Empiribox

Nurturing Future Scientists

Forces, Magnetism & Space

Lesson Plans

FORCES & MAGNETISM

Each lesson plan contains some Essential Knowledge. This is meant for adults, and is not the content to be taught directly to children.

Forces:

A force is a push or pull acting upon an object as a result of its interaction with another object. There are a variety of types of forces.

An **applied force** is a force that is applied to an object by a person or another object. If a person is pushing a desk across the room, then there is an applied force acting upon the object.

The **force of gravity** is the force with which the earth, moon, or other massively large object attracts another object towards itself. By definition, this is the weight of the object. All objects upon earth experience a force of gravity that is directed "downward" towards the centre of the earth.

The **friction force** is the force exerted by a surface as an object moves across it or makes an effort to move across it. Though it is not always the case, the friction force often opposes the motion of an object. For example, if a book slides across the surface of a desk, then the desk exerts a friction force in the opposite direction of its motion.

The **air resistance** is a special type of frictional force that acts upon objects as they travel through the air. The force of air resistance is often observed to oppose the motion of an object.

Air pressure is the force exerted on you by the weight of tiny particles of air. Although air molecules are invisible, they still have weight and take up space. Since there's a lot of "empty" space between air molecules, air can be compressed to fit in a smaller *volume*.

How much pressure are you under? Earth's atmosphere is pressing against each square inch of you with a force of 1 kilogram per square centimetre (14.7 pounds per square inch). The force on 1,000 square centimetres (a little larger than a square foot) is about a ton!

Why doesn't all that pressure squash me? Remember that you have air *inside* your body too, that air balances out the pressure outside so you stay nice and firm and not squishy.

Forces – a synopsis:

1. Newton's 1st Law – a body will stay at rest, or continue moving in a straight line, until a force acts upon it.
2. Newton's 2nd Law – Force =mass x acceleration (A large mass moving slowly will have a greater force than a small mass travelling quickly.)
3. Newton's 3rd Law – all forces have an equal and opposite force.
4. Forces have a direction and a value. So, this arrow ⟶ represents a greater force to the right than this arrow does to the left. ←
5. An object starts to move, change direction, change shape, slow down, or accelerate when the net force (all the forces in all directions are added together) changes.
6. Forces are pushes and pulls.
7. Forces are measured in Newtons – 100g =1N
8. Gas pressure causes forces due to millions of particles colliding with the particles of the walls of the container. The more particles colliding, or the more energetic the particles, the greater the pressure.
9. Gravity, friction, upthrust, drag, torque, atmospheric pressure, are all descriptions of various forces.

Mass and Weight:

Many people confuse weight with mass.

The force of gravity acting upon an object is referred to as the **weight** of the object.

The **mass** of an object refers to the amount of matter that is contained by the object.

Mass is related to how much *stuff* is there and weight is related to the pull of the Earth (or any other planet) upon that *stuff*.

The mass of an object (measured in kg) will be the same no matter where in the universe that object is located. Mass is never altered by location, the pull of gravity, speed or even the existence of other forces. For example, a 2-kg object will have a mass of 2 kg whether it is located on Earth, the moon, or Jupiter; its mass will be 2 kg whether it is moving or not (at least for purposes of our study); and its mass will be 2 kg whether it is being pushed upon or not. On the other hand, the weight of an object (measured in Newton) will vary according to where in the universe the object is. Weight depends upon which planet is exerting the force and the distance the object is from the planet.

Magnetism:

Magnetism is a force of attraction or repulsion that acts at a distance. It is due to a *magnetic field*, which is caused by moving electrically charged particles. It is also inherent in magnetic objects such as a *magnet*.

A magnet is an object that exhibits a strong magnetic field and will attract materials like iron to it. Magnets have two poles, called the north (N) and south (S) poles. Two magnets will be attracted by their opposite poles, and each will repel the like pole of the other magnet. Magnetism has many uses in modern life.

A moving magnet will create a magnetic affect in non-magnetic materials, such as copper. The effect is known as Lenz's Law and is used in the generation of electricity.

Magnetism – a synopsis:

1. Magnetism is a force emitted by magnets and get weaker with distance.
2. A magnetic field is an area of force around the magnet, in all directions.
3. Magnets have two poles.
4. Like poles attract, unlike poles repel.
5. Some magnets are permanent and some are temporary.
6. Magnetism and electricity are linked.

