Upper key stage 2 – years 5-6

The principal focus of science teaching in upper key stage 2 is to enable pupils to develop a deeper understanding of a wide range of scientific ideas. They should do this through exploring and talking about their ideas; asking their own questions about scientific phenomena; and analysing functions, relationships and interactions more systematically. At upper key stage 2, they should encounter more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates. They should also begin to recognise that scientific ideas change and develop over time. They should select the most appropriate ways to answer science questions using different types of scientific enquiry, including observing changes over different periods of time, noticing patterns, grouping and classifying things, carrying out comparative and fair tests and finding things out using a wide range of secondary sources of information. Pupils should draw conclusions based on their data and observations, use evidence to justify their ideas, and use their scientific knowledge and understanding to explain their findings.

'Working and thinking scientifically' is described separately at the beginning of the programme of study, but must always be taught through and clearly related to substantive science content in the programme of study. Throughout the notes and guidance, examples show how scientific methods and skills might be linked to specific elements of the content.

Pupils should read, spell and pronounce scientific vocabulary correctly.

Upper Key Stage 2

Working scientifically

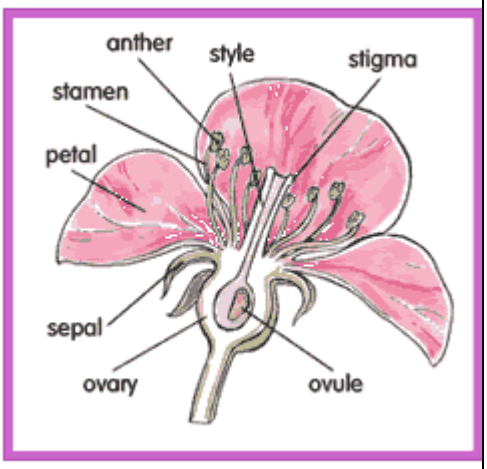
Upper Key Stage 2 programme of study (statutory requirements)	Notes and guidance (non-statutory
During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content: • planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • taking measurements, using a range of scientific equipment, with increasing accuracy and precision • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, and bar and line graphs	Pupils in years 5 and 6 should use their science experiences to: explore ideas and raise different kinds of questions; select and plan the most appropriate type of scientific enquiry to use to answer scientific questions; recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why. They should use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment. They should make their own decisions about what observations to make, what measurements to use and how long to make them for, and

• using test results to make predictions to set up further comparative and fair tests • using simple models to describe scientific ideas • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support	whether to repeat them; choose the most appropriate equipment to make measurements and explain how to use it accurately. They should decide how to record data from a choice of familiar approaches; look for different causal relationships in their data and identify evidence that refutes or supports their ideas. They should use their results to identify when further tests and observations might be needed; recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact. They should use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas and should talk about how scientific ideas have developed over time. These opportunities for working scientifically should be provided across years 5 and 6 so that the expectations in the programme of study can be met by the end of year 6. Pupils are not expected to cover each aspect for every area of study.

Year 5: All living things

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • explain the differences in the life cycles of a mammal, an amphibian, an insect and a bird • describe the life process of reproduction in some plants and animals.	Pupils should study and raise questions about their local environment throughout the year. They should observe life-cycle changes in a variety of living things, for example plants in the vegetable garden or flower border, and animals in the local environment. They should find out about the work of naturalists and animal behaviourists such as David Attenborough and Jane Goodall. Pupils should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals.	• What do seeds require in order to germinate? • How does the ovary of a flower change as the flower wilts? • Which animals have the longest gestation period? Pupils might work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around the world (in the rainforest, in the oceans, in desert areas and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences. They might try to grow new plants from different parts of the parent plant, for example seeds, stem and root cuttings, tubers, bulbs. They might observe changes in an animal over a period of time (for example, by hatching and rearing chicks), comparing how different animals reproduce and grow.
Other teaching ideas 1. Make a poster that explains pollination, fertilization, seed production, seed dispersal, germination and plant growth 2. Research which creatures carry pollen from flower to flower and why 3. List things that aid seed dispersal 4. Explore differences in life cycles between different types of animals.		
Key information Plant life cycles All living things will die; and if the species is to continue, and is to have any future, then it needs to reproduce. Reproduction produces new offspring of their kind - plant or animal. As the old die off, the young take their place. A species that is good at reproduction will survive.		

