Year 6 - Animals including humans - LIFE

National Curriculum objectives

- 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.

Notes and guidance

- build on their learning about the main body parts and internal organs (Y3, Y4) (skeletal, muscular and digestive system) to explore and answer questions that help them to understand how the circulatory system enables the body to function.
- learn how to keep their bodies healthy and how their bodies might be damaged - including how some drugs and other substances can be harmful to the human body.

Sticky knowledge

- The heart pumps blood around the body.
- Oxygen is breathed into the lungs where it is absorbed by the blood.
- Muscles need oxygen to release energy from food to do work. (Oxygen is taken into the blood in the lungs; the heart pumps the blood through blood vessels to the muscles; the muscles take oxygen and nutrients from the blood.)

The heart pumps blood in the blood vessels around to the lungs. Oxygen goes into the blood and carbon dioxide is removed. The blood goes back to the heart and is then pumped around the body. Nutrients, water and oxygen are transported in the blood to the muscles and other parts of the body where they are needed. As they are used, they produce carbon dioxide and other waste products. Carbon dioxide is carried by the blood back to the heart and then the cycle starts again as it is transported back to the lungs to be removed from the body. This is the human circulatory system. Diet, exercise, drugs and lifestyle have an impact on the way our bodies function. They can affect how well out heart and lungs work, how likely we are to suffer from conditions such as diabetes, how clearly we think, and generally how fit and well we feel. Some conditions are caused by deficiencies in our diet e.g. lack of vitamins. This content is also included in PSHE.

Vocabulary

Heart, pulse, rate, pumps, blood, blood vessels, transported, lungs, oxygen, carbon dioxide, nutrients, water, muscles, cycle, circulatory system, diet, exercise, drugs, lifestyle, oxygenated, deoxygenated, valve, respiration, artery, vein, pulmonary, alveoli, capillary, digestive, transport, gas exchange, villi, nutrients, alcohol, drugs, tobacco.

Key scientists

Justus von Liebig
(Theories of Nutrition and Metabolism)

Sir Richard Doll
(Linking Smoking and Health Problems)

Leonardo Da Vinci
(Anatomy)

Linked texts

Pig-Heart Boy (Malorie Blackman)

Skellig (David Almond)

A Heart Pumping Adventure (Heather Manley)

Prior Learning

- Describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene. (Y2 - Animals, including humans)
- Identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. (Y3 - Animals, including humans)
- Describe the simple functions of the basic parts of the digestive system in humans. (Y4 - Animals, including humans)
- Identify the different types of teeth in humans and their simple functions. (Y4 - Animals, including humans)

Future learning

- The consequences of imbalances in the diet, including obesity, starvation and deficiency diseases. (KS3)
- The effects of recreational drugs (including substance misuse) on behaviour, health and life processes. (KS3)
- The structure and functions of the gas exchange system in humans, including adaptations to function. (KS3)
- The mechanism of breathing to move air in and out of the lungs. (KS3)
- The impact of exercise, asthma and smoking on the human gas exchange system. (KS3)

Possible misconceptions

Some children may think:

- your heart is on the left side of your chest
- the heart makes blood
- the blood travels in one loop from the heart to the lungs and around the body
- when we exercise, our heart beats faster to work the muscles more
- some blood in our bodies is blue and some blood is red
- we just eat food for energy
- all fat is bad for you
- all dairy is good for you
- protein is good for you, so you can eat as much as you want
- foods only contain fat if you can see it
- all drugs are bad for you.