In the Classroom:

Lessons are designed to be flexible, and can be organised to suit your class and timetable. Our suggested plan is to spend one lesson delivering the theory and demonstration. The website has a lesson plan and video demonstrations to serve as reminders. Time can then also be spent on the skills focus, ie planning, collecting data or interpreting data. Children can discuss predictions, questions that could be tested, variables and possible outcomes.

The following week time can be taken to revisit the scientific knowledge and children have the opportunity to plan their own investigation. There is then time to work in pairs to carry out the experiment and evaluate their findings and observations at the end of the lesson.

Each lesson plan has homework suggestions and links to further studies.

Differentiation is not stated by year groups as classes vary from year to year, cohort to cohort and school to school. We state our aims for most children and then for some. This means that every demonstration and investigation has been chosen because any KS2 child can access it at some level.

The level of understanding, language used, ability to relate concepts and investigate are the skills which develop as the child learns.

Lessons 1 & 2: Introduction to FORCES

Essential Knowledge/Science Explained – for teachers

This session covers an introduction to basic Newtonian mechanics focusing on Forces. The 3 laws of motion are covered and applied to a wide range of phenomena including gas and atmospheric pressure, space travel, moving objects etc.

1. An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force. This law is often called "the law of inertia".
2. Acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object). This can be expressed mathematically as F=Ma
3. When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body. Newton-meters are covered and the Newton scale of measuring the effect of gravity on mass. Using this to explain why you apparently weigh more if you suddenly crouch down on a mass balance 'weighing scale'.
4. Air pressure – We are surrounded by Pressure is quite complicated, but the best way to describe it is the weight of the air. So pressure is the amount of weight the atmosphere presses down on the Earth's surface. At the top of mountains the pressure will be lower than at sea level.
   By using the rubber Magdeburg spheres the 100 kPa of atmospheric pressure acts on the outside of the rubber spheres preventing (or at least making it very difficult for them to be separated.
5. Gas particles are constantly moving and if they are given more energy, they move faster and therefore collide with more force with any object they strike. Using this phenomena we can explain why footballs get soft if the air is cold and why the egg gets into and out of the flask.

Common Misconceptions

- ✓ Air does not weigh anything – Incorrect – 1 cubic meter of air (allowing for temp and pressure and humidity) is approx 1.3Kg
- ✓ Heavier objects fall faster than light objects. - Incorrect
- ✓ Faster moving objects have a larger force acting on them. - Incorrect
- ✓ An object will slow down if there is no net force. - Incorrect
- ✓ There is no gravity in space. – Yes there is!
- ✓ Light is not affected by gravity – Yes it is.

Termly Scientific Skills Development Focus: Planning

- ✓ Asking a question
- ✓ Determining Independent and Dependent Variables
- ✓ Making a Prediction / establishing a Hypothesis

Opportunities should be given throughout the lesson for children to use and develop their knowledge of planning investigations, through questioning and discussions on questions to investigate, making predictions and suggesting dependent and independent variables.

Learning Outcomes

All children should	✓ Practise the skill of applying the terms "independent" and "dependent" variables. ✓ Practise the skill of making a prediction. ✓ Practise the skill of recording data in a simple way. ✓ Learn what force is and that force arrows are used to demonstrate direction. ✓ Understand that forces work in pairs.
Some children could	✓ Specifically identify the variables. ✓ Practise the skill controlling variables. ✓ Identify a variable to test in an experiment.
A few children could	✓ Specifically identify the variables. ✓ Practise the skill controlling variables. ✓ Identify a variable to test in an experiment.

Introductory Activity

Begin the lesson by putting the word FORCE on the board and encouraging children to share any knowledge they already have. (You may wish to make a record of this to make a comparison with at the end of the unit!)
Explain that whilst watching the demonstrations, children should bear in mind two things:

- Forces work in pairs
- Scientists use arrows to show the direction of the force.

Teacher Demonstration

Demonstration 1.1 – Glass and card trick

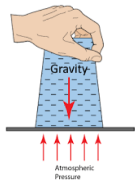
You will need: glass, water, plastic square

1. Fill a glass of water to the brim with water.
2. Place the plastic square on top to make a seal.

Turn the glass upside down, remove your fingers from the plastic and watch.

What is keeping the plastic from falling?

- Children should mention gravity pulling the plastic down.
- Explain that something stronger must be working against gravity, something must be pushing the plastic up.
- This is air pressure.