Green plants reproduce by flowering. The flowers contain the cells that will combine to produce the seeds and then the new plant. Ideally, cells from two different plants will combine; but if all else fails, a plant can fertilise itself to produce seeds.



The flower produces female egg cells in its ovary. The ovary has a sticky stigma on a long style to catch the male pollen cells. The pollen cells are produced in the stamens. These tiny specks are carried to the stigma of another plant by the wind, or on an insect. The insect gets sticky, sugary nectar from one plant and gives it to another plant - like a postal service.

When the egg cell is fertilised, it develops into a seed. The ovary may develop too, into a fruit. Because now the challenge is to move the seed - away from its parent plant to somewhere where it will grow. The wind may blow it, or water may carry it; it may stick to a passing animal, or be swallowed by one, only to emerge in the animal's droppings and grow. The new plant will flower in turn.

This is all a risky business - and so lots of pollen and seeds are produced to help ensure that new plants will grow. The whole process - from flower to flower - is called the flower's life cycle.

Animal Life Cycles

Animals that Grow Up (Simple Life Cycle):

Most animals including fish, mammals, reptiles and birds have very simple life cycles:

they are born (either alive from their mother or hatched from eggs)

they grow up

These animals have three stages -- before birth, young and adult. The young are typically similar to the parent, just smaller. The young slowly "grow" to become adults.

Amphibians:

Amphibians, like frogs and newts, have a slightly more complicated life cycle. They undergo a metamorphosis (a big change):

they are born (either alive from their mother or hatched from eggs)

they spend their childhood under water, breathing with gills

they grow into adults and move to the land, breathing with lungs

Animals that Undergo a Complete Metamorphosis:

Insects

These insects have four stages in their life cycle:

egg: unborn stage.

larva: young stage -- this is when most of the feeding is done.
(they usually look like worms)

pupa: inactive (no feeding) stage between larva and adult stages.
(usually well camouflaged)

adult: final, breeding stage.
(they usually grow wings)

Animals that go through a complete metamorphosis are what my daughter Kaitlyn calls "Wow!" animals -- they go to bed looking one way and wake up a completely different creature. Wow!

Animals that Undergo an Incomplete Metamorphosis:

About 10% of insects go through an incomplete metamorphosis. They do not have a pupal form -- these include dragonflies, grasshoppers and cockroaches.

These insects have three stages in their life cycle:

egg: unborn stage.

nymph: young stage -- this is when most of the feeding is done.

adult: final, breeding stage - including wings.

Year 5: Animals, including humans

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • describe the changes as humans develop from birth to old age.	Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty.	• How does head to body ratio change as a human grows? Pupils could work scientifically by comparing data about the gestation periods of humans and other animals or by finding out and recording the length and mass of a baby as it grows.

Other teaching ideas

1. Link to SRE puberty talks
2. Draw humans at different stages with correct head to body ratios.
3. Plot average height of males and females as they grow into a line graph. Compare differences and rate of growth at different stages.

Key information

THE HUMAN LIFE CYCLE STAGES

The stages of life have been defined by cultures and religions in many ways. In ancient Greece, the human life cycle was mapped in seven-year periods. Today, most people recognize the human life cycle as having four or five distinct stages shared by all humans. Human life can be explained more concretely by looking at these life stages.

Birth

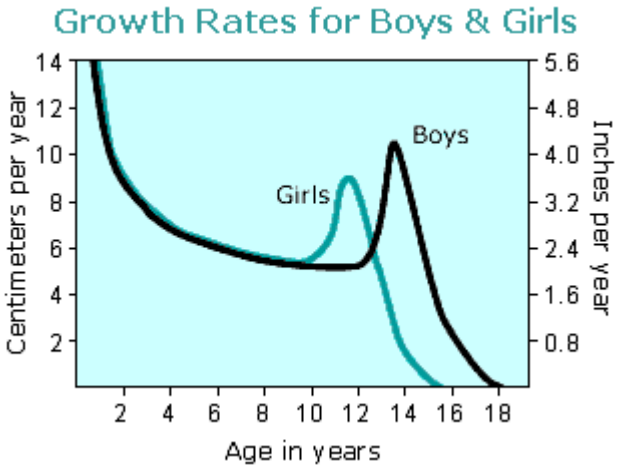
Birth takes place between fertilization and 40 weeks following fertilization, at which point the baby is fully formed and ready to exit the mother's uterus and enter the world. During the birth stage, the baby begins as a single cell, which proceeds to multiply into many cells that form the body parts and organs of new human life.