Enquiry						
Comparative and fair tests	Identify and classify	Observation over time	Pattern seeking	Research	Ideas over time	Key Questions
Which type of exercise has the greatest effect on our heart rate? How does the length of time we exercise for affect our heart rate? Can exercising regularly affect your lung capacity?	Which organs of the body make up the circulatory system, and where are they found?	How does my heart rate change over the day? How much exercise do I do in a week?	Is there a pattern between what we eat for breakfast and how fast we can run?	Is there a pattern between what we eat for breakfast and how fast we can run?	What ideas did Edward Jenner have about small pox and how did he test them?	• Why do we need oxygen? • How do we breathe? • Do fish and plants breathe? • Do all living things need oxygen? • How does the size of a person's lungs affect their lung capacity? • Are there ways to increase/decrease our lung capacity? Is lung capacity fixed? • Why do we have blood? • How does our heart work? • How does size of muscle affect our pulse rate? • How does exercise effect our pulse rate? • How might the circulatory system of an elephant, a hummingbird, or a polar bear differ? • Is the air you breathe out, the same as that you breathe in?
Use an increasingly wide range of equipment to make measurements. Learn what it means to measure accurately and check for reliability. Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make. Use the bar charts to draw conclusions about what they have found out to be the answer to their 'big question' Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. Plan their own tests to collect data. Through fair testing learn to understand the different types of variables: • the dependent variable that they will change in their test, • the independent variable that they are going to measure so that they can find out how the dependent variable affects it, • the control variables which the children will need to keep the same so that they don't affect their results. Measure and record data that can then be displayed in a scatter graph or line graph. Use their data to draw conclusions that identify a causal relationship eg 'when you increase X, Y will always decrease'. Throughout KS2, become progressively more systematic in how they approach fair tests and increasingly independent. Written conclusions to become increasingly sophisticated, with more focus on scientific explanations. Focus on their skills in evaluating their scientific enquiries. Learn to critique not just their experimental methods but also their data by reflecting on reliability and accuracy.	Regularly revisit KS1 skills: Focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. Increased focus on measuring and using data to answer 'big questions'. Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things.	Measuring time in seconds, minutes, hours and days but also measuring a variety of variables that they observe to change such as temperature, light levels, and sound levels. Record their observations in the form of scientific drawings and labelling key features using scientific vocabulary. Look closely and record fine details using magnifying glasses and microscopes. Make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.	Begin to think for themselves when deciding what they should measure and observe. Begin to make decisions about the most appropriate equipment to use to collect data. Begin to think even more about their planning, including identifying the variables that they cannot control and suggesting the potential impact those variables might have on the data they collect. Use a data logger to collect the most accurate data they can. Using data analysis techniques to spot patterns, including using tabulated data and a variety of charts and graphs. Use data and graphs to support their explanations when describing relationships. Use pattern seeking as a preliminary test; use their findings to form and justify their own predictions, then propose further investigations to test these predictions.	Reading for information and note-taking. Learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Use a range of secondary sources, including books, websites, and video to find their information. Listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters Find more data in their research and use this to help answer questions Start to collect their own data through questionnaires and interviews. Begin to evaluate the quality of the information they have found and how well it has enabled them to draw conclusions and answer their 'big question'.	Explore and talk about their own and other people's scientific ideas. Begin to recognise how scientific ideas change and develop over time. Use a range of secondary sources of information. Develop their use of scientific language. Explain ideas using their scientific knowledge and understanding. Evaluate the significance, strengths and weaknesses of different scientists'	

<table>
<tr><th>Linked TAPS Assessment</th><th>Additional TAPS ideas</th><th colspan="2">Working scientifically</th></tr>
<tr><td>Heart Rate Headstands
Can children plan a scientific enquiry to answer their question?
Can children explain their findings and consider the degree of trust in their results?
Can children make predictions based on their results?</td><td>Design an investigation about reactions when catching rulers.</td><td>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.</td><td>exploring the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health.</td></tr>
<tr><th colspan="2">Activities</th><th colspan="2">Possible Evidence</th></tr>
<tr><td colspan="2">Create a role play model for the circulatory system.
Carry out a range of pulse rate investigations:
fair test - effect of different activities on my pulse rate
pattern seeking - exploring which groups of people may have higher or lower resting pulse rates
observation over time - how long does it take my pulse rate to return to my resting pulse rate (recovery rate)
pattern seeking - exploring recovery rate for different groups of people.
Research the negative effects of drugs (e.g. tobacco) and the benefits of a healthy diet and regular exercise by asking an expert or using carefully selected secondary sources.</td><td colspan="2">Can draw a diagram of the circulatory system and label the parts and annotate it to show what the parts do
Produces a piece of writing that demonstrates the key knowledge e.g. explanation text, job description of the heart
Use the role play model to explain the main parts of the circulatory system and their role
Can use subject knowledge about the heart whilst writing conclusions for investigations
Can explain both the positive and negative effects of diet, exercise, drugs and lifestyle on the body
Present information e.g. in a health leaflet describing impact of drugs and lifestyle on the body</td></tr>
</table>

Year 6 - Electricity - ENERGY - Can we vary the effects of electricity?

National Curriculum objectives

- 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.

Notes and guidance

- Build on learning (Y4), construct simple series circuits, to help them to answer questions about what happens when they try different components, for example, switches, bulbs, buzzers and motors.
- Learn how to represent a simple circuit in a diagram using recognised symbols.

Note: Pupils are expected to learn only about series circuits, not parallel circuits. Pupils should be taught to take the necessary precautions for working safely with electricity.

Sticky knowledge

• Batteries are a store of energy. This energy pushes electricity round the circuit. When the battery's energy is gone it stops pushing. Voltage measures the 'push.'
• The greater the current flowing through a device the harder it works.
• Current is how much electricity is flowing round a circuit.
• When current flows through wires heat is released. The greater the current, the more heat is released

. Adding more cells to a complete circuit will make a bulb brighter, a motor spin faster or a buzzer make a louder sound. If you use a battery with a higher voltage, the same thing happens. Adding more bulbs to a circuit will make each bulb less bright. Using more motors or buzzers, each motor will spin more slowly and each buzzer will be quieter. Turning a switch off (open) breaks a circuit so the circuit is not complete and electricity cannot flow. Any bulbs, motors or buzzers will then turn off as well. You can use recognised circuit symbols to draw simple circuit diagrams.

Vocabulary

Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage

N.B. Children do not need to understand what voltage is, but will use volts and voltage to describe different batteries. The words "cells" and "batteries" are now used interchangeably.

