

Big Idea	Cells
Prior knowledge from primary	Students should not yet have been explicitly taught about cells, but should be confident with the life processes with the ASPIRE schools learning this via MRS GREN. Students in education in the UK should have learnt about the digestive system in Y4 and the circulatory system in Y6, but not down to the level of cells. In Y5 students should have been taught to 'describe the life process of reproduction in some plants and animals'.
Year 7	<p>Knowledge: In B1 students learn that all organisms are constituted of one or more cells. Multi-cellular organisms have cells that are differentiated (specialised) according to their function. All the basic functions of life are the result of what happens inside the cells which make up an organism. In B2 students develop their knowledge of examples of specialised cells.</p> <p>Skills: In B1 there is an opportunity to apply knowledge of cells, tissues, organs and organ systems when looking at the effect of drugs on the body. In B2 students learn about sexual reproduction and there is an opportunity for students to revisit their knowledge from Y5, but now link, apply and embed their knowledge of the 'Big Idea' of cells, which was introduced in B1. Pupils are able to apply their knowledge to explain how cells are adapted to their functions.</p>
Year 8	<p>Knowledge: In B3 students learn the functions of specific cells in the human body, particularly relative to the digestive and respiratory system and students develop their knowledge of examples of specialised cells. In B3 pupils learn that an organism can be either multicellular or unicellular, and develop the idea that unicellular organisms reproduce through binary fission.</p> <p>Skills: In B3 there is an opportunity to apply knowledge of cells, tissues, organs and organ systems when looking at the digestive system and respiratory system. In B3 students learn about digestion and respiration and there is an opportunity for students to revisit their knowledge from Y5, but now link, apply and embed their knowledge of the 'Big Idea' of cells, which was introduced in B1. Pupils are able to apply their knowledge to explain how cells are adapted to their functions, to include terms like surface area to volume ratio and adaptations of efficient gas and nutrient exchange. Pupils are able to apply their knowledge to discuss the effects of smoking on the body. In B3 pupils begin to explain why multicellular organisms need efficient transport systems. In B3 students apply their knowledge of cells to the importance of unicellular organisms in the recycling of nutrients. In this unit they also consider how rapid bacterial cell division can lead to the development of global pandemics such as the black death.</p>
Year 9	<p>Knowledge: In B5 students learn that plants are multi-cellular organisms that have cells that are differentiated (specialised) according to their function. All the basic functions of life are the result of what happens inside the cells which make up an organism. Students develop their knowledge of examples of specialised plant cells.</p> <p>Skills: In B5 there is an opportunity to apply knowledge of cells, tissues, organs and organ systems when looking at plants, in particular the leaf as an organ. They should be able to now link, apply and embed their knowledge of the 'Big Idea' of cells, which was introduced in B1. They should be able to use their knowledge to explain how the structure of the leaf is adapted to its function.</p>
GCSE	<p>Knowledge: All organisms are constituted of one or more cells. Multi-cellular organisms have cells that are differentiated according to their function. All the basic functions of life are the result of what happens inside the cells which make up an organism. Revisit of everything in KS3, and CB1, in CB2 students learn that growth is the result of multiple cell divisions.</p> <p>Skills: The big idea of cells can be applied at some point to almost every topic at GCSE, but key topics where it will be a big focus are: CB1 application to transporting substances CB2 application to mitosis, growth, stem cells. CB3 application to Genetics CB4 application to Genes in Agriculture CB5 Health, disease and the development of medicines CB6 application to plant structures and their functions. CB7 application to animal coordination, control and Homeostasis CB8 application to Exchange and transport in animals CB9 application to nutrient cycles CC17 application to climate change</p>
Future Life and Potential Careers	Understanding the 'big idea' of cells allows students to develop their knowledge and understanding of reproduction and health (particularly vaccinations), which are topics that along with the CPSD curriculum will allow our young people to make informed decisions about family planning and lifestyle choices that may affect their health in the future.