Demonstration 1.2 - Classic Egg and Flask

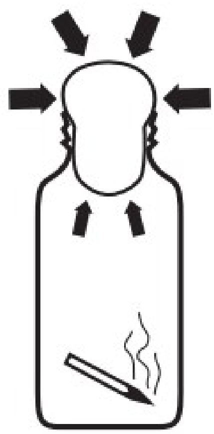
You will need: Conical flask, Cartridge and burner, Matches, Vegetable oil, Paper, Clamp stand, 3x Birthday candles

Show the students the egg balancing on the mouth of the 250 ml flask and ask them if they can suggest ways of getting the egg into the flask without break it?

1. Put a little oil around the mouth of the flask.
2. Light a small piece of paper and quickly place it, still burning, into the flask.
3. Very quickly place the egg on top of the mouth of the flask and watch.
4. Once the egg is inside the flask you can ask the class why they think this occurred and how you might get the egg back out!
5. Using the cartridge burner and a clamp stand, simply up end the flask ensuring the egg slides snugly into the neck, and heat the bottom of the flask vigorously for a few minutes, the egg will obligingly 'squeeze' back out!

The burning paper causes two effects:

- The gas inside the flask heats up and expands.
- The reaction produces carbon dioxide through reaction of the carbon in the paper and oxygen (O_2) in the air and water vapour through a reaction with hydrogen in the paper and O_2 in the air.
- When the flame goes out the air cools, the vapour condenses and occupies less space and so the pressure inside the flask drops.
- The greater air pressure outside the flask then easily forces the soft pliable egg into the flask.
- The opposite is the case when the up-ended flask is heated to extract the egg. The air molecules inside the flask receive lots of energy and start to move with much greater speed impacting with much greater force on the inside of the flask and surface of the egg than the air molecules outside the flask….and so, because the forces are imbalanced the egg is 'forced' out.



Alternatively,

1. Place 3 birthday candles into the pointed end of the egg.
2. Once lighted, quickly hold the conical flask above the candles so they enter the neck of the flask whilst still alight.
3. Gently hold the bottom of the egg and watch!

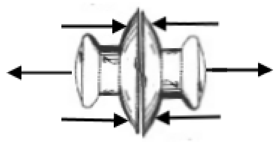
Although the method is more straightforward, the principles are the same. The egg has not been "sucked" into the flask, rather the air pressure outside the flask has become greater than the air pressure inside the flask, so the egg has been pushed inside. It is the same principle as a drinking straw or a vacuum cleaner.

Demonstration 1.3: Magdeburg Spheres

You will need: Magdeburg Spheres

Simply press the two Magdeburg spheres together and get volunteers from the class to try and pull them apart

By now they should begin to make a link. If you are pulling the spheres apart, something stronger must be pushing them together.
Air pressure!
Where have children seen these spheres before?
Air pressure is all around us.



For each demonstration allow children time to discuss and agree where the force arrows should be. You may extend some children by encouraging them to think about which is the greater force/are the forces equal, and the impact that has on the size of the force arrows used. Children could draw the demonstrations with force arrows as a record of their ideas.

Possible Questions/ Suggestions for discussion

Engaging learners through the use of the classic egg into a flask in order to elicit from pupils their understanding of forces and deliberately correct misuse of 'sucking' as an explanation for the effect they see and better shape and refine their understanding of the concept of forces.

Children's Investigation

Investigation 2.1 – Effervescent Rocket Popper

Pairs will need: measuring cylinder, film canister, 2x vitamin C tablets, water, stopwatch, paper towels.

Demonstrate the apparatus that the students will be using and depending on the class either show or give them some written or verbal instructions on how to carry out the investigation.
Do not actually do it at this stage, merely suggest that they should hear a 'sweet little pop' sound, when in actual fact there will be a real bang and the canister will hit the ceiling!

Use this as a baseline for measuring the children's progress in Planning.

1. After deciding how much of each tablet to test, place the piece of tablet in the film canister.
2. Half fill the canister with water (getting pupils to work out how to do this accurately with a measuring cylinder) quickly snap the lid shut and invert the container and stand back with the pupil who is in charge of timing starting the stopwatch as soon as the lid is emplaced.
3. After the little explosion and after the time has been recorded, wipe out the container and either repeat with the same quantities of powder to perform average calculations or perform the next test with whatever agreed variables have been selected.
4. Check procedure and ensure pupils are recording their results.

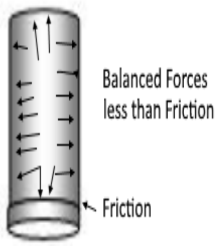
Possible Questions/ Suggestions for discussion

1. Try and devise a way of making the canister travel faster, further, higher etc.
2. Could we make this a fair test? How? Why?
3. List the variables we could possibly change. E.g. liquid, temperature, surface area etc.
4. Write predictions for a selection of these changes.