Electricity, neutrons, protons, electrons, nucleus, atom, electric current, appliances, mains, crocodile clips, wires, bulb, battery cell, battery holder, motor, buzzer, switch, conductor, electrical insulator, conductor.

Key scientists

Alessandro Volta
(Electrical Battery)
Nicola Tesla
(Alternating Currents)

Linked texts

Goodnight Mister Tom
(Michelle Magorian)
Blackout
(John Rocco)
Hitler's Canary
(Sandi Toksvig)

Prior Learning

- Identify common appliances that run on electricity. (Y4 - Electricity)
- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. (Y4 - Electricity)
- Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. (Y4 - Electricity)
- Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. (Y4 - Electricity)
- Recognise some common conductors and insulators, and associate metals with being good conductors. (Y4 - Electricity)

Future learning

- Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge. (KS3)
- Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current. (KS3)
- Differences in resistance between conducting and insulating components (quantitative). (KS3)
- Static electricity. (KS3)

Possible misconceptions

Some children may think:

- larger-sized batteries make bulbs brighter
- a complete circuit uses up electricity
- components in a circuit that are closer to the battery get more electricity.

Enquiry						
Comparative and fair tests	Identify and classify	Observation over time	Pattern seeking	Research	Ideas over time	Key Questions
How does the voltage of the batteries in a circuit affect the brightness of the lamp? How does the voltage of the batteries in a circuit affect the volume of the buzzer? Which make of battery lasts the longest? Which type of fruit makes the best fruity battery?	How would you group electrical components and appliances based on what electricity makes them do?	How does brightness of bulb change as the battery runs out? How can we measure how quickly a battery is used up?	Does the temperature of a light bulb go up the longer it is on?	How has our understanding of electricity changed over time?	How has our understanding of electricity changed over time? How have batteries changed over time?	• Do all batteries push as hard as each other? • What is electricity? • How does the voltage of a batters affect how much current is pushed? • How does the length of time I leave the current flowing for affect the brightness of the bulb? • How does number of bulbs affect the brightness of a bulb? • Are all types of wires as good as conducting electricity? • Why are wires insulated in plastic? Does type of material make a difference? • Does length of wire make a difference? • Does the type of circuit affect how the components work/long the battery lasts? • What renewable ways can we generate electricity? • How does current affect heat? • What are the dangers of a short circuit?
Use an increasingly wide range of equipment to make measurements. Learn what it means to measure accurately and check for reliability. Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make. Use the bar charts to draw conclusions about what they have found out to be the answer to their 'big question' Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. Plan their own tests to collect data. Through fair testing learn to understand the different types of variables: • the dependent variable that they will change in their test, • the independent variable that they are going to measure so that they can find out how the dependent variable affects it, • the control variables which the children will need to keep the same so that they don't affect their results. Measure and record data that can then be displayed in a scatter graph or line graph. Use their data to draw conclusions that identify a causal relationship eg 'when you increase X, Y will always decrease'. Throughout KS2, become progressively more systematic in how they approach fair tests and increasingly independent. Written conclusions to become increasingly sophisticated, with more focus on scientific explanations. Focus on their skills in evaluating their scientific enquiries. Learn to critique not just their experimental methods but also their data by reflecting on reliability and accuracy.	Regularly revisit KS1 skills: Focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. Increased focus on measuring and using data to answer 'big questions'. Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things.	Measuring time in seconds, minutes, hours and days but also measuring a variety of variables that they observe to change such as temperature, light levels, and sound levels. Record their observations in the form of scientific drawings and labelling key features using scientific vocabulary. Look closely and record fine details using magnifying glasses and microscopes. Make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.	Begin to think for themselves when deciding what they should measure and observe. Begin to make decisions about the most appropriate equipment to use to collect data. Begin to think even more about their planning, including identifying the variables that they cannot control and suggesting the potential impact those variables might have on the data they collect. Use a data logger to collect the most accurate data they can. Using data analysis techniques to spot patterns, including using tabulated data and a variety of charts and graphs. Use data and graphs to support their explanations when describing relationships. Use pattern seeking as a preliminary test; use their findings to form and justify their own predictions, then propose further investigations to test these predictions.	Reading for information and note-taking. Learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Use a range of secondary sources, including books, websites, and video to find their information. Listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters Find more data in their research and use this to help answer questions Start to collect their own data through questionnaires and interviews. Begin to evaluate the quality of the information they have found and how well it has enabled them to draw conclusions and answer their 'big question'.	Explore and talk about their own and other people's scientific ideas. Begin to recognise how scientific ideas change and develop over time. Use a range of secondary sources of information. Develop their use of scientific language. Explain ideas using their scientific knowledge and understanding. Evaluate the significance, strengths and weaknesses of different scientists'	