Big Idea	Particles
Prior knowledge from primary	Pupils should not yet have been taught about particles, but should have been taught to: *compare and group materials together, according to whether they are solids, liquids or gases *observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) *identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. Some primary schools are teaching about particle theory early and introducing misconceptions. In Y5, students should have been taught to 'explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda',
Year 7	Knowledge: In C1 students learn that atoms are the building blocks of all materials, living and non-living. The behaviour of the atoms explains the properties of different materials. In C2 students learn that chemical reactions involve rearrangement of atoms in substances to form new substances. <i>Some students may still use the generic term 'particles' at this stage and be able to switch it for more specific terms in the future.</i> Skills: In C2 students can revisit mixtures and separation techniques, which they should have done in Y5, but this time they can link to ideas about particles and begin to explain why different separation techniques are appropriate in different situations. In C2 the acids and alkalis topic builds on the idea that some changes result in the formation of new materials in more detail and is the first time we look at chemical reactions in detail with an opportunity to do some linking back to the 'Big Idea' of particles.
Year 8	Knowledge: In C3 students learn about Daltons ideas of atomic structure, where each atom has a nucleus containing protons and neutrons and electrons that 'fly' around the nucleus in shells. Skills: In C3 students use their ideas of colliding particles to understand the conservation of mass in a chemical reaction, leading on to being able to balance chemical equations. In P3 students are introduced to the particle model to explain the properties of solids, liquids and gases. They learn that reactions can occur when particles collide. They link this to their understanding of collisions, leading onto explaining the effect of temperature and pressure at different states. They learn how density is related to the number of particles in a given space and how density can change with temperature. Students use their understanding that air and water are made up of particles to explain water and air resistance. Other links: - C4 Oxidation and other chemical reactions when discussing reactants as particles. Introduction of impurities in alloys and how these particles effect the metals properties.
Year 9	Skills: In C5 students consider the properties of materials based on the interaction of particles. This is most evident when looking at the formation of ceramics and polymers.
GCSE	Knowledge: In CC3 students build on their knowledge of the structure of an atom learning that nucleus contains neutrons with no charge and protons that are positively charged, and this is surrounded by electrons that are negatively charged. and when considering that opposite electric charges of protons and electrons attract each other, keeping atoms together and accounting for the formation of some compounds.

Big Idea	Forces
Prior knowledge from primary	In Y3 students should have been taught to: • compare how things move on different surfaces • notice that some forces need contact between two objects, but magnetic forces can act at a distance In Y5 students should have been taught to: • explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object • identify the effects of air resistance, water resistance and friction, that act between moving surfaces • recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect Of all the 'Big Ideas', students have been taught the most about forces before they reach us.
Year 7	Knowledge: in P2 students learn that some objects have an effect on other objects at a distance. In some cases, such as sound and light, the effect is through radiation which travels out from the source to the receiver. In other cases action at a distance is explained in terms of the existence of a field of force between objects, such as a magnetic field or the universal gravitational field. Objects change their velocity of motion only if there is a net force acting on them. Gravity is a universal force of attraction between all objects however large or small, keeping the planets in orbit round the Sun and causing terrestrial objects to fall

	towards the centre of the Earth. Skills: In P2 students link forces to pressure, they can describe the effects of balanced and unbalanced forces. They can describe how a force can change the shape of an object (a spring) and use that to measure the size of a force. Students can use the big idea of forces to explain how a sound wave is produced, travels and is detected.
Year 8	Skills: In P3 students can use the idea of forces to explain the cause of pressure in fluids, why objects float and the cause of drag forces on an object moving through a fluid. The big idea of forces is used in the particle model to explain the difference between solids, liquids and gases and that materials expand or contract according to their temperature. In P4 they link forces to the motion of the planets in the solar system and to the effect of the Earth's magnetic field. They are able to calculate the weight of an object in different strength gravitational fields. During LfL they use forces to measure different aspects of their health (weight, grip-strength etc)
Year 9	Knowledge: In P5 students are introduced to Newton's 1st law. They learn that forces can cause rotational movement and learn to calculate turning moments produced by forces. Skills: In P5 students will describe how a lever can multiply a force and identify that ramps and pulleys are simple machines that make things easier to move. They will be able to state what is meant by a force field and link that to magnetic and gravitational fields.
GCSE	Knowledge: Revisit of everything at KS3. Mainly in CP2, CP7-8, CP10 and CP13 Skills: The big idea of forces can be applied at some point to many topics at GCSE, but key topics where it will be a big focus are: CB1 - application to transporting substances CB8 - application to exchange and transport in animals CC5-7 - application to bonding CC10 - application to electrolysis CC14 - application to rates of reaction
Future Life and Potential Careers	Future lives: Our young people will be able to take an understanding of the effect forces have on the objects around them into a wide variety of careers both in STEM fields and elsewhere.