What has happened?

- The tablet is a bicarbonate and acid mixture
- The bicarbonate reacts with the acid to produce carbon dioxide
- The CO_2 fills the space in the canister
- As more CO_2 is produced, the pressure increases inside the canister
- The pressure is suddenly enough to overcome the friction between the lid and the canister
- The lid pops off
- The liquid and gas escapes rapidly which produces thrust
- The canister launches into the air!

- Gravity takes over so the canister falls



Plenary/Review including Skills Progression focus: Planning

1. Ask the class what they learnt / discovered…providing the wherewithal so that children can say
   'I used to think ……… and now I think………. because ……' or
   'I used to think ……… and I still think ………. because ……'
2. Suggest a list of variables that could have been changed if they had more equipment.
3. Ask for volunteers to suggest how they could have improved the experiment and how this might change their results.
4. Ask if anyone seemed to have discovered a pattern in their results.
5. Discuss examples of air pressure in the real world.

Cross curricular links

Literacy	✓ Write instructions for the investigation for another year group. ✓ Begin a class glossary of term used in the Forces topic. This could be used towards a science dictionary, for a particular audience, maybe for parents or younger children. ✓ Research and write a fact file on Sir Isaac Newton.
Numeracy	✓ Practise recording data. ✓ Use of decimals and smaller units of time, such as tenths and hundredths of a second, and comparing them in size ✓ Introduction to the fact 1Kg = 10 Newton's of Force (Weight). Pupils can work out simple mass to Newton equivalents.
Other subjects	✓ Forces in balance, with stable and unstable shapes and identifying pushes and pulls in PE. ✓ Taking pictures of themselves in action poses in a physical education session. Using IT, children could import three of their photographs and write about the forces that were evident during the session. ✓ Make a Powerpoint presentation about Newton. Show children this one for some ideas. bit.ly/tes-Newton

Useful websites

	Type these links
BBC Bitesize on Forces	bit.ly/bbc-Forces
Wikipedia on Isaac Newton	bit.ly/Forces-Newton
Wikipedia on the Newton unit	bit.ly/Unit-Newton
Primary Resources site with Forces activities	bit.ly/Forces-Resources
Forces Olympics Games	bit.ly/Forces-Activities

Lessons 3 & 4: Friction

Essential Knowledge/Science Explained – for teachers

1. Friction is a force that holds back the movement of a sliding object.
   You will find friction everywhere that objects come into contact with each other. The force acts in the **opposite** direction to the way an object wants to slide. If a car needs to stop at a stop sign, it slows because of the friction between the brakes and the wheels. If you run down the sidewalk and stop quickly, you can stop because of the friction between your shoes and the cement.
   What happens if you run down the path and you try to stop on a puddle? Friction is still there, but the liquid makes the surfaces smoother and the friction a lot less. Less friction means it is harder to stop. The low friction thing happens to cars when it rains. That's why there are often so many accidents. Even though the friction of the brakes is still there, the brakes may be wet, and the wheels are not in as much contact with the ground. Cars **hydroplane** when they go too fast on puddles of water.
2. Friction opposes motion through both the physical contact between 2 surfaces and sometimes the chemical attraction between molecules of different substances.
3. Friction can be reduced and increased depending upon where it is not useful and where it is useful through use of lubrication, brakes or reduced drag in design e.g. aircraft, fast cars or Olympic sports equipment.
4. The laws of motion can be applied to the movement of a balloon powered device (and thereafter rockets).

Common Misconceptions

- ✓ Rockets and balloons push against the ground and air – No they don't – they push against the balloon / rocket walls.
- ✓ Children often know what to do to make things move or change shape but are not able to describe how the size or direction of the push, pull, squeeze, or hit relate to the subsequent movement of the object. Stooping movement is usually attributed to the lack of action to keep the object moving: 'The push wore off.'
- ✓ Children usually know how to stop something moving but do not attribute the stopping action to a Force in the opposite direction of the movement. They think that things that recover their shape do so of their own accord, not because of a force coming from the 'springiness' of the material. Children do not have a problem recognising movement but think the moving object, or specific parts of the object (the wheels for instance) have an in-built ability to move. Another example would be that: 'people move because they have legs.'
- ✓ Similarly, children might be said to have a 'simplistic' view of the reason for things falling. Things fall because you let them go and they do not need a force, whereas you need a force to make things 'go up'.
- ✓ When thinking about friction children tend to relate their ideas to how they feel: 'It stops because it gets tired' or 'It's run out of energy'. Other reasons could be because the car is no longer on the slope, or because the toy is heavy.
- ✓ Sometimes they introduce words such as 'power' and 'energy' to explain why things stop.