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<tr><td>Bulb brightness
Can children raise a question relating to simple circuits and the brightness of the bulb?
Can children decide what evidence to collect in order to answer the question?</td><td>Investigate what happens when they change components in a circuit.
Explore different electrical components, pose questions and make predictions.</td><td>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.</td><td>systematically identifying the effect of changing one component at a time in a circuit;
designing and making a set of traffic lights, a burglar alarm or some other useful circuit.</td></tr>
<tr><th colspan="2">Activities</th><th colspan="2">Possible Evidence</th></tr>
<tr><td colspan="2">Explain how a circuit operates to achieve particular operations, such as to control the light from a torch with different brightness's or make a motor go faster or slower.
Make circuits to solve particular problems, such as a quiet and a loud burglar alarm.
Carry out fair tests exploring changes in circuits.
Make circuits that can be controlled as part of a DT project.</td><td colspan="2">Can incorporate a switch into a circuit to turn it on and off
Can change cells and components in a circuit to achieve a specific effect
Can communicate structures of circuits using circuit diagrams with recognised symbols
Can devise ways to measure brightness of bulbs, speed of motors, volume of a buzzer during a fair test
Can predict results and answer questions by drawing on evidence gathered
Can make electric circuits and demonstrate how variation in the working of particular components, such as the brightness of bulbs, can be changed by increasing or decreasing the number of cells or using cells of different voltages
Can draw circuit diagrams of a range of simple series circuits using recognised symbols</td></tr>
</table>

Year 6 - Evolution and inheritance

National Curriculum objectives

- 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.

Sticky knowledge

- Life cycles have evolved to help organisms survive to adulthood.
- Over time the characteristics that are most suited to the environment become increasingly common.

NB: The following could be duplicated in Year 6 Living things and their habitats.

- Organisms best suited to their environment are more likely to survive long enough to reproduce.
- Organisms are best adapted to reproduce are more likely to do so.
- Organisms reproduce and offspring have similar characteristic patterns.
- Variation exists within a population (and between offspring of some plants)
- Competition exists for resources and mates

All living things have offspring of the same kind, as features in the offspring are inherited from the parents. Due to sexual reproduction, the offspring are not identical to their parents and vary from each other. Plants and animals have characteristics that make them suited (adapted) to their environment. If the environment changes rapidly, some variations of a species may not suit the new environment and will die. If the environment changes slowly, animals and plants with variations that are best suited survive in greater numbers to reproduce and pass their characteristics on to their young. Over time, these inherited characteristics become more dominant within the population. Over a very long period of time, these characteristics may be so different to how they were originally that a new species is created. This is evolution. Fossils give us evidence of what lived on the Earth millions of year ago and provide evidence to support the theory of evolution. More recently, scientists such as Darwin and Wallace observed how living things adapt to different environments to become distinct varieties with their own characteristics.

Vocabulary

Offspring, sexual reproduction, vary, characteristics, suited, adapted, environment, inherited, species, fossils, adaptation, evolution, genetics, variation, environmental, mutation, competition, survival of the fittest, evidence,

Notes and guidance

- build on learning about fossils (rocks, Y3), find out more about how living things on earth have changed over time.
- be introduced to the idea that characteristics are passed from parents to their offspring, for instance by considering different breeds of dogs, and what happens when, for example, labradors are crossed with poodles.
- appreciate that variation in offspring over time can make animals more or less able to survive in particular environments, for example, by exploring how giraffes' necks got longer, or the development of insulating fur on the arctic fox.
- find out about the work of palaeontologists such as Mary Anning and about how Charles Darwin and Alfred Wallace developed their ideas on evolution.

Note: At this stage, pupils are not expected to understand how genes and chromosomes work.

Key scientists

Charles Darwin and Alfred Russel Wallace
(Theory of Evolution by Natural Selection)

Jane Goodall
(Chimpanzees)

Linked texts

One Smart Fish
(Christopher Wormell)

The Molliebird
(Jules Pottle)

Our Family Tree
(Lisa Westberg Peters)

Prior Learning

- Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other. (Y2 - Living things and their habitats)
- Notice that animals, including humans, have offspring which grow into adults. (Y2 - Animals, including humans)
- Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal. (Y3 - Plants)
- Describe in simple terms how fossils are formed when things that have lived are trapped within rock. (Y3 - Rocks)
- Recognise that environments can change and that this can sometimes pose dangers to living things. (Y4 - Living things and their habitats)
- Describe the life process of reproduction in some plants and animals. (Living things and their habitats - Y5)

Future learning

- Heredity as the process by which genetic information is transmitted from one generation to the next. (KS3)
- A simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model. (KS3)
- The variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection. (KS3)
- Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction. (KS3)

Possible misconceptions

Some children may think:

- adaptation occurs during an animal's lifetime: giraffes' necks stretch during their lifetime to reach higher leaves and animals living in cold environments grow thick fur during their life
- offspring most resemble their parents of the same sex, so that sons look like fathers
- all characteristics, including those that are due to actions during the parent's life such as dyed hair or footballing skills, can be inherited
- cavemen and dinosaurs were alive at the same time