Big Idea	Energy & Matter
Prior knowledge from primary	Energy is not explicitly taught at KS1/2, but students will have developed their own ideas about energy from everyday life, so it is still important to use the BEST resources to help identify and address misconceptions. Many secondary teachers are surprised about the level of the 'electricity' topic at KS2 (which is where a number of misconceptions about energy can arise), with the following be covered in Y6: <ul style="list-style-type: none"> • 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
Year 7	Knowledge: Many processes or events involve changes and require energy to make them happen. Energy can be transferred from one store to another in various ways. In these processes some energy transferred in a way that means it is less easy to use. Energy cannot be created or destroyed. Energy obtained from fossil fuels is no longer available in a convenient form for use. <i>Food provides materials and energy for organisms to carry out the basic functions of life and to grow (this is introduced briefly and developed in Y8).</i> Animals obtain energy by breaking down complex food molecules and are ultimately dependent on green plants for energy. In any ecosystem there is competition among species for the energy and materials they need to live and reproduce. Skills: In P1 students should begin to link their knowledge of 'electricity' (a phenomenon that students remember well from KS1&2) with their ideas about energy. More able students will be able to link the 'Big Idea' of energy to C2 as well when talking about evaporation etc.
Year 8	Knowledge: In B3 students learn that food provides materials and energy for organisms to carry out the basic functions of life and to grow. In P3 they revisit the knowledge about energy stores and transfers from Y7 in detail.

	Skills: Students link their knowledge of energy to respiration in B3 and to combustion and other chemical reactions in C3 as well as global warming. In P3 student apply their knowledge from Y7 to state changes, energy transfers by heating and radiation as well as efficiency calculations and how we get charged for the energy used in our homes. In B4 students apply their ideas about energy to unicellular organisms. Throughout C4 (Metals and their uses & Rocks) there are a range of opportunities for students to apply their ideas about energy to different chemical processes. In P4 student apply their knowledge of energy transfers by radiation to the topic of 'light'.
Year 9	Knowledge: In B5 students learn that some plants and bacteria are able to use energy from the Sun to generate complex food molecules and animals obtain energy by breaking down complex food molecules and are ultimately dependent on green plants for energy. Skills: Throughout C5 (Making Materials & Reactivity) there are a range of opportunities for students to apply their ideas about energy to different chemical processes. Throught P5 (Forces and Motion & Force Fields and Electromagnets) there are a range of opportunities for students to apply their ideas about energy stores and transfers and lots of opportunities to identify misconceptions as students suggests explanations for more complex phenomenon.
GCSE	Knowledge: Revisit of everything at KS3 mainly in CP3 & CP7 Skills: The big idea of energy can be applied at some point to almost every topic at GCSE, but key topics where it will be a big focus are: CB1 application to enzymes and different methods of transporting substances CB6 application to photosynthesis CB8 application to respiration CB9 application to ecosystems CC5-7 application to the properties of substances that result from different types of bonding CC14 appliaction to rates of reaction CC15 application to endo&exothermic reactions CC16 application to combustion CC17 application to climate change CP4&5 appliaction to waves transferring energy CP9 application of energy being transferred electrically CP11 application to transmitting electricity via the National Grid. CP12 application to specific heat capacity and specific latent heat with calculations CP13 application of energy being transferred to and from the elastic store with calculations
Future Life and Potential Careers	Future lives: Our young people will be able to go on to make informed choices about responsible energy usage and understand how they are charged for energy to support management of their finances.

Big Idea	Survival & diversity
Prior knowledge from primary	Students learn about habitats and microhabitats right from Y2, but in Y6 they focus more on classification, so it may have been a while since students remember learning about habitats.
Year 7	Knowledge: <i>This 'Big Idea' is introduced in Y8. In preparation, there is a lot of scientific terminology to learn in the B2 topic so that students can effectively communicate their ideas, and by considering how organisms interact with their environment, students will be putting down the building blocks to understand the 'Big Idea' of survival and diversity as they move into Y8.</i> Terminology used in B2: evolution, sexual reproduction, fertilisation, life cycles, endangered species, variation, continous, discontinous, hybrid, adaptation, inherited, environmental, habitat, population, community, distribution, ecosystem, food chains and webs, biodiversity
Year 8	Knowledge: In B3 students learn that over countless generations changes resulted from natural diversity within a species which makes possible the selection of those individuals best suited to survive under certain conditions. Organisms not able to respond sufficiently to changes in their environment become extinct. Skills: In B3, in the Lifelab lessons, students are given the opportunity to apply their knowledge on diet and lifestyle to how health is affected and ultimately survival. They can also apply their knowledge of the adaptations of exchange surfaces in different animals. In C3, students can apply their knowledge of how climate change impacts evolution. In B4, students can use their knowledge of biodiversity to classify different habitats and explain why preserving biodiversity has a huge impact on human life.