Termly Scientific Skills Development Focus: Planning

- ✓ Asking a question
- ✓ Determining Independent and Dependent Variables
- ✓ Making a Prediction / establishing a Hypothesis

Opportunities should be given throughout the lesson for children to use and develop their knowledge of planning investigations, through questioning and discussions on questions to investigate, making predictions and suggesting dependent and independent variables.

Learning Outcomes

All children should	✓ Practise the skill of applying the terms "independent" and "dependent" variables. ✓ Practise the skill of making a prediction. ✓ Practise the skill of recording data in a simple way. ✓ Develop the skill of constructing investigation apparatus. ✓ Learn what friction is, what causes it, where it is useful and where it is not. ✓ Learn to use a Newton Metre to measure a force.
Some children could	✓ Specifically identify the variables. ✓ Practise the skill controlling variables. ✓ Identify a variable to test in an experiment.

	✓ Learn that forces can have equal and opposite reactions and are measured using Newton's (N)
A few children could	✓ Research the Life of Sir Isaac Newton or Galileo etc. ✓ Make a neat labelled drawing of the experiment explaining all of the terms introduced and discussed in the lesson. ✓ Provide a detailed rationale why changes in experimental design would change their results. ✓ State clearly Newton's 3rd law and be able to apply it to a range of simple examples.

Teacher Demonstration

Demonstration 3.1 – Newton Meters

You will need: A range of Newton meters

1. Show the students the Newton Meters and get them to analyse them and discuss what they see and what they could be used for.
2. Get the children to use them with equipment found in the classroom.
3. Ask if they notice a scale? And what this scale says. (This may form part of a revision lesson.)
4. Explain the concept of the Newton as the unit for Force and it has the symbol (N) with 1Kg equal to 10 Newton's of force – 'Weight'
5. Pull different objects over different surfaces to measure the grip (Friction) of each.

At what point is the measurement taken?

Demonstration 3.2 – Silk Scarf and Beaker

You will need: Silk Scarf, 1 L Beaker of water/flowers, Smooth table top – no ridged edge, Nerves of steel

Practise this demonstration a few times in your classroom before the doing it in front of the class.

1. Find a particularly smooth desk surface without a rim around the edge.
2. ¾ fill the 1 ltr glass beaker with water (you could add a little food colouring for show!)
3. Open up the silk scarf completely and lay it on the table with enough hanging off the edge to hold tightly
4. Place the beaker on the end of the scarf on the table making sure all surfaces are dry.
5. Firstly, draw the scarf along the table slowly, dragging the beaker towards the edge.
6. Within around 2 cm of the edge of the table very quickly pull the scarf away and the beaker 'should' remain on the table.

For extra drama have the beaker, or a vase, with flowers in on your desk for a few days before the lesson.

Possible Questions/ Suggestions for discussion

Science Explained – Silk scarf and Beaker
bit.ly/Scarf-Beaker Section 1.16

- ✓ What stopped the beaker falling off the table?
- ✓ Would it work with other materials?
- ✓ Would it work on other surfaces?
- ✓ Where is friction used in the real world?

According to Newton's first law, an object at rest tends to remain at rest until acted upon by an external force. In this case, the external force is the friction force between the beaker and the moving cloth. If the cloth is pulled gently (acceleration less than the force due to friction) the beaker accelerates along with it, but if the cloth is jerked suddenly (acceleration greater than the force due to friction) the cloth is removed before the beaker can accelerate to a significant velocity.

What small velocity it does acquire is quickly brought to zero by the friction between the beaker and the table after the cloth has been removed. Note that the mass of the object cancels, in contrast to popular misconception, so that it is no easier to perform the trick with a heavy object than with a light one. This fact can be illustrated by repeating the demonstration with an empty beaker.

Friction is caused by two surfaces moving over each other. When is it important to have reduced friction and when is it better to have a lot of friction?

Children's Investigation

Investigation 4.1 – Friction – Balloon Car Racer

You will need: Children should choose their equipment from that provided.Thick card or photocopy box lids etc.

