Gogglebox – Video Script

FORCES & MOTION

Introduction

<< Examples of forces at work:
Kids going down slide;
Children's toy on a spring;
Bicycle slowing down;
Football goalie pushing ball away;
Snooker balls colliding;
Spring being pushed together and pulled apart;
Kid being pushed on swing. >>

Everything in the world around us, whether it's still or moving, is affected by ***force***. We can't see forces, but we can see the effects of force when we ***push*** or ***pull***. Force can make things ***start to move, slow down, speed up, change direction*** or ***stop***. Force can even change the shape of an object by ***stretching, squashing*** or ***twisting***.

Push & Pull

You can see the forces ***push*** and ***pull*** at work with this door. We can push the door to close it, or pull the handle to open it.

You can push a wheel barrow…bicycle pedals…a swing.

And when you have a tug-of-war, you pull as hard as you can!

You can pull a rubber band, but look what happens when we try to push it…nothing. Well, nothing we can make use of, anyway.

When you pull a rubber band, it stretches. So, you are actually stretching the rubber band.

Stretch, Squash & Twist

You can ***stretch*** and ***squash*** this spring. We can squeeze the spring together by placing force here and using force in the same place, we can also stretch the spring.

The amount of effort we use to stretch and squash the spring affects how much the spring will move. Here, there is a strong force acting against the spring and here there is a weak one.

This sponge can be stretched or squashed. And it can be ***twisted***. Can you see how it always returns to its original shape? This rubber band also returns to its original shape.

We can squash plasticine with our hands and our feet. And we can stretch and twist it. But look – plasticine changes its shape!

This car crusher has enough force to squash old, scrap cars!

Movement

A force can be measured in ***Newton's***, named after a famous scientist, ***Sir Isaac Newton*** who lived over three hundred years ago. He made some very important discoveries, many of these about forces and motion.

Forces act on objects in pairs. For every force acting on an object in one direction, there is a ***reaction force*** - a force acting back in the opposite direction.

If one of these forces is greater than the other, we get movement. If the forces are equal, there is no movement.

Look at the direction of the force acting on the foot and the ball. These forces are acting in opposite directions.

The amount of force acting on the ball is less than the amount of force created by kicking the ball, so the ball begins to move. These are ***unbalanced forces***.

Unbalanced forces can also make things ***speed up***, ***slow down*** or ***change direction***. When two balls collide, the unbalanced forces push them away from each other.

Look at Newton's cradle. What do you think will happen if we drop these two ball-bearings, with an equal amount of force?

The ball-bearings in the middle are not affected – they remain still because the two equal forces acting on the outer ball-bearings have cancelled each other out. These are called ***balanced forces***.

In this tug-of-war, the rope isn't moving because the force from each team of children is equal.

The weight and this hand are balanced because the upwards force of the hand is equal to the downward force of the weight.

If we remove the weight, the hand flies upwards because it is now unbalanced.

So forces can make things move. But forces are at work even when nothing is moving.

This cushion isn't moving, but if we put a weight on the cushion, it squashes – now we can see that something is happening. But a weight can't push in the same way that we do because it doesn't have arms or legs. So, what forces are we seeing?

Gravity, Weight and Mass

We are seeing gravity – a force that is always at work. Gravity pulls us and everything around us towards the ground.

Gravity is a force that can act at a distance. When you drop something, it falls to the ground. When you trip up, you land on the floor. These are called ***gravitational forces***.

What do you think would happen without gravity?

That's because the downward force of gravity acting on us and everything around us, gives us weight.

We can't see gravity, but we can feel its effects. If we were on the Moon, then the effects would be different. That's because our weight is affected by gravity and gravity is affected by the size and mass of a planet.

Mass is the amount of material that makes up an object – the amount inside an object. Mass always stays the same.

The Moon is only one sixth the size of the Earth and therefore has less gravity. That is why we feel 'weightless' on the Moon – we do actually weigh less! On the moon we weigh one sixth of our weight on earth, even though our mass is still the same.

So, a force such as gravity can change the shape of something and it gives weight to us and everything around us. But what else can it do?

Because it's a force, it can make things move. It can also make things change direction.

If we drop objects of the same shape and size, but different weights, which object will reach the ground first?

They fall at exactly the same speed, but we can see by dropping them into sand that the weight of the heavier ball makes a larger dent.

