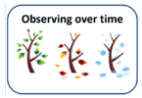
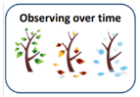
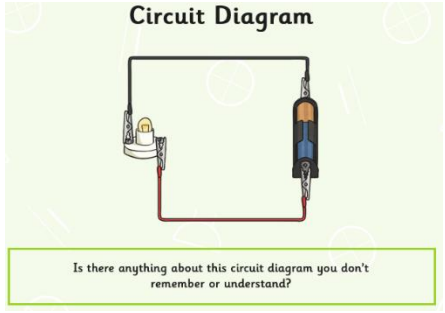
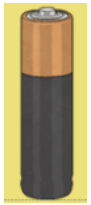
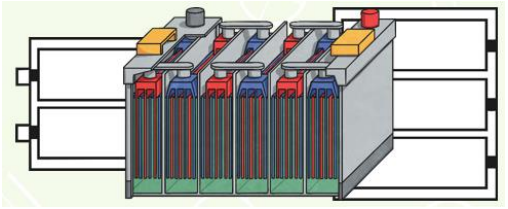
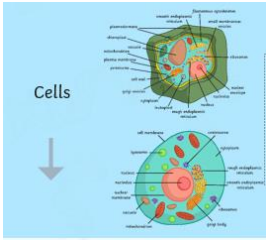
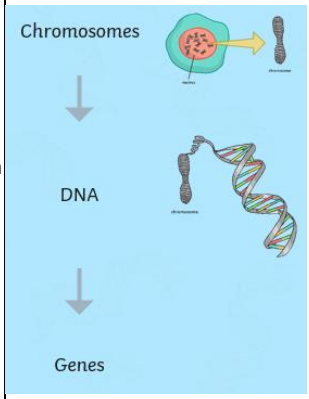
Science Scheme of Work

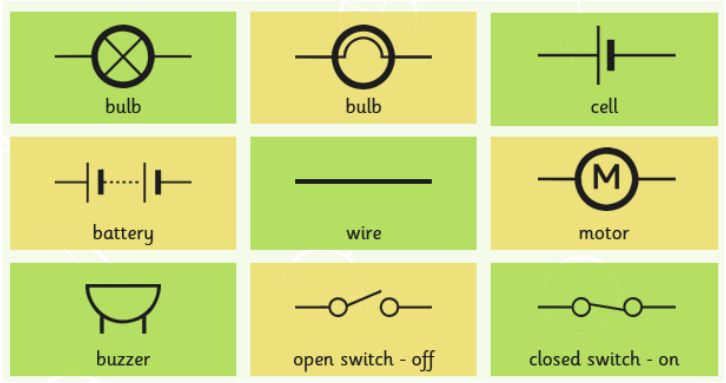
Perranporth C P School

Year 6 Autumn Term

	AUTUMN 1st Half	Autumn 2nd Half
Science (All NC subject content covered)	**Electricity** **Pupils should be taught to:** • associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches • use recognised symbols when representing a simple circuit in a diagram. **Working Scientifically (WS):** During year 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, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar, and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.	**Evolution and Inheritance** **Pupils should be taught to:** • recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago • recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents • identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution **Working Scientifically (WS):** During year 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, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar, and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.
WS opportunities	    What difference does the voltage make in a circuit?  .	     How have humans adapted to living in difference habitats around the world? How have theories of evolution

										changed over time and who are the key scientists in this field.

Key questions / knowledge and understanding to be explained **Key Knowledge and facts to be recalled**	**1. KWL, Mind-map or other 'what I know now' activity starter.** **2. I can recognise and draw scientific circuit symbols.** Start session by asking the simple questions below: What is a circuit? What parts do all circuits contain? Ask children to draw a circuit that includes a bulb.  **Explain the difference between battery and cell.**  In everyday language we call a single cell a 'battery', but this is not the correct scientific usage. Scientifically, this is a **cell**. It is a single unit, containing two electrodes and an electrolyte. Electrodes are charged electrical conductors inside a cell. Each cell has one positive and one negative electrode. An electrolyte is a chemical that reacts with the electrodes to produce an electrical current. **Battery** A battery is the scientific name for a collection of cells joined together.  The above diagrams show single cells in individual cases linked together. Some larger batteries, such as car batteries, contain the multiple cells inside one case. In circuit diagrams, scientists use symbols to represent components. This makes it clear and easier to understand. Most symbols are the same or very similar in all circuit diagrams:	**1. KWL, Mind-map or other 'what I know now' activity starter.** **2. I can explain the scientific concept of inheritance.** **Cells, Chromosomes, DNA and Genes **introduced as a brief background before looking into variation**** Cells are the building blocks of all living things. All living things are made up of cells. Amoebas have one cell. Humans have trillions of cells!   The nucleus of a cell contains chromosomes, which are made up of DNA. DNA carries the characteristics that we inherit. It is located in two places in the cell: the nucleus and the mitochondria. DNA can replicate and make copies of itself. When cells divide, each cell needs to have an exact copy of the DNA in the old cell. Genes are short sections of DNA that contain specific information. This is often called the genetic code. All the genes in the whole cell are called the genome. **Variation** **Inheritance**. These are characteristics that are passed on to offspring from their biological parents.   **Adaptation.** Over many generations, a species will adapt to its environment because the animals with the most successful characteristics are more likely to survive and pass on these characteristics to their offspring. In science, **inheritance** refers to the genes that are passed on from biological parents to offspring. When we refer to inherited characteristics we tend to focus on physical characteristics as these are easy to spot but inherited characteristics include abilities such as taste and smell. **Parents and Offspring**

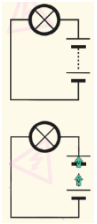


Children complete simple circuit drawings using associated symbols and write an explanation for each circuit and how it will work. Children can also interact with the circuit symbols on this link on the BBC Bitesize page:
https://www.bbc.co.uk/bitesize/topics/zj44jxs/articles/zqryn9q

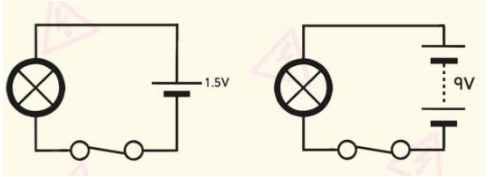
3. I can observe and explain the effects of differing voltages in a circuit.

Current:
This is the steady flow of electrons.
This is measured in amperes (amps)

Voltage:
This is the force that makes the electric current flow.
This is measured in volts (V)
The greater the voltage, the more current will flow.



Volts can be labelled in a circuit diagram, where the cell is positioned. Voltage can also be found on the cells we use in the circuits.



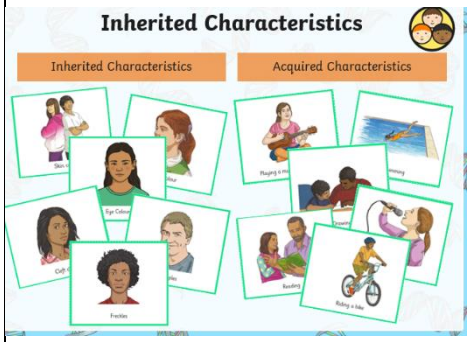
WS INVESTIGATION – what difference does the voltage make in a circuit?
Children given a range of cells of different voltage and asked to create a comparable test circuit to see if the voltage makes a difference – what component will work best for this? Does it matter? A light should be easier to notice a difference, but they may choose a buzzer and identify a difference in the loudness of it..

While offspring does mean child, it does not mean that you are only offspring when you are children! The inherited characteristics you gain from your biological parents are part of your DNA for life.

Even when you are an adult you are your parents' child!

Inheritance and Variation
The majority of living things are the result of sexual reproduction so they have two parents. You inherit the characteristics from both parents but the way they combine makes the offspring unique.

The inherited characteristics can combine in different ways, which is the reason why siblings inherit the same characteristics but are not identical to each other.



Even identical twins that share the exact same combination of DNA are not 100% the same! This is due to the fact that genes develop separately when the twins are embryos or during later development.

We often talk about inheriting characteristics from our biological parents. However, it is not always the case that these are passed on through DNA. Some are learnt as we grow up and can be influenced by a wide range of people - not just from our biological parents.

3. I can understand that adaptations are mutations. I can identify adaptive traits.

Environments and Habitats
Sometimes the words 'environment' and 'habitat' are used as though they have the same meaning. However, there are important differences:

A habitat refers to a specific area or place in which animals and plants can live.

An environment contains many habitats and includes areas where there are both living and non-living things.

So a bird may live in the woods, its habitat, but its environment could include a stream and a mountain, which are habitats in their own right.

Adaptation

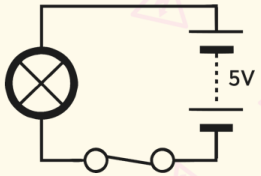
What Difference Does the Volt Make?

	0V	1.5V	3.0V	4.5V
Prediction				
Results				

Complete the session by discussing the question below and link this to real life contexts in our homes and the dangers it may present:

Appropriate Volts

What would happen to an electrical appliance that requires 3V if it were powered by 5V cell or battery?



4. **(a) WS INVESTIGATION: I can plan an investigation. I can understand variations in how components function.**

Children to plan and undertake an investigation into the following question *this is an example question, but children can be encouraged to create their own, depending on cohort confidence*:

Does wire length affect how components in a circuit work? NB – children will need access to wire cutters and wire that can be cut to varying lengths for this, which needs to be checked beforehand.

4. **(b) WS INVESTIGATION: I can conduct an investigation. I can record my data and report my findings.**

Articulate the importance of scientists trusting their results – scientists often repeat investigations to ensure the data they have is an accurate reflection of what has happened…

Scientists conduct lots of investigations which have a big impact on living things. For example, scientists conduct investigations that tell us what type of food humans should eat and what chemicals are safe to use on plants. Because we act on scientific data, we need to make sure that we have a high degree of trust in it before making our conclusions. This is particularly true if we are going to recommend that others act or

A fish is adapted to live and thrive in its habitat. It has gills to breathe in oxygen in the water. It has fins that allow it to move through water easily. It has a special bladder called a swim bladder which allows it to remain buoyant.

The adaptations, each of which have occurred over time (which is called evolution) make it easier for the fish to live in water and survive. We only see the fish as it is now and not the other fish who started off similar to it but whose adaptations made it harder, rather than easier, to live in the water. These fish have become extinct as a result.

The successful adaptations allowed the fish to survive in the water better. Hence the fact that this fish is still alive now.

Adaptation is not a part of a living thing, it is a process. The parts, such as gills, are called the **'adaptive traits'.**

Show children the following video/images of 'flying' fish and debate and discuss the adaptations they have over 'regular' fish and why this might be.

Flying fish video

BBC Earth Flying Fish, David Attenborough

To understand how and why these adaptations occur, we need to go back to our DNA.