Year 9	<p>Knowledge: In B5, students learn that genetic information in a cell is held in the chemical DNA in the form of a four letter code. Genes determine the development and structure of organisms. In asexual reproduction all the genes in the offspring come from one parent. In sexual reproduction half of the genes come from each parent. All life today is directly descended from a universal common ancestor that was a simple one-celled organism.</p> <p>Skills: In B5, students can link their knowledge of adaptations in animals and apply it to plants. This includes how different parts of a plant are adapted to their function and how farmers use their knowledge to maximise crop growth (linked to survival).</p> <p>Students apply their knowledge of DNA to the extraction of it (practical skill: filtering Yr7 C2) and they revisit ideas on survival and extinction and apply it to recreating animals.</p>
GCSE	<p>Knowledge: Revisit of everything at KS3 mainly in CB3, CB4 & CB9</p> <p>Skills: CB3 application to DNA structure and extraction</p> <p>CB4 application to Darwin's theory of evolution by natural selection and selective breeding (linked to survival)</p> <p>CB9 application to ecosystems</p>
Future Life and Potential Careers	<p>Triple only:</p> <p>SB3: advantages and disadvantages of sexual and asexual reproduction</p> <p>SB4: pentadactyl limb</p> <p>SB9: food security</p> <p>Understanding the 'big idea' of survival and diversity allows students to develop their knowledge and understanding of reproduction which will allow our young people to make informed decisions about family planning and lifestyle choices.</p> <p>Our young people will be able to go on to make informed choices about the environment and climate change and be able to recognise how the way that they live their lives impacts others.</p>

Big Idea	Our Planet
Prior knowledge from primary	<p>In year 1, pupils should be taught to:</p> <ul style="list-style-type: none"> - observe changes across the four seasons; - observe and describe weather associated with the seasons and how day length varies. <p>In year 3, pupils are taught to:</p> <ul style="list-style-type: none"> - compare and group together different kinds of rocks on the basis of their appearance and simple physical properties; - describe in simple terms how fossils are formed when things that have lived are trapped within rock; - recognise that soils are made from rocks and organic matter. <p>In year 5, pupils are taught to:</p> <ul style="list-style-type: none"> - describe the movement of the Earth, and other planets, relative to the Sun in the solar system; - describe the movement of the Moon relative to the Earth; - describe the Sun, Earth and Moon as approximately spherical bodies;

	- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.
Year 7	<p>Knowledge: <i>This 'Big Idea' is introduced in Y8. In preparation, there is scientific terminology to learn in the P2 topics so that students can effectively communicate their ideas. These topics also contain a number of key building blocks that pupils will need to understand the 'Big Idea' of our planet as they move into Y8. P2 introduces ideas about forces which are built on when introducing orbits, as well as waves which is required to understand causes of seasons in P4 and causes of climate change and greenhouse effect in C3.</i></p> <p>Terminology used in P2: absorb, transmit, reflect, force, balanced.</p>
Year 8	<p>Knowledge: In P4, pupils learn that the solar system is comprised of our Sun and eight planets and other smaller objects orbiting it and that some planets rotate on their axis as they orbit the Sun, with the Earth's axis being tilted. They also learn that the solar system is part of a galaxy of stars, one of many millions in the Universe, enormous distances apart, many of the stars having planets.</p> <p>In C4, pupils learn that heat from the Earth's interior causes movements in the molten rock below the surface. They also learn about how the solid surface of the Earth is constantly changing through the formation and weathering of rock in the rock cycle, and how igneous, metamorphic and sedimentary form.</p> <p>Skills: In C3, pupils use ideas about combustion and absorption, transmission and reflection of waves to understand the greenhouse effect and how changes in the Earth's atmosphere have led to changes in the Earth's climate.</p> <p>In C4, pupils use ideas about changes of state how igneous, metamorphic and sedimentary rocks form to explain the differences in their properties (including differences in crystal size and properties for intrusive and extrusive igneous rocks).</p> <p>In P4, pupils use their ideas about orbits and the rotation of Earth on its axis as it moves around the Sun to understand causes of day and night, and how the tilt of the Earth's axis as it orbits the Sun causes differences between seasons.</p>
Year 9	Knowledge: In P5, pupils learn that the Earth has a gravitational and a magnetic field, and learn about the factors that affect the strength of these fields.
GCSE	<p>Knowledge: In CC17, pupils learn about how the composition of the Earth's atmosphere has changed over the last 4.5 billion years, and what factors caused these changes. They then learn about the causes and evidence for human-caused climate change, as well as the predicted impacts of climate change and suggested ways of limiting these impacts.</p> <p>In CB9, pupils learn about the processes involved in the water cycle.</p> <p>Skills: In CC17 pupils evaluate the evidence for human activity causing climate change.</p>
Future Life and Potential Careers	<p>Triple only: SP7 Astronomy</p> <p>Jobs: space sector, geology, climate science.</p> <p>Future life: understanding of causes and effects of climate change will allow pupils to make informed decisions about the environment and climate change, which will have an increasingly large impact on lives of pupils.</p>