Infancy

Infancy is categorized as lasting from birth through the first year of life. At this point, the baby exits the mother's uterus. It can breath, its heart can beat and its organs can operate efficiently without the assistance of the mother. However, the infant is completely dependent upon its parents or caretakers for survival.

Childhood

Childhood takes place between ages 1 to 10. The first two years of childhood, the child is called a toddler. During this time, the child learns how to walk, talk and be more self-sufficient. These skills continue to expand during the remainder of childhood, and socialization takes place. Childhood is the building blocks upon which adolescence and, later, adulthood will be built, and the child is susceptible during this time to learned habits and behaviors.



Adolescence

Adolescence takes place between ages 12 and 18 and is a critical turning point because it is when puberty takes place. Boys' voices change and girls get their periods and both sexes become more sexually aware beings. As such, they begin to separate more from the parents and become more independent.

Adulthood

Adulthood is the longest stage and normally lasts from age 18 through old age. While there might be smaller psychological or culturally defined stages, adulthood is when human beings are fully grown and must provide entirely for themselves using the skills they learned throughout the first life stages. This is also a significant time because it is when the life cycle is initiated again by the conception and birth of the adult's own children. At the end of the adult life cycle, the body begins to deteriorate and the life cycle eventually ends in death.

Year 5: Properties and changes of materials

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • compare and group together everyday materials based on evidence from comparative and fair tests, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets • understand that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution • use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating • give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic • demonstrate that dissolving, mixing and changes of state are reversible changes • explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, such as burning, rusting and other reactions, for example vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton. **Note:** Pupils are not required to make quantitative measurements about conductivity and insulation at this stage. It is sufficient for them to observe that some conductors will produce a brighter bulb in a circuit than others and that some materials will feel hotter than others when a heat source is placed against them. Safety guidelines should be followed when burning materials.	• How is evaporation of a liquid affected by size of container/ viscosity/ moving air/ additives/ temperature? • How is boiling time of water affected by adding salt? • Which liquid dissolves antacid tablets quickest? • Do all liquids evaporate at the same rate? - salt water, vinegar, cooking oil, milk, aftershave lotion • Do all frozen materials melt at the same temperature? Pupils might work scientifically by: carrying out tests to answer questions such as 'Which materials would be the most effective for making a warm jacket, for wrapping ice cream to stop it melting, or for making blackout curtains?' They might compare materials in order to make a switch in a circuit. They could

		observe and compare the changes that take place, for example when burning different materials or baking bread or cakes. They might research and discuss how chemical changes have an impact on our lives, for example cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.

Other teaching ideas

1. Discussing the difference between powders and liquids
2. Discussing, sorting and grouping familiar materials as solids or liquids
3. Making a poster or collage illustrating the properties of solids or liquids or gases
4. List all you eat in a day as solids, liquids or gases
5. Explain with a drawing how smells travel around buildings
6. Research gases and their uses
7. Matching words to definitions evaporating, condensing etc.
8. Explore ways to remove salt from water.
9. Group changes into reversible and irreversible reactions.

Key information

Solids retain their fixed shape unless a force is applied to change the shape. The volume of material remains the same even if the shape is changed.

Liquids will pour and will take the shape of their container. The volume of liquid remains the same when it is poured into a different shaped container.

Very small solids, like sand, behave like a liquid; they can be poured and they take the shape of their container. However, each individual grain is a solid and behaves as such.

Gases spread out to fill all the space in a container. In a larger container the amount of gas will remain the same but it will spread out to fill the container and so have a greater volume.

Evaporation is the process by which water changes its state from a liquid to a gas (water vapour).

Heat energy is needed to change water into water vapour.

