Year 6

Working scientifically

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, 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 as well as considering if the test completed was reliable
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a 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

Pupils should read, spell and pronounce scientific vocabulary correctly.

Topic and objectives	Lesson ideas	Key Words	Misconceptions
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	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. 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. **Scientist –** **Carl Linnaeus – classification** **Libby Hyman – classification**	**invertebrates'** insects, spiders, snails, worms **vertebrates** fish, amphibians, reptiles, birds and mammals mico-organisms, plants, animals. classification,	Misconception: Micro-organisms are the same as germs. Fact: Germs are micro-organisms such as bacteria, fungi and protists which cause diseases. Not all micro-organisms are germs. Misconception: Viruses are micro-organisms. Fact: Viruses are not considered to be living things (organisms) as they cannot reproduce on their own; they need living hosts to reproduce. Misconception: All bacteria are bad. Fact: Bacteria that cause diseases are bad, but there are many good bacteria which help to decompose matter, make vitamins in our bodies and recycle important nutrients in the environment. Misconception: Micro-organisms can live in all sorts of places except in or on the human body. Fact: The human body is a habitat for many types of micro-organisms. Misconception: There is no connection between disease and decay and micro-organisms. Fact: Micro-organisms are responsible for infectious diseases and decay. Misconception: A population higher on a food chain is a predator on all the organisms below it. Fact: A population higher on a food chain is a predator on only the organisms directly below it.
Animals including humans Pupils should be taught to: • identify and name the main parts of the human circulatory system, and	Build on their learning from years 3 and 4 about the main body parts and internal organs (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	**Human internal organs** heart, lungs, liver, kidney, brain, skeletal, skeleton, muscle, muscular, digest, digestion, digestive	Misconception: Digestion starts in the stomach. Fact: Digestion starts in the mouth, where the salivary amylase (a digestive enzyme) acts on the starch in food.

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	damaged – including how some drugs and other substances can be harmful to the human body. Work scientifically by: exploring the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health. **Famous Scientist – Claudius Galen – Anatomy** **Leonardo Da Vinci – Anatomy discoveries**	Human circulatory system blood vessels diet, lifestyle, exercise, drugs, nutrients, water	Misconception: Digestion ends in the stomach or large intestine. Fact: Digestion ends in the small intestine, where carbohydrates, proteins and fats are digested. Proteins are digested in the stomach. Water and minerals are absorbed into the bloodstream in the large intestine. Misconception: The digestive system has two outlets – one for faeces and one for urine. Fact: The digestive system has one outlet – the anus through which undigested food is discharged from the body. Misconception: Digestion is the process which releases usable energy from food. Fact: Digestion is the breakdown of large food molecules into smaller ones. Respiration is the process by which energy is released from food. Misconception: The discharge of undigested food through the anus is called excretion. Fact: The discharge of undigested food through the anus is called egestion or defecation. Excretion is the discharge of metabolic wastes from the body, e.g. urine excreted by the kidneys, carbon dioxide excreted by the lungs. Misconception: Gullet is not an organ. Fact: The gullet is an organ, which is formed by different types of tissues to perform a specific function. Skin is also an organ. Misconception: The gullet and windpipe are one and the same tube which splits at the end of the stomach and lungs. Fact: The gullet (oesophagus) and windpipe (trachea) are two different tubes. The gullet connects the mouth to the stomach while the windpipe leads to the lungs. A flap called the epiglottis closes the windpipe while food is being swallowed into the gullet. Clear illustrations or models of the digestive and respiratory systems