Each cell has a copy of the DNA. Random mutations occur when the cell becomes damaged and fails to repair itself completely. Sometimes this failure affects the DNA in the cell.

In this situation, the DNA stays slightly different. When the cell with the mutated DNA replicates, it will do so with the mutation**.**

Mutations are not in themselves good or bad. Some mutations have no effect at all! However, other mutations can cause us to lose or gain functions.

One example of this is the ability of humans to drink milk after infanthood.

All other mammals stop drinking milk after they are weaned. As they develop, they become lactose intolerant (the body stops being able to digest milk).

A mutation in humans has allowed us to carry on drinking milk even after we are weaned as babies. Further mutation means we can drink the milk of other mammals – such as cows, sheep, and goats. Again, no other mammal does this!

behave in a particular way based on our results. When conducting their investigation, encourage children to think about the following:

- **Be Objective:** Have you reported the results honestly? Have you included all the results even when they did not match your prediction? Did you have a control group?
- **Accuracy:** Was your measuring equipment accurate?
- Reproducibility: Can your investigation be repeated? Have you repeated your results? Did you get the same or very similar results?
- **Consensus**: This does not mean that all the data must show the exact same results, but if the majority of other investigations show results that are the same or very similar then we can have a higher degree of trust in our results. If your results are completely different to all the other data sets for similar investigations, then it is necessary to consider why that is.
- **Sample Size**: this is how many were included in your investigation. The more data you have the more likely it is to show the 'real' picture.

Ensure that children check equipment is working properly. They should create a circuit and check that the battery is not flat, or the bulb has blown its filament!

While conducting the investigation, they may need to make changes and adjustments. Ensure they make a note of these.

Repeating the results. Repeating results ensures that results are more precise. By repeating the investigation, children can check if the results were precise the first time around. If the results are very different, then it would indicate a problem with how you conducted your investigation.

4. (c) WS INVESTIGATION I can investigate my results further.

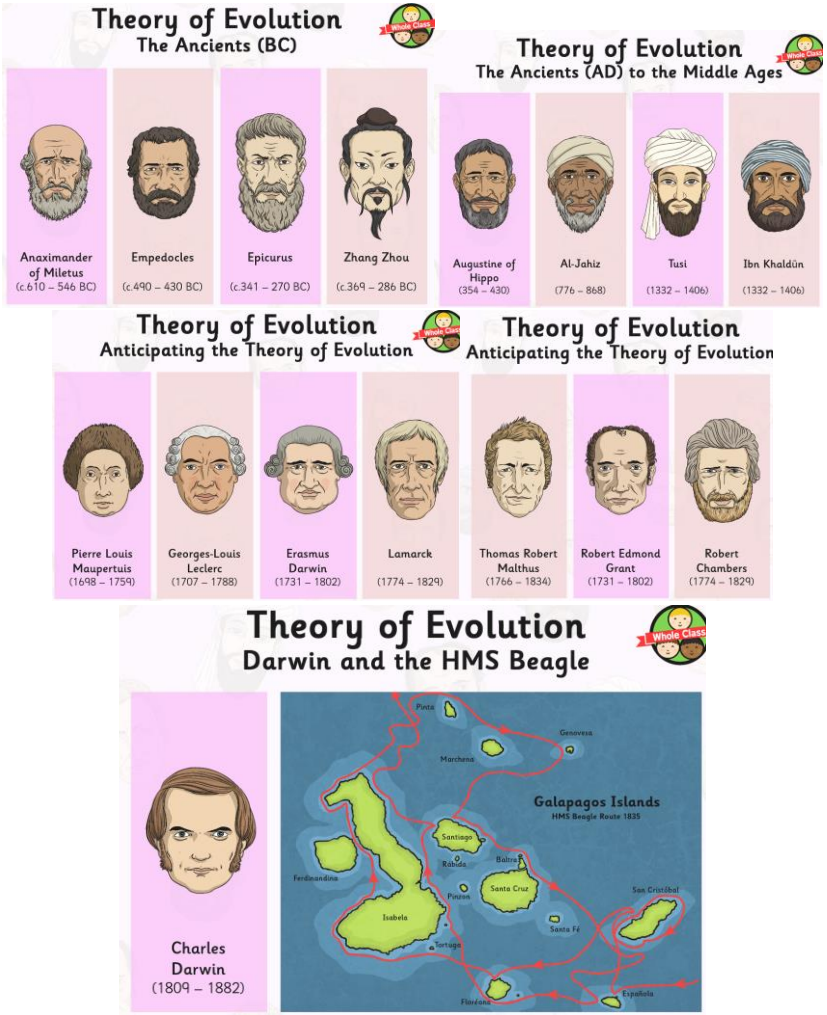
Children are encouraged to look at their results and data and identify what it tells them scientifically about the original investigation question. Reference the '**Degree of Trust'** – can they elicit a clear finding(s) from their data? Do they need to complete a follow up investigation, with, perhaps, a slightly different focus? Children should write their findings in a conclusion, suing the key vocabulary required for the investigation accurately.

Adaptive traits enable a living thing to survive better in its habitat or environment. As it lives longer, it means that it has a greater chance of reproducing and so the adaptive trait gets passed on.

Humans and adaptation

WS INVESTIGATION: How have humans adapted to living in difference habitats around the world?

4. WS INVESTIGATION I can demonstrate understanding of how ideas about evolution developed over time. I can explain the terms adaptation, evolution, and natural selection.



Charles Darwin

From a young age I was fascinated by living things and studied them. I trained to be a doctor but could not deal with all the blood! So I studied plants and animals instead. When I was 22 years old I was able to go on the most fascinating journey to the Galapagos Islands, which took 5 years! It was in the Galapagos Islands that I studied

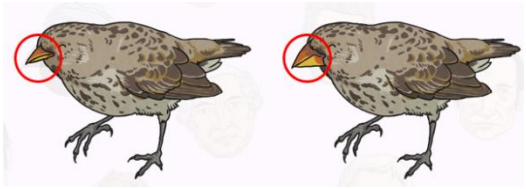
5. **Refer to initial KWL grid from lesson 1 and expand with knowledge learnt and retained. Make links to real world context.**

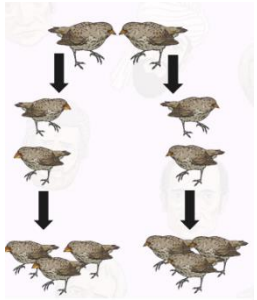
different animals and started to come up with my greatest theory: the theory of evolution. It was the different types of finches (and nightingales) that really got me thinking.

I observed that there were lots of different types of finches. People believed that these were different species of birds that happened to have some similarities. However, I realised that these birds were varieties of the same species and were related.

I thought that all the Galapagos finches had originated from one type of finch. The parents reproduced and created offspring. These offspring would have varied.

- In one part of the Galapagos Islands, bad weather affected the plants and so only those with larger seeds were left. Those finches who had slightly larger beaks were able to eat these seeds while those with smaller beaks could not.
- Only the offspring with large beaks could break open and eat the larger seeds. Therefore, these offspring survived, and the other, smaller beaked offspring died. 'Survival of the fittest' means those that are most suited to their environment because of their inherited or adaptive traits survive while others do not.



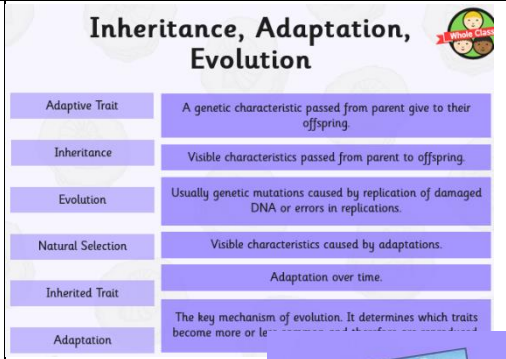


The Galapagos finches with large beaks reproduced and had offspring. More of these offspring inherited large beaks and survived. In other parts of the Galapagos, smaller beaks ensured better survival than larger ones, larger eyes than smaller ones, etc. The adaptations caused by variation meant that over a long period of time the Galapagos finches evolved adaptive traits that caused differences between them.

These offspring would also have differed due to inherited and environmental factors and so eventually over time stopped resembling their common finch ancestors.

Evolution is the process of adaptation over a long period of time. This process, whereby certain inherited and adaptive traits allowed them to live and reproduce while others became extinct, is called natural selection.

5. **I can examine fossil evidence. I can explain how a living thing has evolved over time.**



Begin this session by reviewing key vocabulary from the learning so far – this can be as a discussion or through a knowledge and retrieval activity, such as a quiz or mini mind-map.

Follow this with a refresher activity on how fossils are created – can children remember the process from their learning in Year 3?

Darwin and Fossils

Tree of Life

Darwin believed that there was a single point of origin for all living things and that we then evolved into the living things that we are today through a process of adaptation.

This was the original diagram by Darwin that shows how all living things were related.

Based on his observations and his own fossil finds, he realised that many of the varieties and species of living things simply would not have fossilised or would have been destroyed.

Because of the issues related to fossilisation, he did not think it would be possible to find all the 'transitional forms' (i.e., common ancestors) between two living species.

When looking at fossils alone, however, it is not always possible to detect if the traits began as inherited or adaptive traits. In order to understand this, we need more information about the environment and other related living things.

When examining fossil evidence, it is necessary to look for both the similarities and differences in terms of traits.

Darwin was correct when he said that we would not find complete fossil records for all living things due to the process of fossilisation.

We know that most fossils are found in sedimentary rocks. The lava that forms igneous rock would not enable fossilisation to take place. Fossils in metamorphic rocks that used to be sedimentary rocks are rare, as the magma heats the rock and will distort the fossils embedded within it.

Also, there were periods where greater fossilisation of living things occurred than at other times.

Many varieties and species of living things have no fossil record and therefore scientists must work with the fossils they do have.

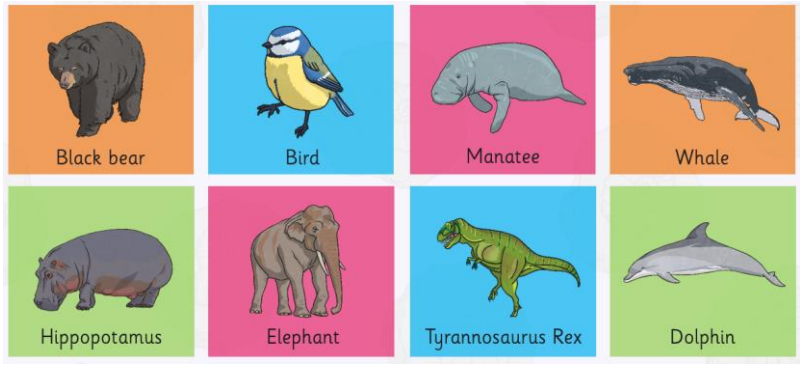
The most complete fossil records are of animals with endo or exoskeletons as the calcium in the bones does not decay as quickly as other matter that makes up living things.