Enquiry						
Comparative and fair tests	Identify and classify	Observation over time	Pattern seeking	Research	Ideas over time	Key Questions
What is the most common eye colour in our class?	Compare the skeletons of apes, humans, and Neanderthals - how are they similar, and how are they different? Can you classify these observations into evidence for the idea of evolution, and evidence against?	How has the skeleton of the horse changed over time?	Is there a pattern between the size and shape of a bird's beak and the food it will eat?	What happened when Charles Darwin visited the Galapagos islands? Why do some people need to wear glasses to see clearly?	What ideas did American geneticist Barbara McClintock have about genes that won her a Nobel Prize?	• Why are we all different? • What is variation, and why is it important? • How did life begin on Earth? • How do we change? • What is evolution? • What evidence is there for evolution? • How does evolution happen? • What reasons do animals become extinct? • Polar Bears' habitat is rapidly changing, what possible futures do they face, and can we predict which is most likely? • How did Darwin come up with the theory? • Why was his theory not initially accepted?
Use an increasingly wide range of equipment to make measurements. Learn what it means to measure accurately and check for reliability. Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make. Use the bar charts to draw conclusions about what they have found out to be the answer to their 'big question' Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. Plan their own tests to collect data. Through fair testing learn to understand the different types of variables: • the dependent variable that they will change in their test, • the independent variable that they are going to measure so that they can find out how the dependent variable affects it, • the control variables which the children will need to keep the same so that they don't affect their results. Measure and record data that can then be displayed in a scatter graph or line graph. Use their data to draw conclusions that identify a causal relationship eg 'when you increase X, Y will always decrease'. Throughout KS2, become progressively more systematic in how they approach fair tests and increasingly independent. Written conclusions to become increasingly sophisticated, with more focus on scientific explanations. Focus on their skills in evaluating their scientific enquiries. Learn to critique not just their experimental methods but also their data by reflecting on reliability and accuracy.	Regularly revisit KSI skills: Focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. Increased focus on measuring and using data to answer 'big questions'. Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things.	Measuring time in seconds, minutes, hours and days but also measuring a variety of variables that they observe to change such as temperature, light levels, and sound levels. Record their observations in the form of scientific drawings and labelling key features using scientific vocabulary. Look closely and record fine details using magnifying glasses and microscopes. Make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.	Begin to think for themselves when deciding what they should measure and observe. Begin to make decisions about the most appropriate equipment to use to collect data. Begin to think even more about their planning, including identifying the variables that they cannot control and suggesting the potential impact those variables might have on the data they collect. Use a data logger to collect the most accurate data they can. Using data analysis techniques to spot patterns, including using tabulated data and a variety of charts and graphs. Use data and graphs to support their explanations when describing relationships. Use pattern seeking as a preliminary test; use their findings to form and justify their own predictions, then propose further investigations to test these predictions.	Reading for information and note-taking. Learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Use a range of secondary sources, including books, websites, and video to find their information. Listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters Find more data in their research and use this to help answer questions Start to collect their own data through questionnaires and interviews. Begin to evaluate the quality of the information they have found and how well it has enabled them to draw conclusions and answer their 'big question'.	Explore and talk about their own and other people's scientific ideas. Begin to recognise how scientific ideas change and develop over time. Use a range of secondary sources of information. Develop their use of scientific language. Explain ideas using their scientific knowledge and understanding. Evaluate the significance, strengths and weaknesses of different scientists'	

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<td>Fossil habitats
♣ Can children use evidence (from fossils or research) to develop ideas?
♣ Can children discuss whether evidence supports ideas?

Egg Strength
♣ Can the children explain how they are testing the strength of the eggs?
• Can the children consider the trustworthiness of their method/results?</td>
<td>• Label how a X is adapted to its environment eg Polar bear and arctic.
• Invent their own animal and explain how it is adapted to its environment.</td>
<td>• 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.</td>
<td>• observing and raising questions about local animals and how they are adapted to their environment
• comparing how some living things are adapted to survive in extreme conditions, for example, cactuses, penguins and camels.
• analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.</td>
</tr>
<tr><th colspan="2">Activities</th><th colspan="2">Possible Evidence</th></tr>
<tr>
<td colspan="2">• Design a new plant or animal to live in a particular habitat.
• Use models to demonstrate evolution e.g. ‘Darwin’s finches’ bird beak activity.
• Use secondary sources to find out about how the population of peppered moths changed during the industrial revolution.
• Make observations of fossils to identify living things that lived on Earth millions of years ago.
• Identify features in animals and plants that are passed on to offspring and explore this process by considering the artificial breeding of animals or plants e.g. dogs.
• Compare the ideas of Charles Darwin and Alfred Wallace on evolution.
• Research the work of Mary Anning and how this provided evidence of evolution.</td>
<td colspan="2">• Can explain the process of evolution • Can give examples of how plants and animals are suited to an environment
• Can give examples of how an animal or plant has evolved over time e.g. penguin, peppered moth
• Give examples of living things that lived millions of years ago and the fossil evidence we have to support this
• Can give examples of fossil evidence that can be used to support the theory of evolution
• Can identify characteristics that will make a plant or animal suited or not suited to a particular habitat
• Can link the patterns seen in the model to real examples
• Can explain why the dominant colour of the peppered moth changed over a very short period of time</td>
</tr>
</table>

Year 6 - Light - Why does my shadow change length over the course of a day?