			may be used to help pupils correct the misconception. Misconception: We breathe in only oxygen and breathe out only carbon dioxide. Fact: We breathe in air and the air we breathe in has more oxygen than the air we breathe out; we breathe out air with more carbon dioxide than the air that we breathe in. Pie-charts showing the compositions of inhaled and exhaled air may be shown to pupils to correct the misconception. Misconception: Inhaled air remains in the head. Fact: The oxygen in inhaled air is transported to the cells all over the body by the red blood cells. Misconception: Air is inhaled into the lungs, then exhaled, without links with the heart and circulatory system. Fact: Air inhaled into the lungs is circulated to the heart, then to the rest of the body through the circulatory system. Misconception: The amount of nitrogen in inhaled and exhaled air is different. Fact: The body does not use the nitrogen in the inhaled air, thus the amount of nitrogen in inhaled and exhaled air is the same. Misconception: Air is blown into the straw (which represents the airway) to inflate the balloon (which represents the lung) in the model of a lung. Fact: The plastic or rubber sheet representing the diaphragm should be pulled to inflate the lung. Misconception: Inability to link the need for oxygen with the use of food. Fact: Oxygen is needed for aerobic respiration, to release energy from food in the cells.

			Misconception: Respiration is the same as breathing; the respiratory system is for carrying out respiration. Fact: Respiration is the release of energy from food and takes place in the cells, with or without oxygen. Breathing is the exchange of respiratory gases between the body and the surroundings through the respiratory system. Misconception: There are air tubes linking the lungs and the heart. Fact: The lungs and the heart are linked by blood vessels. Misconception: Blood from the lungs to the other parts of the body has only one gas – oxygen. Fact: Blood from the lungs is rich in oxygen. Misconception: The brain is responsible for thinking (cognition) but not responsible for physical actions, voluntary movements (e.g. swimming) and involuntary movements (e.g. coughing and sneezing), emotions or sensations. Fact: Different parts of the brain are responsible for cognition, emotions, personality, sensations and voluntary and involuntary movements. Misconception: No relationship between muscles and meat. Fact: Meat is the muscles of animals. Misconception: Muscles and brain are not involved in the workings of the digestive, circulatory or respiratory systems. Fact: The brain controls the workings of these systems and many of the organs in these systems are made up of muscular tissues
Evolution and inheritance Pupils should be taught to:	Building on what they learned about fossils in the topic on rocks in year 3, pupils should find out more about how living things on earth have changed over time. They should 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	evolution natural selection extinct fossils	Misconception: Evolution claims that we evolved from monkeys. Fact: No, it doesn't. It doesn't even claim we evolved from chimpanzees! Rather, evolution predicts that all life on the planet is related. That is to say that if you go back enough generations,

• 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	with poodles. They should also 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. Note: at this stage, pupils are not expected to understand how genes and chromosomes work. Work scientifically by: 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. They might analyse the advantages and disadvantages of specific adaptations, such as being on 2 feet rather than 4, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers. **Famous scientists – Rosalind Franklin – DNA** **Charles Darwin and Alfred Wallace – Evolution** **Re-cap the work of Mary Anning - palaeontologist**	sedimentary palaeontologist environment habitat adaptation maladaptation animal appearance diet defence predator prey protection habitat	you'll come to a common ancestor for any two life forms. For humans and chimpanzees, the best evidence strongly suggests that the line leading to humans diverged from the line leading to chimpanzees six or seven million years ago. That original population was neither human nor chimpanzee. Misconception: If we evolved from monkeys, why are there still monkeys around? Fact: Start with the same correction as given in #1—apes are closer relatives than monkeys. And then there is a similar misconception. The theory of evolution does not say that currently existing species came from other currently existing species. The most recent common ancestors between humans and Old World monkeys (those from Africa and Asia) were about 25 million years ago (the New World monkeys in South and Central America split off earlier). Misconception: No new information can be added to DNA through natural processes. Fact: Yes it can. Any reasonable definition of "new information" in this context has to mean something like "instructions to build something useful that weren't there before." That happens a lot through genetic mutations and gene duplication. Here's a short YouTube video that explains how. Misconceptions: Evolution is a theory in crisis No it's not. Of course, scientists debate and argue about the specifics—that's how science works. But the general framework of evolution including the common descent of all species is overwhelmingly supported by scientists. 98% of the members of AAAS (and 99% of research scientists) accept human evolution (see study). Some of the confusion on this point is that the term "Neo-Darwinism" is often used to mean the specific proposal that there is nothing more to evolution than random genetic mutations and natural selection. There is a lot of debate and