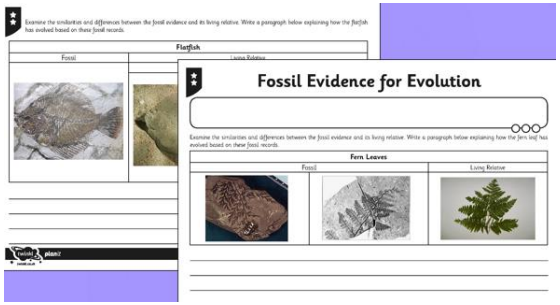
For this reason, many living things, such as soft bodied animals and most types of plants, have very incomplete records and fossil finds are very rare.

Not all animals with endo and exoskeletons have complete fossil records.

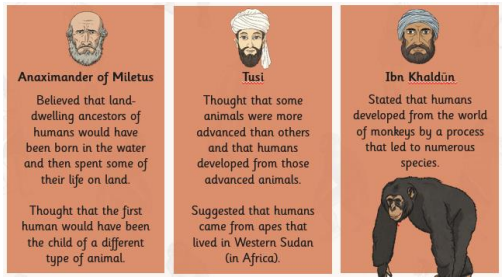
Darwin observed a bear diving into the water and made the observation that it was 'just like a whale'. It has now been proven that bears and whales do indeed have a common ancestor but he would not have known this at the time!

The animal pairs below all have common ancestors!





6. I can identify adaptive traits in humans as a species. I can describe the known stages of human evolution. I can compare modern humans with members of the same genus and family.



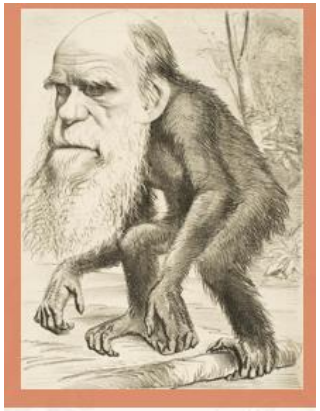
In science, the theory of evolution is seen as the most comprehensive theory of how humans came to be on Earth. There have been many scientists in the past who have had differing views.

However, Darwin had shied away from publishing his findings as he knew it was controversial. Indeed it was, and in his lifetime, the reception to his ideas was mixed.

Many people believed, for several different reasons, that humans were fundamentally different to other living things. Therefore, they would not even have classed humans as animals.

Most people would not have read the books and or come across the ideas that Darwin had. While he was building on the ideas of others, for many ordinary people, his ideas were brand new and a complete break from what they had thought before.

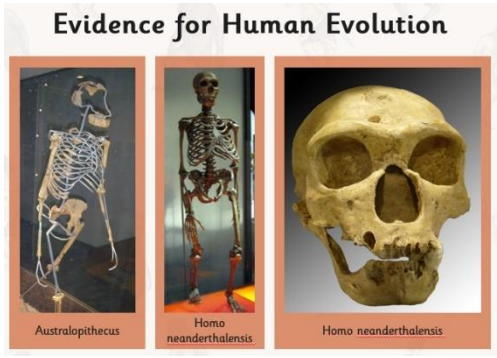
The cartoon to the right was one of many from people who were sceptical about his theory.



"A Venerable Orang-outang", a caricature of Charles Darwin as an ape published in The Hornet, a satirical magazine

The greater knowledge of fossils and their collection by scientists meant that in the 20th Century they were better understood when found.

Over the course of the last century many fossils have been found that demonstrate the evolution of humans (homo sapiens).



Initially, fossils were compared to the human skeleton to indicate the degree of similarity or difference. However, modern scientists have been able to map DNA in detail and this gives them another way to compare how closely related we are to different living things in ways that could not have been detected by comparing skeletons alone.

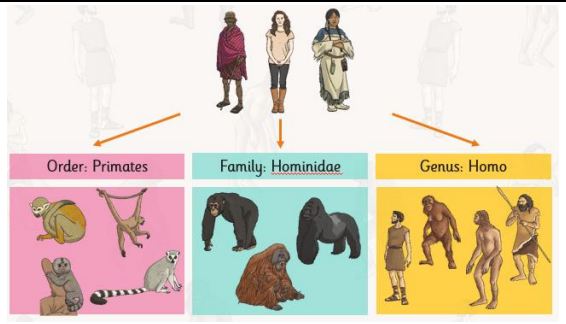
Biological Taxonomy

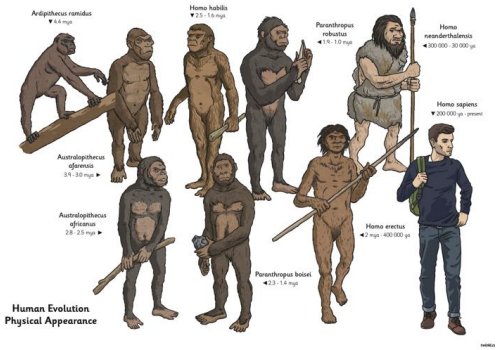
Before you explore the fossils further it is important to understand how we classify living things.

Biological taxonomy is a system of classification used by scientists. This system is based on the work on biological classification by Carl Linnaeus. In this system the lowest rank (species) is the most specific and the highest rank (domain) is the most general group that a living thing belongs to.

When referring to a living thing in this classification, it is done by adding the Genus and Species names together – so a human is a Homo Sapien, the lion is a Panthera Leo and large cacti is a Carnegia Gigantea.

Taxonomic Rank	Example 1: Human	Example 2: Lion	Example 3: Large Cactus
Domain	Eukaryote	Eukaryote	Eukaryote
Kingdom	Animal	Animal	Plant
Phylum	Chordate	Chordate	Chordate
Subphyla	Vertebrate	Vertebrate	Angiosperms
Class	Mammal	Mammal	Dicots
Order	Primate	Carnivore	Caryophyllales
Family	Hominidae	Felidae	Cactacaea
Genus	Homo	Panthera	Carnegia
Species	Sapien	Leo	Gigantea





7. I can explain how adaptations can results in both advantages and disadvantages.
I can explain how human intervention affects evolution.

Adaptation is the result of mutations which occur randomly.

These can result in adaptive traits which confer the living thing with a function that enables it to survive better.

However, the adaptive trait could also do the complete opposite and involve losing a function.

In some cases, the adaptive trait neither confers an advantage or disadvantage. It has a neutral effect!

Adaptation by natural selection results in evolution if the following 3 conditions are met:

1) The mutation causes a variation in an existing trait.
(The trait exists already, not an entirely new one which is rare).

2) This trait is heritable.

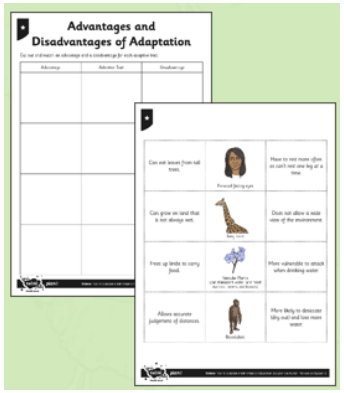
(It can be passed on from parent to offspring. Some traits are dependent on DNA in more than one gene. If the offspring does not inherit all of those genes and DNA then the trait will not be passed on to them.)

3) This version of the trait enables a greater chance of survival than other versions of the trait.
(Having thicker fur is an adaptation that has enabled animals in colder parts of the world to survive better so animals with thinner fur became extinct in those parts of the world. Being taller or shorter as a human confers no advantage in terms of survival and therefore the different versions of this trait have continued to exist.)

Living Fossils
All living things have not adapted or evolved to the same extent.

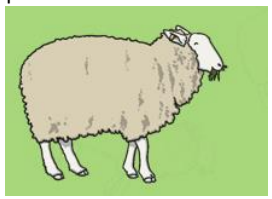
A living fossil is a living species that is highly similar to its ancestors found in fossils. These living things have either had little occurrence of adaptation or the adaptations that did occur did not prove to be an advantage so died out.

Examples of living fossils include:



It is rare that an adaptation will have a completely positive or negative effect on the living thing. Often the adaptive trait confers an advantage but can cause other disadvantages, even if these do not harm the chances of the living thing's survival.

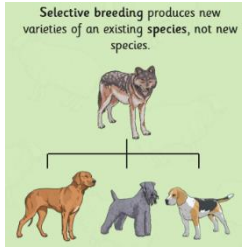
Evolution and Human Intervention
Examples of **selective breeding** include cows that can produce more milk, sheep with thicker coats of wool, wheat that produces more grain and different colouring in flowers.



There is **no evolutionary advantage** to the living thing from the selective breeding process. If there had been, these characteristics would have occurred through the natural selection process.

Process of Selective Breeding:

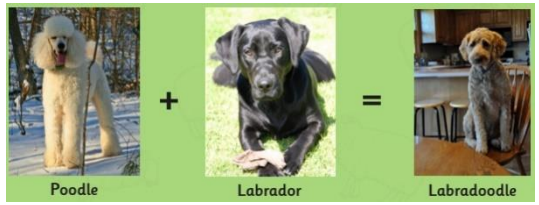
- Decide which characteristic is important e.g., amount of milk produced.
- Find parents who show this characteristic.
- From their offspring, choose the ones who share this characteristic and only let them reproduce.
- Repeat the process continuously.

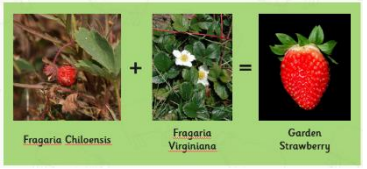


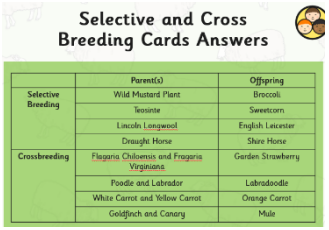
Cross Breeding

Cross breeding is a process through which two parents from the same species are bred to combine particular characteristics from each parent.

The process is very similar to the selective breeding process, except the offspring must have the selected characteristics from both parents.







	Parent(s)	Offspring
Selective Breeding	Wild Mustard Plant	Broccoli
	Teosinte	Sweetcorn
	Lincoln Longwool	English Leicester
	Draught Horse	Shire Horse
Crossbreeding	Fragaria Chiloensis and Fragaria Virginiana	Garden Strawberry
	Poodle and Labrador	Labradoodle
	White Carrot and Yellow Carrot	Orange Carrot
	Goldfinch and Canary	Mule

Genetic Modifications

Selective and cross breeding was limited and was not successful in all cases. Typically, the living things would have to be from the same species or at a push the same genus. However, some attempts a breeding did not work. Breeding did not result in a successful embryo or plant. At other times, there were offspring, but they were sterile (therefore could not reproduce).