As water evaporates from the washing the air around becomes full of moisture. The wind moves the air around so that more water can evaporate. On a very damp day the air becomes saturated

with water vapour so no more water can evaporate. (This means that the washing will not dry and the puddles won't dry up!).

The process of condensation occurs when the water vapour in the air cools down and changes state from a gas to a liquid.

The air around a cold surface cools down and some of the water vapour in the air condenses, forming tiny droplets of water on the cold surface.

Outside, condensation can be seen in the form of mist or fog; the air becomes saturated with water vapour, some of which starts to condense and hangs in the air as tiny droplets of water.

Thermometers can be used to take the temperature of gases, liquids or solids. The liquid in the thermometer rises as it gets warmer. The higher the temperature, the higher the liquid will rise. (The liquid expands on heating.) The number of degrees Celsius will be greater as the temperature rises.

Water boils at 100°C. The temperature of the water will not rise above 100°C, at which point the water will evaporate.

Changing state

- When two or more substances are mixed together and a chemical reaction takes place new substances are formed and the change is irreversible.
- Using different proportions of materials can affect the properties of the new substance that is formed e.g. the new substance can vary in hardness, flexibility, strength according to the proportions of original materials used.
- Bricks can be tested by dropping from successive heights until they break.
- Some substances are more soluble than others i.e. a greater mass will dissolve in a given amount of water.
- Some substances will not dissolve; they are insoluble.
- More solute will dissolve in a greater amount of water.
- In most cases more solute will dissolve in hot water than in cold water.
- A saturated solution will not dissolve any more solute.
- Some substances will not dissolve; they are insoluble. Insoluble substances can be separated from liquids by filtering or sieving.
- Soluble substances can be recovered by evaporating the liquid from the solution. Evaporation is the process by which water changes its state from a liquid to a gas (water vapour). When the liquid evaporates, the solid substance is left behind.
- Mass is the amount of matter in a substance.
- Matter cannot be lost during reactions. Matter is always conserved.
- During the evaporation process the water changes its state from a liquid to a gas leaving behind the solid substance in its original state. The matter has not changed during this process; the change that takes place when a substance dissolves in water is called a physical change because the substance can be recovered.
- Evaporation is the process by which water changes its state from a liquid to a gas (water vapour).
- Heat energy is needed to change water into water vapour.
- As water evaporates from the washing the air around becomes full of moisture. The wind moves the air around so that more water can evaporate. On a very damp day the

air becomes saturated with water vapour so no more water can evaporate. (This means that the washing will not dry and the puddles won't dry up!)

- The process of condensation occurs when the water vapour in the air cools down and changes state from a gas to a liquid.
- The air around a cold surface cools down and some of the water vapour in the air condenses, forming tiny droplets of water on the cold surface.
- Outside, condensation can be seen in the form of mist or fog; the air becomes saturated with water vapour, some of which starts to condense and hangs in the air as tiny droplets of water.
- Thermometers can be used to take the temperature of gases, liquids or solids. The liquid in the thermometer rises as it gets warmer. The higher the temperature, the higher the liquid will rise. (The liquid expands on heating.) The number of degrees Celsius will be greater as the temperature rises.
- Water boils at 100°C. The temperature of the water will not rise above 100°C, instead the water will evaporate.
- Changes in temperature can be recorded on a graph or bar chart. IT can be used to store, retrieve and display data.
- The water cycle is a never-ending process in which water is exchanged between land and air.
- Heat energy from the Sun causes millions of tonnes of water to evaporate from the Earth's surface every day. Over a period of time the same amount of water will return to the Earth's surface in the form of rain or snow.
- As the water vapour in the atmosphere cools it condenses into water droplets and forms clouds. When the droplets in the clouds become larger and heavier they fall to the Earth as rain.
- The rain that falls on the mountains runs down in streams that join rivers and eventually reach the sea.
- Burning is a process that is not reversible.
- A fuel is a form of stored energy. The process of burning converts the chemical energy stored in the fuel to heat and light energy.
- Waste products are given off during the burning process. The matter that is burned is not destroyed but is converted into a different form or released into the atmosphere in the form of gases.
- Melting, freezing, evaporation, condensation and boiling are changes that can be reversed.
- Water freezes at 0°C. Other liquids may freeze at a lower temperature.
- Heat energy is required for melting to take place. Ice melts at 0°C. Other solids usually melt at higher temperatures.
- When two or more substances are mixed together and a chemical reaction takes place new substances are formed and the change is irreversible.
- Burning is a process that is irreversible.