			dissension among scientists about that point. But it is completely illegitimate to go from "There is vigorous debate about Neo-Darwinism" to the conclusion, "Therefore evolution is a theory in crisis." That is only rhetoric. [Editor's note: For more on this, go to our new Common Questions page on the subject.] Misconception: Evolution is only a theory.so could be wrong. Fact: The formal scientific definition of theory is quite different from the everyday meaning of the word. It refers to a comprehensive explanation of some aspect of nature that is supported by a vast body of evidence. Many scientific theories are so well-established that no new evidence is likely to alter them substantially. For example, no new evidence will demonstrate that the Earth does not orbit around the sun (heliocentric theory), or that living things are not made of cells (cell theory), that matter is not composed of atoms, or that the surface of the Earth is not divided into solid plates that have moved over geological timescales (the theory of plate tectonics
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	Building on their work in year 4, pupils should 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. They should 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. Work scientifically by: 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. **Famous scientist – Nikola Telsa – Founder of AC electric system**	voltage, brightness, volume, switches, danger, series circuit, diagram, bulb, buzzer, motor, symbols,	Misconception: Electric current flows from the negative to the positive terminal. Fact: The conventional current flows from the positive to the negative terminal, although in actual fact, current in a wire in a circuit is due to the flow of electrons from the negative to the positive terminal. Misconception: Electric current is 'used up' by an electric bulb in a circuit, so there is less current 'going back' to the battery in the wire after the electric bulb in a series circuit. Fact: Electric current in the wires on both sides of the electric bulb is the same. Misconception: The second bulb is less bright than the first bulb in a series circuit because

• use recognised symbols when representing a simple circuit in a diagram			electric current has been ‘used up’ by the first bulb in the circuit. Fact: Both bulbs are equally bright if they are identical. The current flowing through both bulbs is the same in a series circuit and depends on the voltage and total effective resistance of the two bulbs. Misconception: In an open circuit, current flows to the part where there is a gap and ‘turns back’ to the battery when it finds that it cannot flow through the gap. Fact: In an open circuit, current does not flow at all. Misconception: An electric cell is called a battery. Fact: A battery is made up of two or more electric cells connected in series. Misconception: An electric cell delivers a constant current in a closed circuit. Fact: An electric cell maintains a constant voltage or potential difference. The current delivered depends on the voltage and the effective resistance of the circuit. Misconception: Electric current is the same as electrical energy. Fact: Electric current is the rate of flow of electric charges. Misconception: A change in one place of a circuit only affects the parts ‘downstream’ from the change (sequential model). Fact: An electric circuit is a complete system and different parts of the circuit interact so that a change in one place affects the whole circuit. Misconception: When electric current increases, voltage increases; there is no voltage when there is no current flowing.

			Fact: Voltage is a precondition for current to flow, not a property of current. Voltage is present even when no current is flowing.
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	Build on the work on light in year 3, exploring the way that light behaves, including light sources, reflection and shadows. They should talk about what happens and make predictions. Work scientifically by: 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. They might investigate the relationship between light sources, objects and shadows by using shadow puppets. They could 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). **Famous scientist – Thomas Edison – Invented electric light bulbs** **DR Patricia Bath (look on BP website) - invented the Laserphaco Probe for the treatment of cataracts**	light, travels, straight, light source, object, shadows, rainbow, filters, mirror, reflect, reflection, periscope	Misconception: Light is not necessary for vision; it is possible to see in the dark. Fact: Light is necessary for vision. It is impossible to see in total darkness. Misconception: Only smooth, shiny objects like mirrors reflect light; dull and rough objects do not reflect light. Fact: Dull objects do reflect light, otherwise we would not be able to see them. Smooth surfaces produce regular reflection while rough surfaces produce scattered, diffused or irregular reflection. Misconception: Light travels from the source to both the observer and the object, but there is no link between the two. Fact: Light travels from the source to the object; the object reflects the light from the source into the eyes of the observer; the receptor cells in the observer's retinas detect the light and send the signals to the brain. Misconception: Shadow is the presence of something that light allows us to see. Fact: Shadow is the absence of light.