Advances in genetics and technology has pushed the science of breeding to a new level.

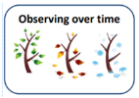
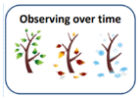
- Genetically Modified Foods (GM Foods)
- Cloning
- Animals growing human parts and organs

This provides opportunity for debate on whether genetic modifications are a positive impact of human intervention.

8. **Refer to initial KWL grid from lesson 1 and expand with knowledge learnt and retained. Make links to real world context.**

Vocabulary	As previous plus: • series circuit • parallel circuit (explain only to HA, not required). • cell • motor • circuit diagram • recognised symbols • volume • voltage • Amps brightness • switches • LED's • Alternating current • Thomas Edison • Michael Faraday • Nikola Tesla	As previous plus: • Evolution • Adaptation • Inherited traits • Adaptive traits • Natural selection • Inheritance • Charles Darwin • DNA • Genes • Variation • Parent • Offspring • Fossil / Fossilisation • Environment • Habitat • Plants • Animals • Living things • Palaeontologist s • Mary Anning • Alfred Wallace • Charles Darwin

Year 6 Spring Term

	Spring 1st Half	Spring 2nd Half
Science (All NC subject content covered)	**Animals, including Humans** **Pupils should be taught to:** • identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood • recognise the impact of diet, exercise, drugs, and lifestyle on the way their bodies function • describe the ways in which nutrients and water are transported within animals, including humans. **Working Scientifically (WS):** During year 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, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar, and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.	**Light** **Pupils should be taught to:** • recognise that light appears to travel in straight lines • use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye • explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes • use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. **Working Scientifically (WS):** During year 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, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar, and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.
WS opportunities	 How long does it take for my heart rate to recover after exercise?	
	 Do taller people have faster/slower resting heart rates? How long does it take for my heart rate to recover after exercise?	 How does exercise affect heart rate?
	 Why does exercise affect heart rate? Why aren't everybody's resting heart rates the same? Why should we exercise daily? Which is better, aerobic or strength-based exercise?	
		
		 What surfaces does light reflect off?
		 What happens when I change the medium light travels through?
		 How does light reflect off surfaces?
		 How does a periscope work?

Key questions / knowledge and understanding to be explained
Key Knowledge and facts to be recalled

1. **KWL, Mind-map or other 'what I know now' activity starter.**

2. **I can identify the three main parts of the human circulatory system. I can explain what the heart does. I can work with others to create a living model of the circulatory system.**

The heart is a powerful organ that is situated between your lungs and is protected by the ribcage. The heart is a muscle that pumps blood all around your body. It is made up of four chambers (enclosed spaces).

There are many tubes, called blood vessels, coming in and out of the heart. The blood vessels carry blood around the body. If they carry blood away from the heart, they are called arteries; if they carry blood into the heart, they are called veins.

How to remember this…

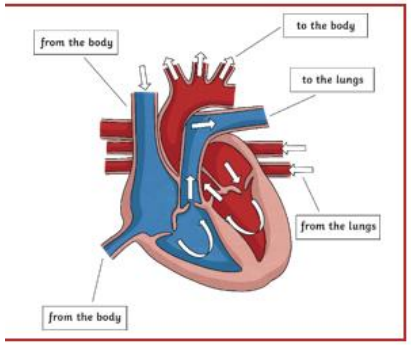
Arteries carry blood **a**way - they both start with the letter '**A**'.
Ve**in**s carry blood **in**to the heart - 'veins' and 'into' both have the word '**in**' hidden in them!

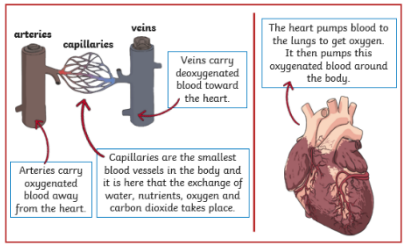
Children should use an IPAD to look at the AR clip of the heart on this link: Augmented Reality Heart Link

Children could also be shown the short video clip on the circulatory system at this point: how-our-circulatory-system-keeps-us-alive

Children should be made aware that their hearts are roughly the same size as their clenched fist and should compare a discuss this with each other and adults.

Children should complete a labelling activity on the heart and where the blood comes from and is sent to:





3. **I can describe the differences between arteries, capillaries, and veins. I can discuss the four parts that blood is made up from. I can explain why blood is oxygenated and deoxygenated.**

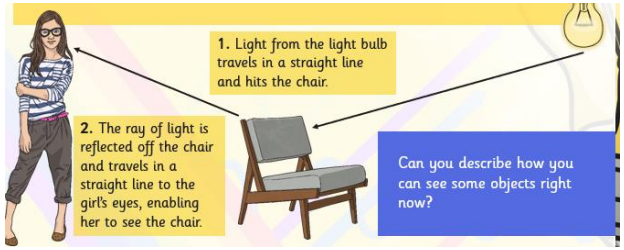
The Heart

1. **KWL, Mind-map or other 'what I know now' activity starter.**

2. **I can demonstrate that light travels in a straight line. I can create a model to show how light travels from a light source to our eyes, or to an object and then our eyes. I can explain how we see things.**

Light is a type of energy known as electromagnetic radiation. It is made up of photons, little particles of energy. Light travels as a wave. But unlike waves of water, or sound waves, it does not need any medium to travel through. This means light can travel through a vacuum - a completely airless space. Light waves travel out from sources of light in straight lines. These lines are often called rays or beams of light.

Rays of light travel from a light source and hit objects around us.
The rays of light reflect, or bounce, off an object, and then travel into our eyes.
This reflection of light allows us to see the object.



Children work with collaboratively to create a human model to show how light enables us to see things. The children use yellow wool as the ray of light – remind them that it should always go in a straight line!
One group member acts as the light source, and one member acting as an object, children show how the ray of light travels to the other group members' eyes.
Encourage the children to demonstrate these models to the rest of the class. Do they agree with the way they have demonstrated how we see? This provides the children with an opportunity to odentify and correct misconceptions from peers.

3. **I can explain how light is reflected. I can measure the angles of incidence and reflection. I can use my understanding of reflection to create a working**

The hearts pumps blood to the lungs to get oxygen (blue on the diagram to show that it is deoxygenated).

The heart then pumps this oxygenated blood around the body (red on the diagram to show that it is oxygenated).

The heart is split into the left and right side and consists of four chambers.

The air we breathe contains a very important gas, oxygen, that all of the cells in our body need for us to stay alive.

Animals need lots of things to survive. Oxygen, water and food are very important. But how are these things moved around our body?

Blood

Blood is very important. It moves oxygen and the nutrients from food and water to where they are needed in the body. Blood also transports the waste products to the lungs and kidneys to be removed from the body.

Blood is made up of four parts:

I. The liquid part of blood contains water and protein. This is called **plasma**. Plasma is a liquid and the other parts are solid.
II. **Red blood cells** carry oxygen through your body.
III. **White blood cells** fight infections when you are sick
IV. **Platelets** help you stop bleeding when you get a cut or graze.

Arteries take blood away from the heart to the organs and other body tissues. Arteries have a narrow internal diameter and thick muscular walls. This allows them to carry blood that is at a **high pressure**.

Capillaries are tiny, thin-walled vessels that form a network to take blood through the organs and other body tissues. The dense networks of capillaries present a large surface area, which allows materials to be exchanged between body cells and the blood rapidly. Oxygen and dissolved foods diffuse into body cells from the blood, and carbon dioxide and other waste products diffuse out of body cells into the blood.

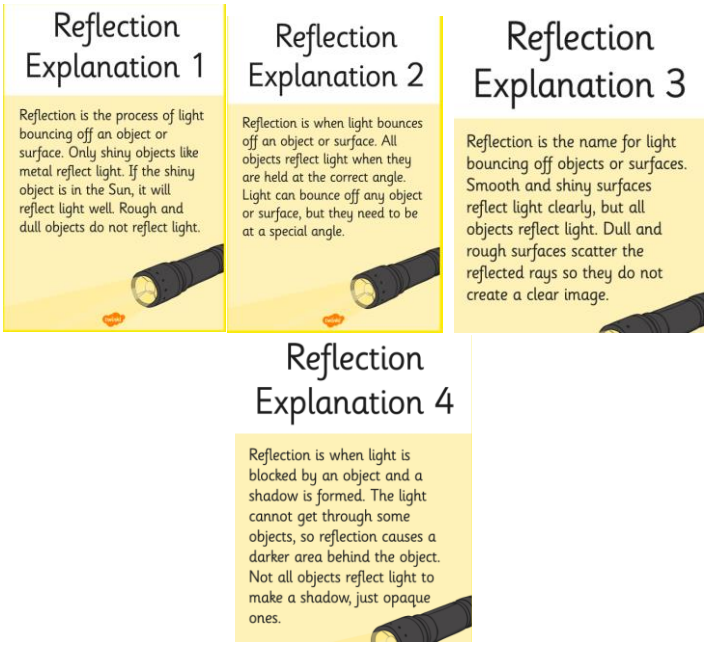
Veins carry blood under **low pressure** from the capillaries and return the blood to the heart. The vein walls have thinner muscular walls than arteries and have a wider internal diameter. Veins contain valves to prevent the backflow of low-pressure blood.

4. I can make a prediction about the effect of exercise on heart rate. I can carry out an investigation to look at how exercise affects heart rate. I can draw a conclusion from my results.

Finding your pulse

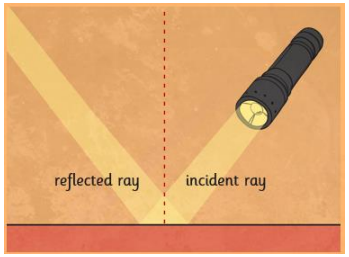
Heart rate, also called pulse, is the number of times your heart beats per minute.

periscope. I can explain how the periscope allows me to see objects I would not usually be able to see.



Start this session with these explanation cards on display around the room – ask the children to read and choose the explanation they think is correct. Discuss misconceptions…

How is light reflected?



Reflection is when light bounces off a surface, changing the direction of a ray of light. All objects reflect light; smooth and shiny surface reflect all the rays of light at the same angle, rather than scattering the rays of light like rough or dull surfaces. The light ray that hits the mirror or other object is described as the incident ray, and the ray of light that bounces off is known as the reflected ray.

From the last lesson, we know that the heart pumps blood around the body. Our pulse is the flow of the blood that can be felt at specific parts of our body where arteries are closer to the skin's surface.

Two of the easiest places to feel your pulse are on your neck and on your wrist.

a) In your neck

Gently press your first and second fingertips into one of the soft grooves on either side of the windpipe - the tube down the centre of your neck. When you have found the correct position, you should feel your heartbeat.

b) **In your wrist**

Turn one hand over, so that your palm is facing upwards.

