plastic plate. Resource sheet FORCES 5**	When objects move in water, there is friction between them and the water. This is called water resistance. Water resistance slows down objects moving in water. Some shapes, known as streamlined shapes, cause less resistance than others. Penguins and fish are streamlined, so that they move through water as easily as possible.	Do children use the words 'friction' or 'water resistance'? Are they aware of its effects?
06	**A pencil, a ruler and a weight secured to one end of the ruler.**	Levers are one of the oldest and simplest machines. They consist of two parts – a beam (ruler) and a fulcrum/pivot (pencil) and allow humans to lift heavy objects by applying a small force. Levers can be classified according to the relative position of the load, fulcrum and force. In 1st Class levers, the pivot is in between the effort and the load, e.g. seesaw. In 2nd Class levers, the load is between the fulcrum and the effort, e.g. wheelbarrow. And in 3rd Class levers, the effort is between the fulcrum and the load, e.g. fishing rod.	Can children name examples of real life levers?

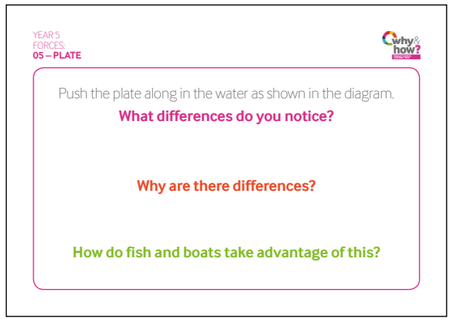
LESSON ACTIVITY CARDS:

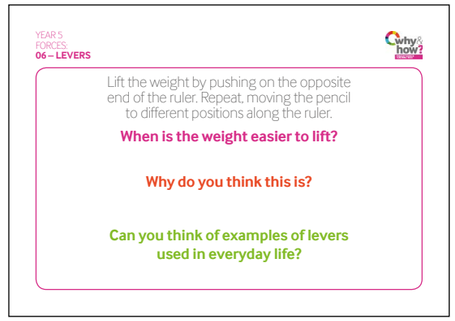












All the activity cards and supporting pictures needed for all activities can be downloaded from the PSTT website once the reources has been purchased.

Year 5 – Forces

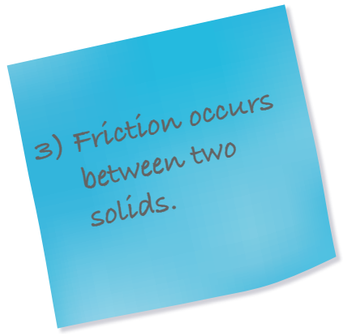
CHALLENGING MISCONCEPTIONS:

1) If the weight of an object is equal to or less than the upthrust pushing against it, the object will float. A heavy object can be made to float if its shape means that it displaces a greater volume of water than its weight, e.g. a ship.

- Show children images of container ships.
- Investigate a range of different items – weigh them with a force meter and then test to see if they float or sink. Can children find a light object that sinks? Can children find a heavy object that floats?
- Demonstrate a ball of plasticine sinking. Can children make it float by changing its shape? Create a class challenge – in small groups, give each group the same amount of plasticine and challenge them to make it float AND hold marbles – who can hold the greatest number of marbles? The weight of the object (plasticine) will be the same for each group, but they can change its shape to increase the amount of upthrust so that it will float.

2) Heavy and light objects fall at the same rate. Air resistance slows down the fall of objects. Objects with a greater surface area will cause greater air resistance.

- Use two identical plastic bottles – one empty and one filled with water. Pass round so that children can feel the difference in weight. Ask children to predict which one would fall faster, giving reasons for their predictions. Drop both bottles from the same height, at the same time – as high as is safely possible. Which one hits the ground first? Why? (Film in slow motion to help with observations.)
- Use two sheets of A4 paper – one flat and one screwed into a ball. Ask children to predict which one would fall faster, giving reasons for their predictions. Drop both pieces of paper from the same height, at the same time – as high as is safely possible. Which one hits the ground first? Why?
- Set a question for children to investigate – how can you make an egg fall slower? Give all children an egg of similar size and weight to adapt and make fall slower. Test by dropping – if the height is great enough drop one by one and time; if the height isn't great enough, drop all at the same time and see which hits the floor last. (Film in slow motion to help with observations.)



3) Friction occurs between all surfaces and materials, including air and water. Friction produced between water and a moving object is called water resistance. Friction produced between air and a moving object is called air resistance.