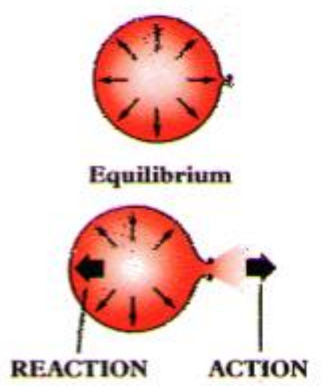
In pairs, the children need to produce a vehicle which will travel only by balloon power. This is an open ended challenge in which children should be allowed to choose their own design and experiment with the equipment given. Teachers may wish to provide card or boxes for a chassis if preferred. *(The lids from the photocopying paper boxes are ideal.)*
Demonstrate the apparatus that the students can choose from, and depending on the class either show or give them some written or verbal instructions on how to carry out the investigation.
The following links to provide useful visual and guidance aids for your pupils:

Video of children making balloon cars: bit.ly/Design-Squad
A worksheet and template for car design: bit.ly/Bloodhound-Template
More ideas from the Steve Spangler website: bit.ly/Spangler-Car
Balloon forces explained: bit.ly/Balloon-Forces
BBC Bitesize video: bit.ly/Rocket-Forces

Possible Questions/ Suggestions for discussion

There are a wide range of objectives that can be investigated in this experiment such as:
- ✓ Effect of mass on distance
- ✓ Do two balloons affect the distance travelled?
- ✓ Does wheel size change the time for which the car travels?

Turn this experiment into a class competition with the winning team being those whose car goes the fastest, furthest etc.



First, ask the winners why they think their car won using as much of the language of forces, friction and resistance as possible. Then the class to try and explain why they saw what they saw using all of the language of friction, and forces.
Ask for volunteers to suggest how they could have improved the experiment and make the car go further, faster etc.
Split the class into 4 groups and get 2 of the groups to write 2 tests using all the concepts and terminology covered in these 2 lessons for the other groups to do.

Plenary/Review including Skills Progression focus: Planning

Ask the class what they learnt / discovered…providing the wherewithal so that children can say

'I used to think ……… and now I think………. because ……' or

'I used to think ……… and I still think ………. because ……'

1. Suggest a list of variables that could have been changed if they had more equipment.
2. Ask for volunteers to suggest how they could have improved the experiment and how this might change their results.
3. Ask if anyone seemed to have discovered a pattern in their results.
4. Discuss examples of jet power in the real world.

Cross curricular links

Literacy	✓ Write instructions for the investigation for another year group. ✓ Begin a class glossary of term used in the Forces topic. This could be used towards a science dictionary, for a particular audience, maybe for parents or younger children. ✓ Research and write a fact file on Sir Isaac Newton.
Numeracy	✓ Practise recording data. ✓ Measuring and recording distances and times with accuracy and precision in tables. ✓ Use of decimals and averages.
Other subjects	✓ Extend the Balloon Car Challenge to incorporate a range of design features. ✓ Use Computing to film and edit footage to produce a video.

Useful websites	
	Shortened web links (Type these)
BBC Bitesize	bit.ly/bbc-Forces
A range of primary science activities	bit.ly/Activity-Videos
Wikipedia on Isaac newton	bit.ly/Forces-Newton
Wikipedia on the Newton unit	bit.ly/Unit-Newton
Primary Resources website with Forces resources	bit.ly/Forces-Resources
Children's Forces Olympics	bit.ly/Forces-Activities

Assessment Guide				
Planning to investigate a scientific question. Has the pupil..		Level / Grade / % / Mark /Meeting/ Working towards / Exceeding expectations.		
		Direct constant assistance	Some help	No help
		e.g 0-1	e.g. 2-3	e.g. 4-6
1	Clearly stated, drawn or written a question that can be tested in class with the apparatus available to them.			
2	Identified at least 1 Independent Variable that directly applies to their investigation.			
3	Identified at least 1 Independent Variable that directly applies to their investigation that they will test?			
4	Identified at least 1 Dependent Variable that directly applies to their investigation.			
5	Clearly identified at least 1 Dependent Variable that they will measure.			
6	Clearly stated which variables they must control in order to ensure their data is Valid (or use the phrase 'fair test'			
7	Clearly stated a prediction or Hypothesis they will test?			
8	Clearly explained why they have made the prediction they have? Attempted to rationalise or Justify their prediction.			
9	Either verbally, pictorially or written a method they will follow to conduct their experiment?			
10	Either verbally, pictorially or written a list of equipment method they will need to conduct their experiment?			
11	Stated what Risk considerations needs to be made in undertaking this experiment.			
12	Pupils have made suitable suggestions to mitigate the risks they've identified.			
	Total			