Using your other hand, place the first and second fingertips gently in the groove and on the arteries, down from the base of the thumb. When you have found the correct position, you should feel your heartbeat.

The heart pumps blood around the body to get nutrients and oxygen to every cell. Your heart rate changes to suit your body's need for oxygen and nutrients and is adjusted when you exercise or when you are sleeping, for example.

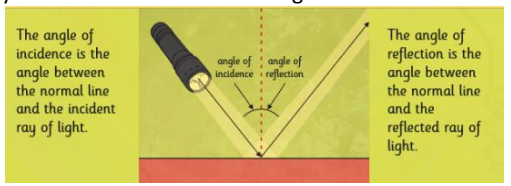
WS INVESTIGATION

Children to work collaboratively to plan and carry out an investigation into heart rate and exercise. Children need to start with a question and their initial prediction, before developing a methodology and identifying appropriate equipment needed. Once completed, children should be encouraged to use data to draw conclusions, linking back to their investigation question and initial prediction. Remind them on important of trustworthy data…

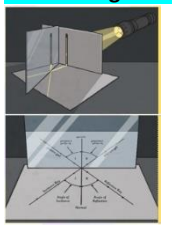
Scientists conduct lots of investigations which have a big impact on living things. For example, scientists conduct investigations that tell us what type of food humans should eat and what chemicals are safe to use on plants. Because we act on scientific data, we need to make sure that we have a high degree of trust in it before making our conclusions. This is particularly true if we are going to recommend that others act or behave in a particular way based on our results. When conducting their investigation, encourage children to think about the following:

- ***Be Objective:*** *Have you reported the results honestly? Have you included all the results even when they did not match your prediction? Did you have a control group?*
- ***Accuracy:*** *Was your measuring equipment accurate?*
- *Reproducibility: Can your investigation be repeated? Have you repeated your results? Did you get the same or very similar results?*
- ***Consensus****: This does not mean that all the data must show the exact same results, but if the majority of other investigations show results that are the same or very similar then we can have a higher degree of trust in our results.*

When rays of light reflect, they obey the law of reflection: The angle of incidence always equals the angle of reflection. The red dashed line is called the 'normal' line. It is drawn at a right angle, or perpendicular to the reflector.



WS investigation: Angles of Incidence and Reflection



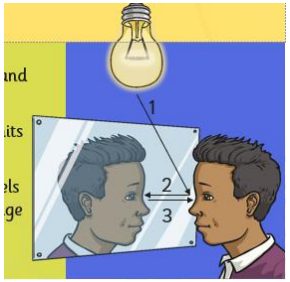
Children use modelling clay to stand a mirror up on a piece of white paper. They make a very narrow slit in a piece of card, dim the lights and shine a torch through the slit towards the mirror.

On the white paper, children look for the incident ray and the reflected ray of light. They may have to play around with the angle of the torch and the distance they hold it from the mirror. Teacher may need to demonstrate this to show the law working correctly.

The incident and reflected ray's angles should be equal as whenever light hits a surface it obeys this law.

Seeing Reflections

The law of reflection is what allows us to see an object reflected in a mirror.
Look at the way light travels to enable the boy to see his face reflected in the mirror:



(a) Light from the bulb hits the boy's face and bounces off.

(b) The light reflected from the boy's face hits the mirror.

(c) The light reflected from the mirror travels to the boy's eyes, so he can see the image of his face reflected in the mirror.

WS INVESTIGATION: Periscope investigation

Children use understanding of reflection and the angles of incidence and reflection to make a periscope.

Background Information on Periscopes

If your results are completely different to all the other data sets for similar investigations, then it is necessary to consider why that is.

- ***Sample Size**: this is how many were included in your investigation. The more data you have the more likely it is to show the 'real' picture.*

5. WS INVESTIGATION I can state the benefits of exercise. I can explain the importance of exercise and its impact on the body.

Exercise is very good for us**.**

It can:

A. Strengthen muscles, including the heart
B. Improve circulation
C. Increase the amount of oxygen around our body
D. Release brain chemicals which help us feel calm and relaxed
E. Help us sleep more easily
F. Strengthen our bones and prevent injuries.

Government experts tell us that young people aged 5 to 18 years old need to do two different types of exercise to stay healthy:

i. Aerobic exercise, such as running or star jumps
ii. Strength exercise, such as balances and gymnastic disciplines

Share the website link below with the children – they could research and feedback or discuss as a whole class.

NHS exercise guidelines for children

Children could take part in this 8-minute workout with Body Coach, Joe Wicks:
Joe Wicks 8 Minute workout Video

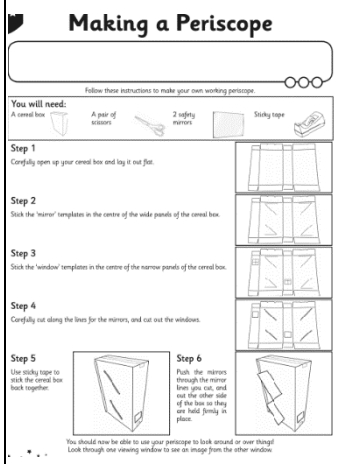
6. I can discuss what might make a lifestyle more healthy or less healthy. I can interpret information about the diet and activities of different people. I can explain why different people have different calorie requirements.

Energy from Food

Food and drink have many different nutrients depending on how they are grown, made and/or processed before we eat or drink them. All food and drink contain calories. A calorie is the unit measurement of how much energy is in a certain food or drink.

Government guidelines tell us that:
An average man needs around 2500kcal a day to maintain a healthy body.
For an average woman, that figure is around 2000kcal a day.
These values can vary depending on age, size and levels of physical activity, among other factors.

Elicit and address this possible misconception from real world contexts:



A periscope is a device for seeing over or around something.

Periscopes were first used by sailors in around 1860, who used them in submarines to see above the surface of the water. They were also used by soldiers in the First World War, to see over the top of their trenches. They are still used today by tanks and some submarines.

A simple periscope is a tube with a mirror at either end. The mirrors need to be positioned so that the light is reflected from the mirror at one end, down the tube to the other mirror, then out of the tube to the observer's eyes.

Children use the instructions and research to create their own periscope in pairs/small groups (depending on the number of mirrors available).

4. I can understand how light is refracted. I can investigate the effects of refraction. I can understand the way refraction alters the direction of light.

This photo shows the effect created when light is refracted.

Refraction is when light bends when it travels from one medium to another medium. Refraction is caused by a change in the speed of a wave of light when it moves from one medium to another.

When light hits a denser medium it slows down, when it hits a less dense medium it speeds up – articulate this using the analogy of riding a bike moving from a road surface to a beach – you would slow down when crossing to the beach.

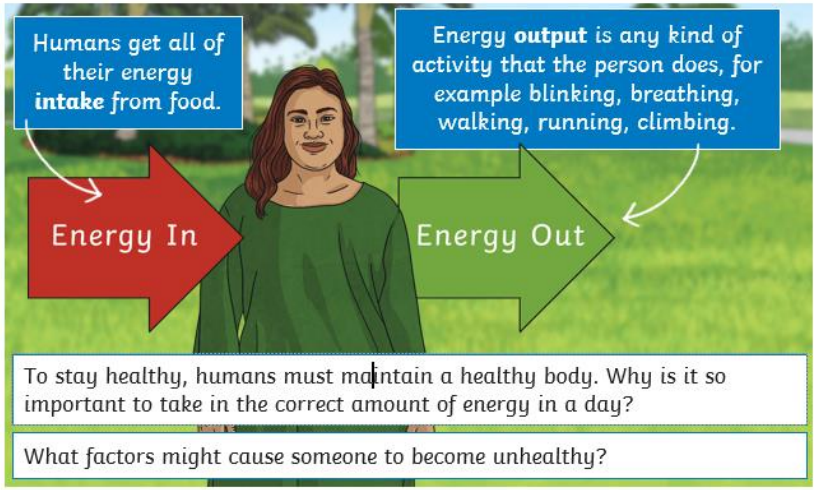
In most cases, when light waves speed up or slow down, they change direction.

Share the video link below to show the children this. You may be able to repeat one or more of the demonstrations in class, using torches and lenses.

Understanding Refraction - YouTube

Light waves travel at a different speed when they go through other transparent materials, such as water or glass. This causes the rays of light to change direction and bend. This is known as **refraction.**

Confusingly, a kilocalorie is another word for what is commonly called a calorie, so 1000 **calories** will be written as 1000**kcal**.



We do not all need to eat the same number of calories as each other.
People have different lifestyles; some people are very active and children and young people are still growing, so that can affect the number of calories needed too!
Older people need fewer calories because their body processes need less energy. They still need the same nutrients though, so picking healthy foods that have lots of goodness in them is still very important.

7. **I can explain how drugs and alcohol can affect the body. I can describe the impact of drugs and alcohol on the circulatory system. I can give my opinion about whether the government guidance on drugs and alcohol is suitable.**

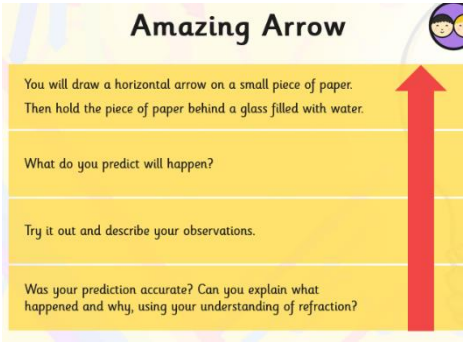
Review of last session:
Why would the 12-year-old girl and the 70-year-old man have different calorie requirements? Discuss this in small groups and feedback. Address any misconceptions before beginning today's session of learning.

A drug is any substance that influences your body when it enters your system. Drugs contain chemicals which can either be human-made or from natural sources.

Refraction creates illusions. Because light bends when it travels between air and water or glass, objects seen through these materials look bent or distorted.

WS INVESTIGATION: Refraction Investigation Opportunity

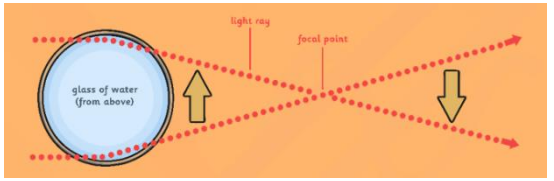
a) Amazing Arrow



b) Incredible Images

Children draw a small picture on a piece of paper - a smiley face or star, for example. Then, place an empty glass over the top of the picture and look at the image through the side of the glass.
As children watch their picture, they should slowly fill the glass with water.
When the glass is full, children should cover the top of the glass with a saucer.