Let's compare a sheet of paper with a crumpled piece of paper. Which of these do you think will fall faster?
The crumpled paper falls faster because the sheet of paper acts in a similar way to a parachute.

Gravity is pulling this parachute towards the ground, but what is slowing it down?

As the parachute moves through the air, it is acted on by another force called ***air resistance***. The force of the wind pushes upwards against the parachute.

Without air resistance, objects would fall faster and faster and faster. Air resistance causes an object to fall at a constant speed.

The boy on this bicycle also slows down when he stops pedaling because of air resistance, but there is another force at work here. The tires moving over the ground are affected by ***friction***.

Friction

When one surface moves over another, you get a force called friction. Friction slows down cars, bicycles, balls – anything moving.

Friction can be very helpful – it can even keep us safe! On a bicycle we use brakes to slow us down and stop us from falling off. In the house we use a bath mat to stop us from slipping.

Friction between your shoes and the ground causes your shoes to wear away, but this friction also helps us not to fall. Which of these shoes would you wear on a slippery surface?

This surface may look flat, but no surface is perfectly smooth. All surfaces have tiny bumps and dents. When these bumps and dents slide across another surface with bumps and dents, we get friction.

A heavy object will be harder to move because the weight of it will push the bumps and dents on its surface into another surface with greater force.

Friction turns movement into heat. So, although we can't see friction, we can feel the heat made by friction when we rub our hands together.

Floating & Sinking

This hollow ball floats because it is full of air. So, why does this sponge float? And why does this coin sink?

The sponge is larger than the coin, but it is very light for its size. The coin is heavy for its size so, it sinks. Do you think this wood will float…or sink?

The wood floats because it is light for its size, but look what happens when we place this block of wood on water…it sinks!

This is hard, heave wood called 'African Black Wood'. It sinks because it has a high ***density***. The first block of wood is exactly the same size, but it is less dense.

Density could be described by imagining a lift. When it is empty it has a low density, but as it fills with people its density increases – even though it stays exactly the same size.

So, African Black Wood is more dense than the wood that floats because the fibres that hold it together are heavier and packed more tightly together.

Objects float because of the upwards force of the water as it pushes against an object. This upwards force, or ***upthrust***, must be equal to the weight of the object for it to float. So, objects that float use balanced forces.

Changing the shape of an object can also make it float.

When we drop this heavy plasticine into water, it sinks. The weight of the plasticine is heavier than the upwards force of the water. These forces are unbalanced.

But, if we mould the plasticine into a boat-shape, the upthrust is increased and the plasticine will float because more water is pushed aside.

The plasticine now weighs less than the amount of water being pushed aside. The upwards force is equal to the downward force.

So, this hollow ball needs only a small amount of upthrust to make it float, but a rubber ball needs more upthrust to support its weight.

We call this a floating magnet, but there isn't any water, so how does the magnet appear to float?

Magnetism

A ***magnet*** is a natural piece of stone or metal found in the ground. Magnets can be different shapes, sizes and strengths – but bigger doesn't mean stronger.

Here are two different sized magnets. Which do you think will hold more paperclips in a line?

The smaller magnet is stronger!

This magnet is ***attracting*** the paperclips – it is pulling them towards itself. This is the force we call ***magnetism***. You can see from this line of paperclips that magnetism, just like gravity, also acts at a distance.

A magnet attracts magnetic materials like, iron, nickel, cobalt and steel. But materials like these can also become magnetic by rubbing them in one direction against a magnet.

This pin can now attract other magnetic materials, but it still isn't a magnet – it is ***magnetic*** and this will eventually wear off!

Do you think this pencil can be made magnetic? No, because the pencil is made of wood and is a ***non-magnetic*** material.

All magnets have an invisible split down the middle, dividing them into North and South. You can find the North side by hanging a magnet from a piece of string. Where it rests, one side will always point towards the North.

The North side of one magnet will attract the South side of another. You can feel the force as they pull together.

So, how do we get a floating magnet? By placing two North or two South sides together. You can feel the force between the magnets as they push away from each other. We call this ***repelling***.

Remember, even though we can make certain materials magnetic, only a magnet can repel another magnet.

So, magnetism is a force that attracts and repels.

And forces can make things ***start to move, slow down***, ***speed up***, ***change direction*** or ***stop***. Forces can change the shape of an object by ***stretching***, ***squashing*** or ***twisting***.

And even when nothing is happening, forces are still at work.