Year 5: Earth and space

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • describe the movement of the Earth, and other planets, relative to the Sun in the solar system • describe the movement of the Moon relative to the Earth • describe the Sun, Earth and Moon as approximately spherical bodies • use the idea of the Earth's rotation to explain day and night.	Pupils should be introduced to a model of the Sun and Earth that enables them to explain day and night. Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a 'dwarf planet' in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones). **Note:** Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses. Pupils should find out about the way that ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus.	• How is the size of shadow affected by the time of day/distance from light source/brightness of light source? • How does the position of the Sun change during the day? • How does the shape of the moon appear to change over a month? • How does day length change through a term/year? • How does air temperature change through a term/year? Pupils might work scientifically by: comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; finding out why some people think that structures such as Stonehenge might have been used as astronomical clocks.

Other teaching ideas

1. Discuss why different parts of the school are sunny/shady at different times of the day
2. Draw around the shadow of a child in the same place at different times of the day
3. Keep a record of how the position of sun changes through the day
4. Design and make a sundial
5. Make 3D models of Earth, Moon and Sun from plasticine, papier mache, fruit or balloons
6. Discuss a moving model of the Earth, Moon and Sun
7. Use a globe and a spotlight to discuss day and night
8. Use a globe and a spotlight to discuss the year
9. Explore the Perseid meteor and how this yearly meteor shower can be explained by moving of the Earth around the sun.

Key information

- The Sun is a source of light.
- Opaque objects cast shadows.
- The sharpness of shadows will vary with different weather conditions.
- The brighter the Sun the sharper the shadow.
- The angle at which light falls on an object will affect the shape of the shadow.
- The Sun appears to move across the sky during the day.
- The shadows are shorter at mid-day.
- The Sun is higher in the sky at mid-day in summer than it is at the same time in winter.
- In summer the sun rises earlier in the day and sets later in the evening than it does in the winter.
- We have more hours of daylight in the summer than in the winter.
- The differences in the hours of sunlight is the reason for the seasons.
- Countries on the equator have the same hours of sunlight throughout the year and therefore no seasons
- The Moon appears to change shape. It follows a monthly cycle.
- The Moon reflects light from the Sun.
- Stars give out their own light
- Darkness is the absence of light.
- True darkness is only found in places like caves underground.
- The Sun, Earth and Moon are approximately round or spherical.
- The Sun is over a million times bigger than the Earth.
- The Earth is six times bigger than the Moon.
- The Sun is 150 million km from the Earth.
- The Moon is quite close - only 400,000 km away!
- We don't feel as if we are on a roundabout because the "park" or atmosphere is spinning at the same rate.

Year 5: Forces

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
Pupils should be taught to: • explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object • identify the effects of air resistance, water resistance and friction, that act between moving surfaces • understand that force and motion can be transferred through mechanical devices such as gears, pulleys, levers and springs.	Pupils should explore falling objects and raise questions about the effects of air resistance. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example by observing the effects of a brake on a bicycle wheel. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists such as Galileo Galilei and Isaac Newton helped to develop the theory of gravitation.	• How does type of material/weight added/shape/ making holes affect the falling time of a parachute? • How does moving the fulcrum on a lever affect the force needed to move an object? • What factors affect the sag of a simple beam bridge? • What affects the time of the swing of a pendulum? • What affects the height bounced by a ball? • What affects the time for different Plasticine shapes to fall in water? • How does air resistance affect our ability to run? Pupils might work scientifically by: exploring falling paper cones or cup-cake cases, and designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore

		resistance in water by making and testing boats of different shapes. They might design and make artefacts that use simple levers, pulleys, gears and/or springs and explore their effects.