What Happened?
Amazing Arrow
In this investigation, when you place your arrow at a certain distance behind the glass of water, it appears to point in the opposite direction. The arrow turns because the light travelled from the air, through the glass, through the water, through the back of the glass, and then back through the air, before hitting the arrow. When light passes from air through a transparent material, it refracts, causing it to bend.
Because the glass is curved, it also acts a lens, focusing the rays of light. Where the light all comes together is called the focal point, but beyond the focal point the image appears to reverse. The rays of light that were bent cross each other, so that the light from the left of the arrow is now on the right, and light from the right of the arrow is now on the left. This is what causes the arrow to appear reversed.



Do you know any drugs that would be considered legal?

Legal drugs include medicines like cough syrup and substances like caffeine, which is found in tea, coffee and even chocolate!
If used properly, these substances are not considered harmful and don't have serious negative **side effects**. However, even drugs you can buy in shops can be dangerous if you take too much.

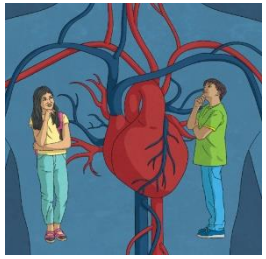
A **side effect** is any effect that is not the main intended effect of the drug. This can be either positive or negative.

Prescription Drugs
Some medicines, for example sleeping tablets, contain substances which could become addictive.

Certain drugs should not be taken at the same time as they could have serious side effects, so a doctor needs to check a patient's records. Therefore, you should never take medication that has been prescribed for anyone else.

- Prescription drugs can have serious side effects.
- Prescription drugs may not be suitable for some people, such as children or pregnant women.
- Medicines may not work or may cause harm if they are not taken at the correct dose.

The Circulatory System

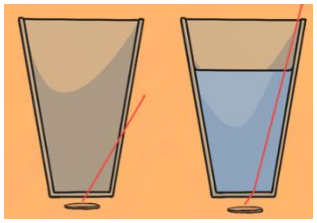


The circulatory system is a system which includes the heart, blood vessels and blood transporting substances around the body.

Drugs can have a positive or negative effect on our bodies, including the circulatory system.

Drugs and the Circulatory System
Smoking Cigarettes

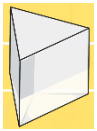
Incredible Images
When you filled the glass with water and placed a saucer on top, the image seemed to have disappeared. Light rays falling on the image are refracted through the glass, then the water, then back into the air. When the refracted rays are bent at different angles by adding the water, it means they can be blocked by the saucer on top of the glass.
Since the rays of light cannot get through the saucer, they cannot reach our eyes and we cannot see the image. It seems to have disappeared!



5. I can understand how a prism affects a ray of light. I can explain what this tells us about the visible spectrum.

What Colour Is Light?
Ask children to stand next to the coloured card they think represents the colour of light – have them displayed around the room. Do they all agree? Discuss and make a class discussion 'board' of ideas and reasoning.

Isaac Newton and Light
In 1666, Newton made a discovery about light that led him to develop his Theory of Colour, a theory that still informs our understanding of light today. He placed a prism in front of ray of light, and his observations were incredible!



A prism is a solid shape whose 2 ends are the same size and shape. Isaac Newton used a transparent triangular prism in his investigation. Ask children what they remember about what happens to light when it travels between air and a transparent material.

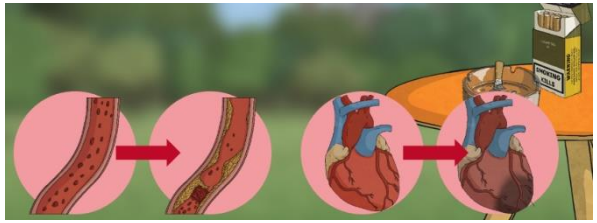
When light travels from air through a transparent material, it **refracts**, or bends.
This is an important fact, as it is this refraction that caused the amazing effects that Newton observed.

Children experiment with Newton's theory; shine a torch through a transparent prism and hold a piece of white card in front of the refracted ray of light as it leaves the prism.
Can they see what Newton observed?

The children should have seen a rainbow of colours form on the white card. These colours are known as the **'Visible Spectrum'**.

This is what Isaac Newton observed, and it made him realise that although light looks white, it is made up of all the colours of the rainbow!

Cigarettes contain a drug called nicotine which is very addictive. There are lots of harmful chemicals in a cigarette. These chemicals make our body form something called plaque inside our blood vessels. Coronary heart disease can occur when blood vessels that carry blood to the heart muscle are narrowed by plaque or blocked by clots. Chemicals in cigarettes can cause the blood to thicken. This thickened blood and narrowing of vessels can form clots inside veins and arteries and an increase in blood pressure. Smokers are also at risk from an increased heart rate and possible irregular heartbeat.

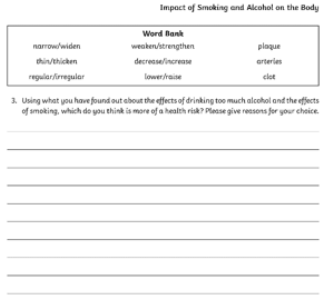


Smoking E-Cigarettes

In theory, e-cigarettes are less harmful than normal cigarettes as they don't contain the same harmful chemicals. However, people who smoke e-cigarettes (or 'vape') are still inhaling nicotine so they would still suffer the health problems associated with this. Also, the effects of smoking nicotine in this way are not yet known, so it may not be less damaging to the body after all.

Alcohol

Alcohol can certainly affect our body. You might know it can harm the liver, but did you know it can even harm the heart? At the time of drinking, alcohol causes a temporary increase in heart rate and blood pressure. Over time, drinking heavily can lead to a long-term increased heart rate, higher blood pressure, weakened heart muscle and irregular heartbeat.

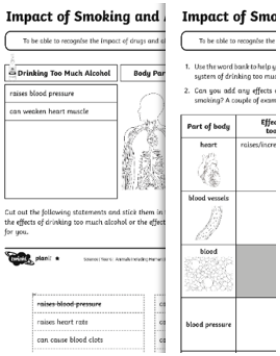

Impact of Smoking and Alcohol on the Body

Word Bank

narrow/widen	weaken/strengthen	plaque
thin/thicken	decrease/increase	arteries
regular/irregular	lower/raise	clot

3. Using what you have found out about the effects of drinking too much alcohol and the effects of smoking, which do you think is more of a health risk? Please give reasons for your choice.

Children complete the Impact of Smoking and Alcohol on the Body Activity Sheet.


Impact of Smoking and

Drinking Too Much Alcohol

raises blood pressure

can weaken heart muscle

Impact of Smo

Part of body

heart

blood vessels

blood

blood pressure

raises blood pressure

raises heart rate

can cause blood clots

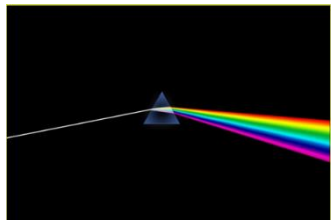
When these colours merge, it looks white to our eyes. But we can use a prism to separate the different colours of the spectrum, as the children have just demonstrated.

This happens because each colour within a ray of light has a **different wavelength**. **Red has the longest wavelength**, and **violet has the shortest**.

When a ray of light travels from air through a transparent material, it refracts.

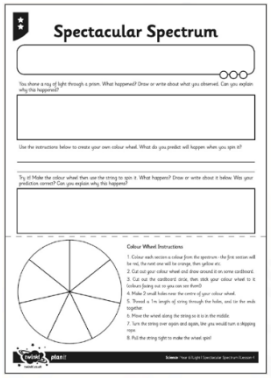
Since each colour's wavelength is slightly different, the colours in the ray of light bend slightly differently. This causes them to separate and become visible to our eyes.

Red bends the least, and violet bends the most.



Rainbow Colours

They are red, orange, yellow, green, blue, indigo and violet.


Spectacular Spectrum

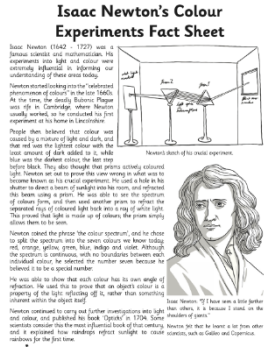
A colour wheel can be used to show the colours of the spectrum that Newton discovered.

Children make their own colour wheel by following the instructions on the Spectacular Spectrum Activity Sheet.

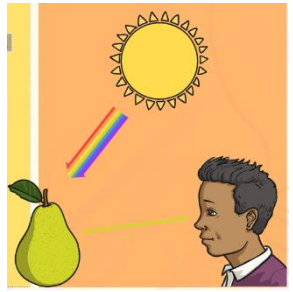
After completing this sheet, refer back to the start of the session – would the children change their mind on their original answer for the colour of light?

5. **I can explain what Isaac Newton discovered about colour. I can investigate and understand how light enables us to see colours.**

WS INVESTIGATION: What did Isaac Newton learn about light? Share some facts about Isaac Newton using the research fact sheet shown and/or the children researching themselves (ensure their research focuses on Newton's work on light).


Isaac Newton's Colour Experiments Fact Sheet

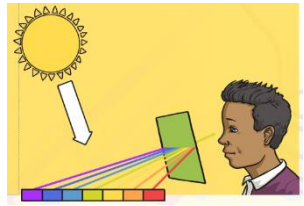
8. **Refer to initial KWL grid from lesson 1 and expand with knowledge learnt and retained. Make links to real world context.**



As the children found out in the last lesson, white light is actually made up of all the colours of the rainbow. This is called the **'visible spectrum'.** When a ray of white light shines on an object, the object absorbs some colours and reflects others. **A pear reflects the green light and absorbs the other colours of light**.
It is only the green light that bounces back into our eye.
The pear looks green to our eyes!

Blue objects absorb all colours of light but blue, which they reflect.
Red objects absorb all colours of light but red, which they reflect.
White objects reflect all the colours of light.
Black objects absorb all the colours of light.

Filtering Light
A filter only allows certain colours of light through. For example, a green filter allows green light through, but absorbs the other colours.



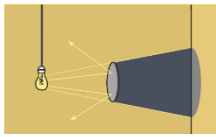
So, if you look at a green pear through a green filter, it will still look green, because the green light will get through the filter to your eyes.

But if you look at it through a red filter, it will look black, because there is no red light reflecting off the pear, and the green light that is reflecting off it will be absorbed by the filter.

6. **I can explain how a shadow is formed. I can explain why shadows are the same shape as the object that casts them.**

Shadows
Shadows are formed when an opaque object blocks a ray of light. A shadow can change size depending on the distance the object casting it is from the light source. Shadows can also be elongated or shortened depending on the angle of the light source.

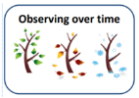
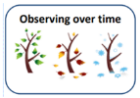
However, a shadow is always the same shape as the object that casts it. This is because when an object is in the path of light travelling from a light source, it will block the light rays that hit it, while the rest of the light can continue travelling. Therefore, the shadow it casts is the same shape.