National Curriculum objectives

- 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.

Notes and guidance

- build on learning (Y3), exploring the way that light behaves, including light sources, reflection and shadows.
- talk about what happens and make predictions.

Sticky knowledge

• Animals see light sources when light travels from the source into their eyes.
• Animals see objects when light is reflected off that object and enters their eyes.
• Light reflects off all objects (unless they are black). Non shiny surfaces scatter the light, so we do not see the beam.
• Light travels in straight lines.

Light appears to travel in straight lines, and we see objects when light from them goes into our eyes. The light may come directly from light sources, but for other objects some light must be reflected from the object into our eyes for the object to be seen. Objects that block light (are not fully transparent) will cause shadows. Because light travels in straight lines the shape of the shadow will be the same as the outline shape of the object.

Vocabulary

Light, light source, dark, absence of light, transparent, translucent, opaque, shiny, matt, surface, shadow, reflect, mirror, sunlight, dangerous - All covered in Y3

straight lines, light rays, ray, bounce, visible, beam, sun, glare, travel, straight, block, absorb emitted scattered refraction

Key scientists

Thomas Young
(Wave Theory of Light)
Ibn al-Haytham (Alhazen)
(Light and our Eyes)
Percy Shaw
(The Cats Eye)

Linked texts

Letters from the Lighthouse
(Emma Carroll)
The Gruffalo's Child
(Julia Donaldson)
The King Who Banned the Dark
(Emily Haworth-Booth)

Prior Learning

- Recognise that they need light in order to see things and that dark is the absence of light. (Y3 - Light)
- Notice that light is reflected from surfaces. (Y3 - Light)
- Recognise that light from the sun can be dangerous and that there are ways to protect their eyes. (Y3 - Light)
- Recognise that shadows are formed when the light from a light source is blocked by an opaque object. (Y3 - Light)
- Find patterns in the way that the size of shadows change. (Y3 - Light)
- Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. (Y5 - Properties and changes of materials)

Future learning

- The similarities and differences between light waves and waves in matter. (KS3)
- Light waves travelling through a vacuum; speed of light. (KS3)
- The transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface. (KS3)
- Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye. (KS3)
- Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras. (KS3)
- Colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection. (KS3)

Possible misconceptions

Some children may think:

We see objects because light travels from our eyes to the object.

Enquiry

Comparative and fair tests	Identify and classify	Observation over time	Pattern seeking	Research	Ideas over time	Key Questions
How does the angle that a light ray hits a plane mirror affect the angle at which it reflects off the surface? Which material is most reflective?	Can you identify all the colours of light that make white light when mixed together? What colours do you get if you mix different colours of light together?	How does my shadow change over the day?	Is there a pattern to how bright it is in school over the day? And, if there is a pattern, is it the same in every classroom?	Why do some people need to wear glasses to see clearly? How do our eyes adapt to different conditions?	Cameras detect light - how has our understanding of light and its effects changed camera design throughout history?	• How does the size of an object affect the size of a shadow? • How does the distance between the light and the object change the size of a shadow? • How does the distance between the object and the size of the screen affect the size of a shadow? • How would a solar eclipse be different if: - The moon was a different size? - The earth span faster or slower? - The sun was larger or smaller? - If the earth and moon where the same size but further away in the solar system? • How does the amount of aluminium foil scrunched affect how much light is scatters? • How does the amount of polishing affect how well a piece of metal scatters light? • How perfect are our mirrors? Do some scatter light more than others? • What happens to light when it is shone through water? How is this affected by putting glitter, salt or talc in the water? • How does a periscope/microscope/telescope work?
Use an increasingly wide range of equipment to make measurements. Learn what it means to measure accurately and check for reliability. Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make. Use the bar charts to draw conclusions about what they have found out to be the answer to their 'big question' Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. Plan their own tests to collect data. Through fair testing learn to understand the different types of variables: • the dependent variable that they will change in their test, • the independent variable that they are going to measure so that they can find out how the dependent variable affects it, • the control variables which the children will need to keep the same so that they don't affect their results. Measure and record data that can then be displayed in a scatter graph or line graph. Use their data to draw conclusions that identify a causal relationship eg 'when you increase X, Y will always decrease'. Throughout KS2, become progressively more systematic in how they approach fair tests and increasingly independent. Written conclusions to become increasingly sophisticated, with more focus on scientific explanations. Focus on their skills in evaluating their scientific enquiries. Learn to critique not just their experimental methods but also their data by reflecting on reliability and accuracy.	Regularly revisit KS1 skills: Focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. Increased focus on measuring and using data to answer 'big questions'. Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things.	Measuring time in seconds, minutes, hours and days but also measuring a variety of variables that they observe to change such as temperature, light levels, and sound levels. Record their observations in the form of scientific drawings and labelling key features using scientific vocabulary. Look closely and record fine details using magnifying glasses and microscopes. Make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.	Begin to think for themselves when deciding what they should measure and observe. Begin to make decisions about the most appropriate equipment to use to collect data. Begin to think even more about their planning, including identifying the variables that they cannot control and suggesting the potential impact those variables might have on the data they collect. Use a data logger to collect the most accurate data they can. Using data analysis techniques to spot patterns, including using tabulated data and a variety of charts and graphs. Use data and graphs to support their explanations when describing relationships. Use pattern seeking as a preliminary test; use their findings to form and justify their own predictions, then propose further investigations to test these predictions.	Reading for information and note-taking. Learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Use a range of secondary sources, including books, websites, and video to find their information. Listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters Find more data in their research and use this to help answer questions Start to collect their own data through questionnaires and interviews. Begin to evaluate the quality of the information they have found and how well it has enabled them to draw conclusions and answer their 'big question'.	Explore and talk about their own and other people's scientific ideas. Begin to recognise how scientific ideas change and develop over time. Use a range of secondary sources of information. Develop their use of scientific language. Explain ideas using their scientific knowledge and understanding. Evaluate the significance, strengths and weaknesses of different scientists'	