Other teaching ideas

1. Rolling the same ball or car down different steps
2. Make and discuss parachutes - what slows them down
3. Explore why racing cars and motorbikes are strange shapes.
4. Discussion about floating and sinking - what pulls things down and what pushes them up?
5. Discuss autogyros - what pulls them down what holds them up
6. Discuss paper aeroplanes - what makes them go, what makes them stop
7. Make a plasticine boat that will support 50g

Key information

- Pushes and pulls are examples of forces.
- Forces act in particular directions.
- When a force is applied it will make an object start moving, stop moving, change shape or change direction.
- The greater the force, the greater the movement or change in shape.
- The speed with which an object falls to the ground does not depend on its mass.
- The rate will vary if the object offers more resistance to the air because of its shape, e.g. a feather.
- Weight is another name for the gravitational force from a large object like the Earth.
- If a feather and a lead ball were dropped together they would both hit the ground at the same time if there was no air on this planet.
- The greater the mass the bigger the push or pull needed to move it.
- The greater the mass, the greater the force needed to pull the mass. The steeper the incline, the greater the force required to pull the object up the ramp The greater the mass/incline the more the elastic band will stretch. This can be measured with a ruler. Forces are measured in newtons.
- A boat shape will float if it includes a large volume of air even though the material from which it is made is heavier than water.
- The mass of the boat is being pulled down due to gravity.
- The water is pushing the boat up. This is called upthrust.
- The boat floats when these two forces are balanced.
- When an object does not move the forces are balanced.
- There are many examples of this:
    - The tug of war game when the ribbon does not move.
    - A book on a table - the book presses down on the table with a force equal to its weight - the table pushes up with the same force.

    - A boat when it is floating.
- Objects will move when the force in one direction is greater than any other forces preventing it from moving.
- Objects move in the same direction unless a force is applied to change it.
- A force can make a moving object stop, speed up, slow down or change direction.
- When a moving truck hits a barrier, the force will make the barrier move or change shape or cause the truck to change shape or move backwards.
- Softer materials will be able to absorb the force by changing shape. Harder materials will be more likely to move or cause the truck to crumple or move back.
- Magnets attract certain metals. Like ends of magnets repel each other. Unlike ends attract.
- Objects fall to the ground at the same rate regardless of their mass providing they offer the same resistance to the air. Air resistance slows down the rate of fall e.g. autogyros, sycamore seeds. *Galileo first proved this in the 1600s when he dropped three balls of different masses from the Leaning Tower of Pisa. They all hit the ground at the same time.*

- The greater the air resistance the slower the autogyro or parachute will fall. Air resistance will be increased if there is a greater surface area of fabric or card. Force **is** measured **in** newtons **with** a newton meter. When a scale is put on a meter it is called calibration. When a newton meter is used to measure the force needed to lift an object it is the same as its weight.

    - *100g is equal to 1N*
    - *1g is equal to 0. 01N*
    - *1kg is equal to 10N*

- *Because the gravity of the Moon is only one sixth of the Earth, objects weigh 6 times less on the Moon. This means that if a 600g stone from Earth is lifted on the Moon it will <u>only</u>* weigh 100g.
- Friction is a force that reduces the sliding movements between two surfaces.
- It has many important applications in our lives - for instance - we slip on icy pavements, we could not walk without friction, braking depends on friction, a nail is held in a wall by friction, parachutes descend slowly due to friction.
- The moving parts of machines are lubricated to reduce friction. *When two surfaces rub together some of the energy is converted into heat.* Forces can be represented with arrows showing the direction of the force. If equal and opposite forces are applied, the object does not move. If unequal and opposite forces are applied, the object moves in the direction of the greater force. If forces are applied at right angles, the object moves diagonally. Objects are balanced when the forces acting upon them are equal. According to Newton's law of motion - "action and reaction are equal and opposite". An object will stay at rest until a force is applied which changes the balance of the forces. The object will then move in the same direction as the greater force. When springs and elastic bands are stretched they exert a force on whatever is compressing them. When springs are compressed they exert a force on whatever is compressing them. The see-saw will be balanced when the forces on both sides are balanced. When a boat floats, the up thrust from the water equals the pull of gravity. *Sea water is more dense than fresh water so it has a greater up thrust. Heavily laden boats that float in sea water could sink when they sail into fresh water.*