There is an opportunity for children to use the knowledge of shadows to create simple shadow puppets and a 'shadow puppet' performance at this point.

		7. Refer to initial KWL grid from lesson 1 and expand with knowledge learnt and retained. Make links to real world context.
Vocabulary	As previous plus: • internal organs • heart • lungs • liver • kidney • brain • skeletal • skeleton • muscle • muscular • digest • digestion • digestive • circulatory system • heart • blood vessels • blood • impact • diet • exercise • drugs • lifestyle • nutrients • water • damage • drugs • alcohol • substances	As previous plus: • Evolution • Adaptation • Inherited traits • Adaptive traits • Natural selection • Inheritance • Charles Darwin • DNA • Genes • Variation • Parent • Offspring • Fossil / Fossilisation • Environment • Habitat • Plants • Animals • Living things • Palaeontologist s • Mary Anning • Alfred Wallace • Charles Darwin

Year 6 Summer Term

	Summer 1st Half	Summer 2nd Half
Science (All NC subject content covered)	**Living Things and their Habitats** **Pupils should be taught to:** • describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals • give reasons for classifying plants and animals based on specific characteristics **Working Scientifically (WS):** During year 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, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar, and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.	**Researching Real Life Scientists**   
WS opportunities	  How many ways can I sort these living things?   What affects the speed of mould growth?  .	    
Key questions / knowledge and understanding to be explained Key Knowledge and facts to be recalled	1. **KWL, Mind-map or other 'what I know now' activity starter.** 2. **I can give reasons for classifying animals based on their similarities and differences.** Scientists believe that there could be as many as 10 million different species on Earth! It would be very hard to study the lives and behaviours of all these living things without grouping them together somehow. Scientists sort and group living things according to their similarities and differences. This is called classification. Scientists who classify living things are called taxonomists.	1. **Initial thoughts –** present children with a photograph of each scientist. Children to make notes on who **Initial thoughts** – present children with a photograph of each scientist. Children to make notes on who they think the people are and what they may do. Elicit that each is a scientist and explain their links to our science learning. 2. (a) Scientist 1 

Taxonomists classify living things by comparing them.

Look at the snacks on this table. How could we group them? Taxonomists would start by splitting them into two large groups. Can you think of two groups to use to split up the snacks?
There are several ways you could split these snacks into two groups.

Let's say they were split into 'Healthy' snacks and 'Unhealthy' snacks.
Now each group can be split into another two groups. Look at the 'Healthy' snacks. How could they be split into two smaller groups?

Again, there are several ways to split these snacks into two groups. They could be grouped into 'Fruits' and 'Vegetables'.

Now, the 'Vegetables' group can be split up into two smaller groups. They could be split into 'Roots' and 'Florets', or even 'Carrots' and 'Broccoli'.

This is how taxonomists classify living things. They group similar things together, then split the groups again and again so they become smaller and smaller. Each group allows scientists to observe and understand their similarities and differences more clearly.

WS Investigation: Classification Conundrum

Imagine that a new zoo is going to open in your local area. You have been asked to sort and group the animals that will live in the zoo, so that similar species can be housed in enclosures near one another.
You will act as a taxonomist, so it is up to you to decide how to classify the animals and give reasons for your classification.

Look at the animals on your Zoo Animals List and use the Zoo Classification Activity Sheet to sort and group the animals.

After completing this task in pairs or small groups, discuss the different ways children grouped and housed the animals. Ask children to articulate reasons for their classification and grouping and discuss the pros and cons for each decision.

Children will be learning that scientists (taxonomists) use standard methods for classification to ensure clarity across the world.

Stephen Hawking was born in Oxford on 8th January 1942. He grew up with his parents, his brother, and sisters. At school, Hawking enjoyed science and maths and he was nicknamed 'Einstein' by his friends. He wanted to study maths at the University of Oxford, but Oxford didn't offer a maths degree at that time. Instead, Hawking chose to study physics and chemistry. Hawking found the work at university very easy. He joined the college boat club and was known as a daredevil because of the risks he took when rowing the boats. After graduating from Oxford, Stephen Hawking studied for his PhD at the University of Cambridge.

It was at Cambridge that Stephen Hawking first became aware of problems with this health. He noticed that he was regularly falling and dropping things. His speech became slurred and hard to understand. Doctors diagnosed Hawking with Amyotrophic Lateral Sclerosis, or ALS, when he was 21 years old. He was given just two years to live. However, his disease progressed more slowly than doctors had predicted, and he returned to his studies. ***ALS: A motor neurone disease that causes muscle weakness, paralysis and respiratory failure. It is a degenerative disease, which means it gets worse over time. There is no cure.**

Stephen Hawking faced many challenges in his time but showed a positive attitude, a love for life and a passion for learning. He used a wheelchair to move around and a computer with a voice synthesizer to talk. His condition did continue to deteriorate, though, and this renowned scientist sadly died on 14th March 2018, aged 76.

Stephen Hawking is remembered as one of the greatest scientists that ever lived. His theories, such as those concerning black holes, have changed the way we understand the universe. His many books have helped millions to understand difficult scientific concepts and he has inspired people around the world with his passion for science and his ability to overcome difficulties.

Stephen Hawking developed theories about how black holes are formed, how they behave and where they can be found in the universe. This is one of his theories:

2. (b) Scientist 2

Libbie Hyman was born on 6th December 1888, in Iowa, USA. She was a zoologist who researched vertebrates and invertebrates. Her father was originally from Poland and her mother was from Germany; they were Jewish immigrants. Young Libbie was interested in nature and collected moths and butterflies. She learned scientific names for flowers from her brothers' textbooks. Interested in botany (plants), Libbie was put off by the antisemitic harassment (anti-Jewish bullying) that she encountered from a laboratory assistant in the Botany department. She studied zoology instead.

After graduating, Libbie's mother still required her daughter to take care of the house for her and her brothers. Her mother disapproved of Hyman's scientific career. While she was working at the university, Hyman found that the textbooks used by the students were not accurate or comprehensive enough, so she decided to write her own reference guide.

She published highly detailed volumes of work about the characteristics and the taxonomy of invertebrates. By 1930, Hyman realised she could live on the royalties from the sale of her book on vertebrates. Her mother had died in 1929, so she had no ties to Chicago and so she travelled to Europe.

3. I can describe who Carl Linnaeus was. I can explain how living things are classified using the Linnaean system. I can classify living things using the Linnaean system.

Scientists need to use a standard recognised method for classifying living things. A standard system is useful because it allows scientists to accurately identify, group and properly name animals. Without a standard system, living things could be classified and named differently by different scientists.

Carl Linnaeus

Carl Linnaeus was a Swedish scientist who believed it was very important to have a standard system of classification. At the time he was alive, in the 1700s, there was no agreed standard method. Linnaeus collected and examined over 40,000 specimens of plants, animals and shells. In 1735, he published his first edition of 'Systema Naturae', which described his system for classifying living things. Over the next several years, Linnaeus continued to publish new editions of 'Systema Naturae' that included more species of living things. His tenth edition was published in 1758 and is the most important edition.

Linnaeus' original system of classification classified everything in nature into a hierarchy.

He proposed that there were three large groups, called kingdoms, into which the whole of nature could fit. These kingdoms were plants, animals, and minerals. He then split each kingdom into smaller and smaller groups, or levels.

Today, the Linnaean system is only used to classify living things, so it does not include minerals. Furthermore, as new living things have been discovered, scientists have had to add additional levels in the hierarchy. A new level above kingdom, called domain, has also been introduced.

The Linnaean System

Living things can be classified by following the levels in this system. The number of living things in each group gets smaller and smaller, until there will just be one type of animal in the species group.

There are 3 domains: Archaea, Bacteria and Eukarya. Plants and animals are all eukaryotes.

There are 6 kingdoms, including animals, plants, fungi and bacteria.

The 6 kingdoms are then split into phyla. There are more than 30 phyla in the animal kingdom. Phylum chordata includes all vertebrates.

Each phyla is divided into classes. The chordata phylum includes amphibians, birds, mammals, reptiles and fish.

In 1967, at the age of 78, Hyman published her sixth and final volume of The Invertebrates. She died on 3rd August, 1969.

Her work is widely regarded as an incredible achievement and is extremely important and useful for the study of different animals. She described the anatomy and characteristics of different vertebrates and invertebrates and explained how they should be classified. The books that she wrote are still used by scientists today.

2. (c) Scientist 3

Steve Jobs was born on 24th February 1955 and died on 5th October 2011.

Steve Jobs was born in San Francisco, California in 1955. He was adopted by Paul and Clara Jobs. As a child, Steve enjoyed working on electronics with his father. They liked to take radios and televisions apart to try to put them back together.

Steve was a clever student, but often got into trouble at school. He made friends with other students who were interested in engineering and electronics like he was. When he was 13, he became friends with Steve Wozniak. Wozniak was especially good at electronics.

First Inventions

In the early 1970s, Jobs was making video games for a computer company called Atari. He was still friends with Steve Wozniak. In 1976, Wozniak showed Jobs a personal computer he had invented. Jobs said that they should set up a company together to make and sell computers. They called their company Apple Computers, and began making computers in Jobs' garage when Jobs was just 21. Together, they invented the Apple I and Apple II computers. The Apple II was a very successful product and by the time Jobs was 23, he was a millionaire.

Unfortunately, the next two Apple computers, the Apple III and the Apple Lisa, were not as successful. The Apple Macintosh computer was designed to improve things for the Apple company, and people were impressed with it. However, another computer company called IBM sold cheaper PCs, so Apple didn't sell as many of their computers as they hoped. Members of the Apple company were unhappy and had arguments. Steve Jobs resigned in 1985.

Other Ventures

After he left Apple, Jobs still wanted to work with technology. He started a company called NeXT computers and designed successful software systems. In 1986, Jobs bought a computer graphics company that he called Pixar. The first film produced by Pixar was Toy Story in 1991, and it was hugely popular. Pixar has gone on to produce other box office hits, such as 'Monsters, Inc.', 'Finding Nemo', 'Cars' and 'Up'.

Return to Apple

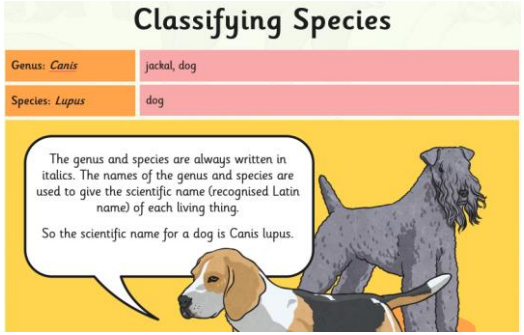
Jobs returned to Apple as the CEO (Chief Executive Officer) in 1997. Jobs saved the company from going bankrupt by introducing the iPod and iTunes music software. In 2007, Apple launched the iPhone, which changed mobile phones forever. The iPad was launched in 2010. Steve Jobs died in 2011 after being ill with cancer for a long time. He is remembered as a great inventor who always had new and exciting ideas.