<table>
<tr><th>Linked TAPS Assessment</th><th>Additional TAPS ideas</th><th colspan="2">Working scientifically</th></tr>
<tr><td>Investigating Shadows
Can children make accurate measurements?
Can children choose the appropriate type of graph to present their results?</td><td>Gather ideas about light at beginning and end of unit.
Investigate shadows and distance from light source - draw diagram or create table.</td><td>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.</td><td>deciding where to place rear-view mirrors on cars
designing and making a periscope and using the idea that light appears to travel in straight lines to explain how it works.
investigate the relationship between light sources, objects and shadows by using shadow puppets.
extend their experience of light by looking a range of phenomena including rainbows, colours on soap bubbles, objects looking bent in water and coloured filters (they do not need to explain why these phenomena occur).</td></tr>
<tr><th colspan="2">Activities</th><th colspan="2">Possible Evidence</th></tr>
<tr><td colspan="2">• Explore different ways to demonstrate that light travels in straight lines e.g. shining a torch down a bent and straight hose pipe, shining a torch through different shaped holes in card. • Explore the uses of the behaviour of light, reflection and shadows, such as in periscope design, rear view mirrors and shadow puppets.</td><td colspan="2">Can explain how evidence from enquiries shows that light travels in straight lines • Can predict and explain, with diagrams or models as appropriate, how the path of light rays can be directed by reflection to be seen, e.g. the reflection in car rear view mirrors or in a periscope • Can predict and explain, with diagrams or models as appropriate, how the shape of shadows can be varied
Can describe, with diagrams or models as appropriate, how light travels in straight lines either from sources or reflected from other objects into our eyes
Can describe, with diagrams or models as appropriate, how light travels in straight lines past translucent or opaque objects to form a shadow of the same shape</td></tr>
</table>

Year 6 - living things and their habitats

National Curriculum objectives

- 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

Sticky knowledge

- Variation exists within a population (and between offspring of some plants) - NB: this Key Idea is duplicated in Year 6 Evolution and Inheritance.
- Organisms best suited to their environment are more likely to survive long enough to reproduce.
- Organisms are best adapted to reproduce are more likely to do so.
- Organisms reproduce and offspring have similar characteristic patterns. Competition exists for resources and mates.

Living things can be formally grouped according to characteristics. Plants and animals are two main groups but there are other livings things that do not fit into these groups e.g. micro-organisms such as bacteria and yeast, and toadstools and mushrooms. Plants can make their own food whereas animals cannot. Animals can be divided into two main groups: those that have backbones (vertebrates); and those that do not (invertebrates). Vertebrates can be divided into five small groups: fish; amphibians; reptiles; birds; and mammals. Each group has common characteristics. Invertebrates can be divided into a number of groups, including insects, spiders, snails and worms. Plants can be divided broadly into two main groups: flowering plants; and non-flowering plants.

Vocabulary

Variation, organisms, populations. Classification, characteristics, environment, flowering, nonflowering, plants, animals, vertebrates, fish, birds, amphibians, reptiles, insects, spiders, snails, worms mammals, human impact, nature reserves, deforestation. Classify, compare, bacteria, microorganism, organism, invertebrates, vertebrates, Linnaean.

Notes and guidance

Pupils should build on their learning about grouping living things in year 4 by looking at the classification system in more detail. They should be introduced to the idea that broad groupings, such as micro-organisms, plants and animals can be subdivided. Through direct observations where possible, they should classify animals into commonly found invertebrates (such as insects, spiders, snails, worms) and vertebrates (fish, amphibians, reptiles, birds and mammals). They should discuss reasons why living things are placed in one group and not another. Pupils might find out about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.

Pupils might work scientifically by: using classification systems and keys to identify some animals and plants in the immediate environment. They could research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.

Key scientists

Carl Linnaeus
(Identifying, Naming and Classifying Organisms)

Linked texts

Beetle Boy (M G Leonard)
Insect Soup (Barry Louis Polisar)
Fur and Feathers (Janet Halfmann)

Prior Learning

Recognise that living things can be grouped in a variety of ways. (Y4 - Living things and their habitats)
Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment. (Y4 - Living things and their habitats)
Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird. (Y5 - Living things and their habitats)
Describe the life process of reproduction in some plants and animals. (Y5 - Living things and their habitats)

Future learning

Differences between species. (KS3)

Possible misconceptions

Some children may think:
- all micro-organisms are harmful
- mushrooms are plants.