- Demonstrate air resistance by asking children to run across the playground holding a large sheet of card in front of them. What do they feel? This is air pushing against the movement and is a type of friction.
- Investigate air resistance by modifying sportswear to create maximum air resistance.
- Demonstrate water resistance by repeating activity Forces 5. Which way round did the children feel the biggest push against the plate?
- Investigate how animals use increased/decreased water and air resistance to help them, e.g. flippers and webbed feet, streamlined shapes, wings, etc.

QUESTIONS CHILDREN MAY ASK:

1) Porous objects have many small holes, so liquid or air can pass through. These objects may initially float as the holes full of air make the object more buoyant. However, when these holes fill with water, the weight of the object increases and the object may sink.

- Children could use a microscope to compare the porosity of objects and materials and look for a link between porosity and floating/sinking.

2) The large surface area of an open parachute creates a lot of air resistance, which pushes against the pull of gravity and slows down the descent. Parachutes can fail to open for a variety of reasons, e.g. the release mechanism does not work, the parachute gets tangled. Whenever a parachute only opens partially or does not open at all, the surface area will be decreased and will not be great enough to slow down the descent effectively.

- Arrange a visitor to show children a parachute – how it is packed, how it is released, how it opens and the procedures to follow if it fails.

3) There are four forces acting on a plane as it takes off and flies – thrust from the engine, which pushes the plane forwards, air resistance or drag, which works against the forward movement, gravity, which pulls the plane to Earth and lift, which holds the plane in the air. Daniel Bernoulli discovered that the faster air flows over the surface of something, the less the air pushes on that surface (and so the lower its pressure). The wings of a plane are aerofoils, which means they are shaped to make air flow faster over the top, causing higher pressure beneath the wings and creating lift.

- Demonstrate the Bernoulli principle. Turn on a hair dryer to the highest setting and point it straight up. Ask children to predict what will happen if you place a ping pong ball in the air flow and ask them to give reasons for their predictions. Carefully place a ping pong ball in the stream of air. Why doesn't the ping pong ball fly into the air?
- Observe and sketch birds' and planes' wings. What do children notice about the shape?
- Demonstrate how an aerofoil creates lift by making a paper aerofoil. Make a line across a piece of paper to form two unequal parts. Make a light fold along the line – do not crease heavily. Bring the corners of the paper together causing the longer side to arch and secure with tape. With a sharp pencil carefully make a hole through the top and bottom of the wing near the front edge. Push a straw through, – this may need to be glued into place if it does not fit snugly enough. Cut a long piece of string and thread it through the straw, making sure that it doesn't catch and can move easily up and down it. Hold the string tight and blow air from a hair dryer or fan towards the curved edge. It will move up the string.