The order and the family divide into further groups.
The genus includes species that are very closely related and share unique body structures.
A species is defined as a group of animals that can reproduce to produce fertile offspring.

Classifying Species

Here you can see how a species can be classified at each level of the standard system.

Domain: Eukarya	jackal, clownfish, cat, dog, ladybird, daisy, rabbit, fox, human
Kingdom: Animals	jackal, clownfish, cat, dog, ladybird, rabbit, fox, human
Phylum: Chordata	jackal, clownfish, cat, dog, rabbit, fox, human
Class: Mammals	jackal, cat, dog, rabbit, fox, human
Order: Carnivora	jackal, cat, dog, fox
Family: Canidae	jackal, dog, fox
Genus: *Canis*	jackal, dog
Species: *Lupus*	dog



4. I can identify the characteristics of different types of animals. I can classify a creature based on its characteristics.

Each group of animals is defined by a set of characteristics. The animals in a particular group share similar characteristics and are different to the animals in other groups.

New creatures

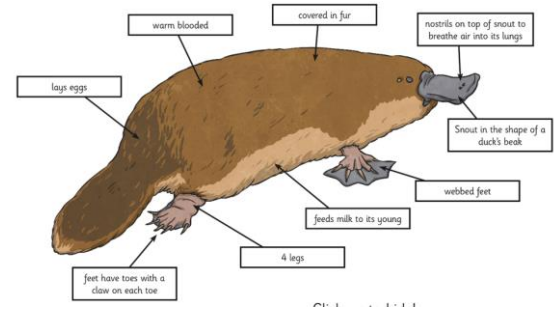
When a new species of animal is discovered, taxonomists observe its characteristics to decide how to classify it. However, some animals are so unusual that taxonomists struggle to classify them.

The platypus was discovered in 1797, and scientists around the world joined the attempt to classify this unusual animal. It seemed to have characteristics from several different types of animals!

3. (a) Preparing to present - what have we found out? What surprised you? Each pair of children given one of the five scientists to develop their knowledge into an oral presentation.

3. (b) Presenting our findings – children present their research to another pair of children in class.

4. What have we learnt about each scientist? How is their research linked? What do we know now that we didn't know in lesson 1?



Children then use the platypus as inspiration to create their own unique animal and work on classifying it.

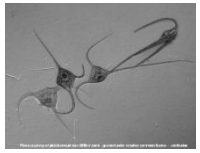
5. **I can identify types of microorganism. I can describe helpful and harmful microorganisms. I can investigate harmful microorganisms.**

What are microorganisms?

Microorganisms are very tiny living things. They are so small that they are not visible to the naked eye, so a microscope is needed to see them. Microorganisms can be found all around us. They can live on and in our bodies, in the air, in water and on the objects around us. They can be found in almost every habitat on Earth.

Some animals and plants are microorganisms. Examples include dust mites and plankton.

A magnified image of a household dust mite.

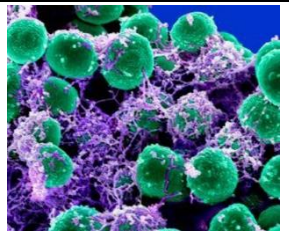


Plankton are microscopic organisms drifting in fresh or sea water, including plants and animals.

Other microorganisms are fungi, such as mould, yeast and Penicillium.

Mould is the common word for any fungus that grows on food or other materials.
Penicillium fungus is used to make the antibiotic penicillin.
Yeast is a microscopic fungus that can be used to raise bread dough.

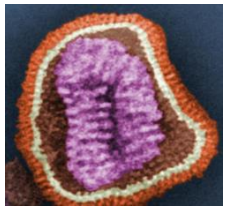
Bacteria are single-celled microorganisms. Bacteria are found in diverse habitats all over the Earth.



This image was produced by a scanning electron microscope. It shows a clump of staphylococcus epidermidis bacteria that is typically found growing on human skin, usually harmlessly.

Sometimes viruses are called microorganisms, but they are not really alive. They are infectious agents that can replicate only inside the cells of living things. Scientists disagree on whether or not to call viruses microorganisms. In this lesson we will consider them to be unusual microorganisms.

This image is a scanning electron micrograph of an influenza virus particle. This microorganism could cause you to have the flu.



Helpful or Harmful?
Some microorganisms can be helpful in certain situations. Others can be harmful, and their spread needs to be controlled or contained.

Helpful
Bacteria are used to ferment milk as part of the cheese making process.
Yeast ferments the carbohydrates found in grapes to make alcoholic wine.
Yoghurt is made using milk that has been soured by bacteria.
Yeast is added to bread dough to make it rise.
Microorganisms feed on leaves, plants and other matter, decomposing it and creating compost.
Antibiotics are used to kill bacteria that cause infections. They are created from fungi such as Penicillium.

Harmful
Harmful microorganisms are often called **germs**.
Food poisoning can be caused by bacteria that grow on uncooked or undercooked food.
Chicken pox is caused by a virus. It spreads very easily.
The influenza virus causes flu symptoms, such as a headache and fever.
Covid-19 could be mentioned here too!
Athlete's foot is caused by a fungus that grows between the toes.
Plaque on our teeth is formed when bacteria in the mouth combine with small food particles.
The fungi that grow on food are called moulds. Mould can make you ill if you eat it.

WS INVESTIGATION: What makes mould grow?

Mould is the name for the types of fungi that grow on food, but what makes mould grow?
It is useful to know what makes mould grow so that we can stop it happening as fast and keep our food fresher for longer.
Children work with a partner to investigate the conditions which cause mould to grow. They will use 2 slices of bread and 2 clear plastic bags. Place each slice of bread in a plastic bag, then change the conditions that each slice of bread is exposed to over a week. For example, they may put one slice of bread in the light and one in the dark. Or one may go in the fridge and the other over a radiator. Or they may choose to dampen one slice of bread before putting it in the bag, while leaving the other dry.


Mould Investigation

6. I can draw conclusions from my results. I can describe and compare the structure of different cells. I can describe the characteristics of different microorganisms. I can design a microorganism using these characteristics.

WS INVESTIGATION: What makes mould grow? CONCLUSION
In the last lesson the children set up an investigation to find out which conditions cause mould to grow.
They have been observing their slices of bread and recording results over the last week or two.
Now it is time to use the results to form their conclusion.
*****Children will collect their slices of bread but must not open the sealed bags*****

Get the children to observe their slices of bread again and look at their results table.
Use the following questions to promote scientific discussion amongst the group:

Do you notice anything about the different slices of bread?
Did mould appear earlier on one of the slices?
Is there more mould growing on one of the slices?

Ask the children to think about what this tells them. Can they use the results to answer their initial investigation question?

Children then complete the Mould Investigation Conclusions Activity Sheet.


Conclusion

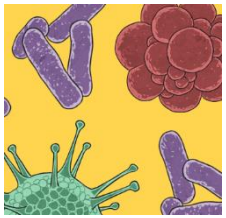
The children's investigation allowed them to test only one condition. For example, they may have found that mould grows well in damp conditions.
However, there are many more conditions that will cause mould to grow. Ask children to move around the classroom to talk to other pairs to find out what these conditions are.

Mould is a fungus, which is just one type of microorganism. All microorganisms share similarities and differences and can be classified using the Linnaean taxonomic system. Can children recall any of the levels of this classification system?

All living things are initially grouped into 3 domains: archaea, bacteria and eukaryotes.
The living things in the archaea and bacteria domains are collectively known as the prokaryotes.
Fungi, plants and animals are all eukaryotic kingdoms. Eukaryotic microorganisms include mould and yeast, as well as microscopic animals and plants such as dust mites or plankton.
Bacteria are prokaryotic microorganisms.
Viruses are not classified using the standard classification system.

Different Cells

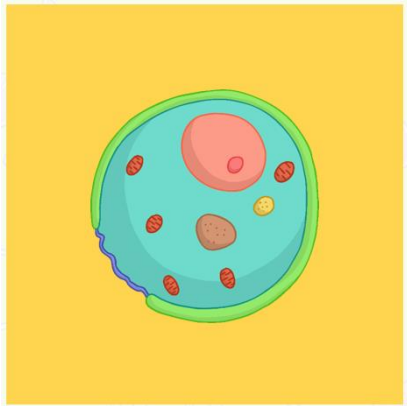
What is the difference between eukaryotic microorganisms and prokaryotic microorganisms?



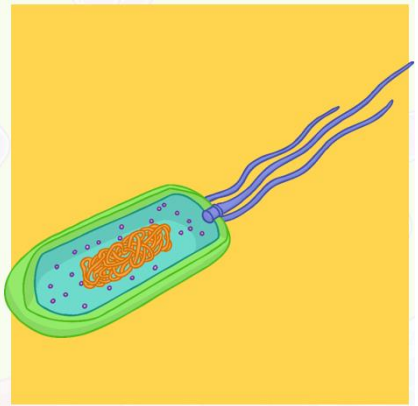
The main difference between the two types of organisms is the structure of their cells.
Cells are the building blocks of an organism. Many microorganisms are made of just one single cell. It may help you to think of cells as small compartments that contain the things needed to keep an organism alive.

Eukaryotic cells, such as the mould cells on your bread, contain smaller parts called organelles. A very important organelle in eukaryote cells is the nucleus. It acts as the control centre of the cell and includes all the genetic information of the cell, which is known as its DNA. The DNA is organised inside the nucleus.
Prokaryotic cells such as bacteria do not usually contain any organelles. They do not have a nucleus and their DNA is not organised or contained within any structure in the cell.

Identifying Cells



This cell is a Prokaryotic cell.



This cell is a Eukaryotic cell.

	The Eukaryotic cell has a more organised structure, containing the nucleus in the organelles. **Make a microorganism** Children use playdough to design their own single-celled microorganism. Use a petri petri dish to hold the sculpted cell. Encourage children to think about which type of microorganism it will be. Will it be eukaryotic (fungi, animals and plants) or prokaryotic (bacteria)? Perhaps it will be a fungus, with a nucleus containing its DNA. Or maybe it will be a bacterium, with its DNA free within the cell. Children complete the Make a Microorganism Activity Sheet with the name of their microorganism, its classification and any other information including its uses or effects. **7. Refer to initial KWL grid from lesson 1 and expand with knowledge learnt and retained. Make links to real world context.**	
Vocabulary	As previous plus: • classify • compare • Linnaean • Carl Linnaeus • Classification • Domain • Kingdom • Phylum • Class • Order • Family • Genus • Species • Characteristic s • Microorganism • Organism	Stephen Hawking Black Holes Libbie Hyman Invertebrates, Classification Steve Jobs Technology, Apple, iPad