Enquiry						
Comparative and fair tests	Identify and classify	Observation over time	Pattern seeking	Research	Ideas over time	Key Questions
Which is the most common invertebrate on our school playing field?	How would you make a classification key for vertebrates/invertebrates or microorganisms?	What happens to a piece of bread if you leave it on the windowsill for two weeks?	Do all flowers have the same number of petals?	What do different types of microorganisms do? Are they always harmful?	How did Carl Linneaus' ideas help us to group plants?	• Why do we need to classify living things? How do we classify? What are the difficulties with classification? (penguins, whales, platypus) How do animals change over time? Why does variation exist? What happens if animals of different species breed? (hybrids) • What happens to house plants outside? • What are microorganisms? • How can we prevent the spread of disease? • Why do animals and plants compete - and what for?
Use an increasingly wide range of equipment to make measurements. Learn what it means to measure accurately and check for reliability. Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make. Use the bar charts to draw conclusions about what they have found out to be the answer to their 'big question' Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. Plan their own tests to collect data. Through fair testing learn to understand the different types of variables: • the dependent variable that they will change in their test, • the independent variable that they are going to measure so that they can find out how the dependent variable affects it, • the control variables which the children will need to keep the same so that they don't affect their results. Measure and record data that can then be displayed in a scatter graph or line graph. Use their data to draw conclusions that identify a causal relationship eg 'when you increase X, Y will always decrease'. Throughout KS2, become progressively more systematic in how they approach fair tests and increasingly independent. Written conclusions to become increasingly sophisticated, with more focus on scientific explanations. Focus on their skills in evaluating their scientific enquiries. Learn to critique not just their experimental methods but also their data by reflecting on reliability and accuracy.	Regularly revisit KS1 skills: Focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. Increased focus on measuring and using data to answer 'big questions'. Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things.	Measuring time in seconds, minutes, hours and days but also measuring a variety of variables that they observe to change such as temperature, light levels, and sound levels. Record their observations in the form of scientific drawings and labelling key features using scientific vocabulary. Look closely and record fine details using magnifying glasses and microscopes. Make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.	Begin to think for themselves when deciding what they should measure and observe. Begin to make decisions about the most appropriate equipment to use to collect data. Begin to think even more about their planning, including identifying the variables that they cannot control and suggesting the potential impact those variables might have on the data they collect. Use a data logger to collect the most accurate data they can. Using data analysis techniques to spot patterns, including using tabulated data and a variety of charts and graphs. Use data and graphs to support their explanations when describing relationships. Use pattern seeking as a preliminary test; use their findings to form and justify their own predictions, then propose further investigations to test these predictions.	Reading for information and note-taking. Learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Use a range of secondary sources, including books, websites, and video to find their information. Listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters Find more data in their research and use this to help answer questions Start to collect their own data through questionnaires and interviews. Begin to evaluate the quality of the information they have found and how well it has enabled them to draw conclusions and answer their 'big question'.	Explore and talk about their own and other people's scientific ideas. Begin to recognise how scientific ideas change and develop over time. Use a range of secondary sources of information. Develop their use of scientific language. Explain ideas using their scientific knowledge and understanding. Evaluate the significance, strengths and weaknesses of different scientists'	

<table>
<tr><th>Linked TAPS Assessment</th><th>Additional TAPS ideas</th><th colspan="2">Working scientifically</th></tr>
<tr>
<td>Invertebrate research
Can children report and present information about an invertebrate classification group
Outdoor Keys
Can children create questions which separate animal groups?
Can children use a classification key?
Can children record their research clearly, using scientific language?</td>
<td>Create keys to classify animals.</td>
<td>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.</td>
<td>using classification systems and keys to identify some animals and plants in the immediate environment.
research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.</td>
</tr>
<tr><th colspan="2">Activities</th><th colspan="2">Possible Evidence</th></tr>
<tr>
<td colspan="2">Use secondary sources to learn about the formal classification system devised by Carl Linnaeus and why it is important.
Use first-hand observation to identify characteristics shared by the animals in a group.
Use secondary sources to research the characteristics of animals that belong to a group.
Use information about the characteristics of an unknown animal or plant to assign it to a group.
Classify plants and animals, presenting this in a range of ways e.g. Venn diagrams, Carroll diagrams and keys.
Create an imaginary animal which has features from one or more groups.</td>
<td colspan="2">Can give examples of animals in the five vertebrate groups and some of the invertebrate groups
Can give the key characteristics of the five vertebrate groups and some invertebrate groups
Can compare the characteristics of animals in different groups
Can give examples of flowering and non-flowering plants
Can use classification materials to identify unknown plants and animals
Can create classification keys for plants and animals
Can give a number of characteristics that explain why an animal belongs to a particular group</td>
</tr>
</table>