05 – PLATE

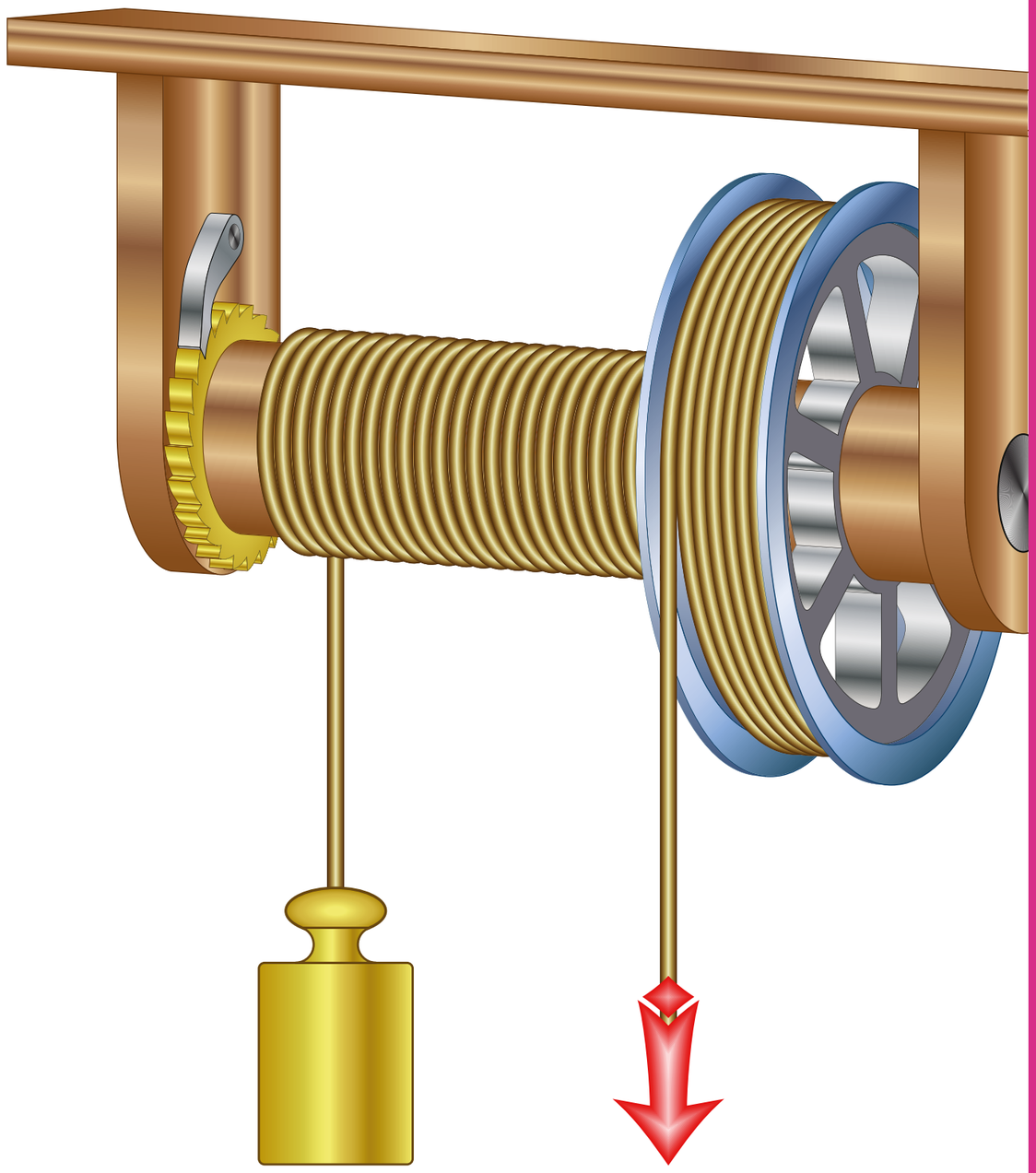
YEAR 5
FORCES:
05 – PLATE

Push the plate along in the water as shown in the diagram.

What differences do you notice?

Why are there differences?

How do fish and boats take advantage of this?



Throw the javelin as far as you can.

What makes it move forwards?

What makes it fall?

Can you name all the forces acting on the javelin as it travels through the air?

What about when it is back on the ground?

Examine the shoes and pull each one along the floor using a force meter.

What differences can you see?

Can you feel any differences as you pull them?

Why do you think this is?

Take a corner of the sheet each.

What happens when you lift it up together?
What happens if you pull it down together?

Why does this happen?

Can you think of uses of this in real life?

Place each item in the water, one at a time.

Which ones float and which ones sink?

Why do some float and some sink?

Can you name something else that would float?
Can you name something else that would sink?

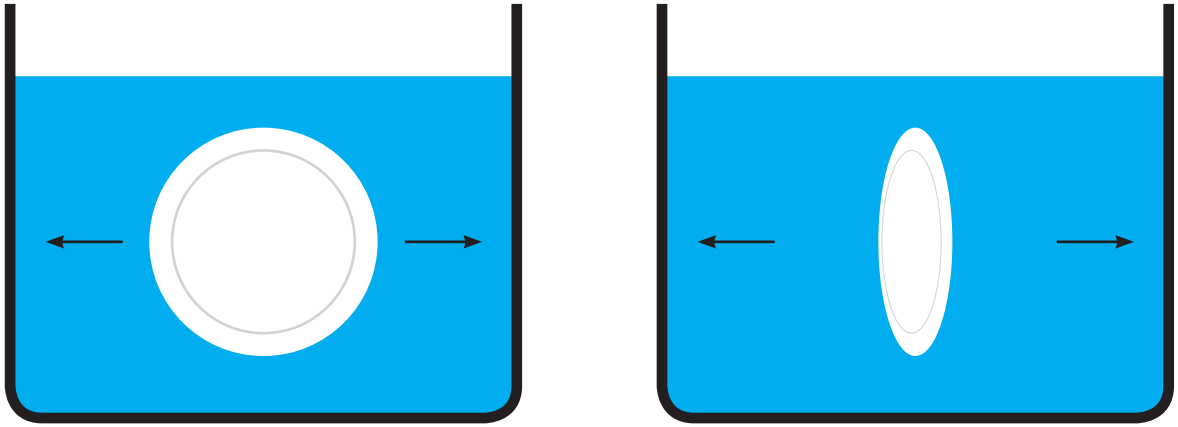
Push the plate along in the water as shown in the diagram.

What differences do you notice?

Why are there differences?

How do fish and boats take advantage of this?

YEAR 5
FORCES:
05 – PLATE



Lift the weight by pushing on the opposite end of the ruler. Repeat, moving the pencil to different positions along the ruler.

When is the weight easier to lift?

Why do you think this is?

Can you think of examples of levers used in everyday life?