

## **Science**

### **Skill**

Science is the systematic study of the structure and behaviour of the physical and natural world through observation and experiment. We foster curiosity in our students, and teach them to generate hypotheses and systematically gather evidence. Scientists can solve problems logically, apply reasoning, work both in a team and independently and can communicate their ideas clearly.

### **Experiences**

Every student will have the opportunity to take part in a variety of science related activities with a particular emphasis on practical investigation and the conclusions that can be drawn from it. They will be encouraged to question how the world works and to use their scientific knowledge to find explanations.

### **Character**

The study of science aims to develop systematic and logical thought to enable students to explain observations and solve problems. This will mean that students will need to develop resilience as they are exposed to increasingly more difficult and complicated concepts as they progress through their science career in school.

### **Criticality**

Scientific thinking involves applying scepticism to ideas and forming testable hypotheses. This type of thinking can lead to experiments, and it can help people develop skills for determining whether something they hear or see is true. Scientists are trained to only trust what is supported by evidence, so scientific thought requires not believing something unless it is supported with proof. Science, however, also requires creativity, so scientific thinking includes determining means of testing specific ideas to prove them true or false. In many cases, people who think in a scientific manner are able to devise experiments to test

Biologists seek answers to the big questions that inspire them, to gain a better understanding of how the body and nature works, and that is our aspiration for our biologists of all key stages.

Our biology students have excellent memory and observational skills and use nature as a laboratory to combine the principles of biology with other sciences to study the diversity and interactions of plants, animals and micro-organisms in their natural environment.

### **The Biology Story, Years 7-11**

Biology is the story of life. Year 7 begins this story with a recap of human biology from key stage two, including the main organ systems. Students then 'zoom in' to look at animal cells, contrasting them with specialised cells and plant cells. They go on to look at reproduction: how more cells are produced. To develop their understanding of this at the cellular level, students learn about reproductive organs, the menstrual cycle, reproduction and birth. Following this, Students learn how reproduction, with mutation, leads to adaptations, enabling organisms to survive in complex, interrelated ecosystems. They learn about food chains within these ecosystems, including how photosynthesis is used to generate glucose.

Having learned about the building blocks of life and their creation, students move on to the sustenance of life. Learning about the digestive system gives them a chance to combine their understanding of cells, tissues, organ systems and their knowledge of how animals take in nutrition and obtain glucose. They go on to learn about aerobic and anaerobic respiration and how the respiration system combines with the digestive system to sustain life. Students examine how life defends itself against hostile microorganisms and apply their conceptual understanding of defines a living organism things to assess whether viruses can be thought of as alive.

Students are now ready to revisit cells, knitting together their prior learning on cells, digestion and respiration to examine how cells use water, nutrients and oxygen. With this more in-depth understanding of cell biology they revisit the digestive system, learning about the importance of enzymes in the breaking down of biological molecules in order to release these nutrients. They move on to look at the blood and the circulatory system, and its role in transporting the products of digestion to cells. This leads on to an examination of breathing and gas exchange, which in turn leads onto respiration, which is studied in greater detail.

Students now repeat the journey they have just completed for human biology, this time learning about plant biology. They begin with photosynthetic and root hair cells, which, like the digestive system in humans, are significant in acquiring nutrients. They move on to study the xylem and phloem, which, like the circulatory system, transport these nutrients around the plant, before adding to this an understanding of the movement of water around plants: transpiration.

Students now move onto diseases, beginning with non-communicable diseases, where they can see how lifestyle choices can disrupt the body systems they have learned about. Learning about communicable diseases allows students to revisit their learning on the components of blood and fungus, viruses and bacteria.

The next step in the story is to turn to homeostasis, learning how cells and individual systems communicate with each other through the nervous systems and hormones. Study of hormones naturally leads onto menstruation and fertility, which in turn leads on to reproduction and thence to reproduction, genetics and evolution, including contemporary ethical and scientific debate around these issues. This finally takes students to ecology, where they learn how both animals and plants have evolved to live together within environments and how competition leads to further evolution. They learn how these ecosystems can be threatened, or protected, through human action.

**Programme of study Year 8, 9, 10 & 11 Biology**

	<b>Autumn 1</b>	<b>Autumn 2</b>	<b>Spring 1</b>	<b>Spring 2</b>	<b>Summer 1</b>	<b>Summer 2</b>
<b>Year 7</b>	Cells		Reproduction		Ecosystems	
<b>Year 8</b>	Ecosystems		Breathing and respiration		Mircoorganisms	
<b>Year 9</b>	Cell structure and division	Organisation and the digestive system		The circulatory system and respiration		Intervention and challenge
<b>Year 10</b>	Disease and medicine	Respiration	Photosynthesis	The nervous system	Hormonal system	Intervention and challenge
<b>Year 11</b>	Digestion and food	Circulation and non-communicable diseases	Communicable diseases and human defence	Organising an ecosystem. Biodiversity. Adaptations.	Examination	

## Year 7 and 8 fundamentals

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 7, Term 1: cells	<p><b>The parts of animal and plant cells and their functions.</b></p> <ul style="list-style-type: none"> <li>• Be able to name, explain the function of and identify / label on a diagram parts of plant and animal cells</li> <li>• Be able to list which organelle is present in which cell.</li> </ul> <p><b>To prepare a slide and use a microscope</b></p> <ul style="list-style-type: none"> <li>• Be able to identify parts of the microscope and label a diagram of one.</li> <li>• Be able to explain why microscopes are used and what they are used to observe.</li> <li>• Be able to use a microscope to obtain a clear image of plant and animal cells and explain the different steps involved</li> </ul>	Nucleus, cytoplasm, cell membrane, vacuole, cell wall, chloroplast, organ, tissue, cell, microscope, slide, eyepiece lens, objective lens, coarse and fine focussing wheels, coverslip, stage, focus, magnification, scaling needle.
Year 7, Term 2: reproduction	<p><b>The role of gametes and how they are specialised.</b></p> <ul style="list-style-type: none"> <li>• Be able to use the term gamete and identify them as sperm and egg cells.</li> <li>• Define the term fertilisation and explain what happens in fertilisation</li> <li>• identify examples of internal and external fertilisation, including human fertilisation.</li> <li>• Be able to describe the structure of egg and sperm cells and their functions.</li> </ul> <p><b>To understand the scientific method and how experiments are carried out</b></p> <ul style="list-style-type: none"> <li>• Be able to explain Redi's experiment</li> <li>• Be able to explain what makes a good observation</li> <li>• Be able to explain what valid data looks like.</li> <li>• Explain what is done with anomalous results and how to identify them.</li> <li>• Describe trends and patterns in tabulated and graphical data.</li> </ul>	Hypothesis, prediction, experiment, data, observation, conclusion, theory, evaluation, observation, gamete, egg, sperm, nucleus, streamlined, enzyme, cytoplasm.
Year 7, Term 3: ecosystems	<p><b>How animals and plants are adapted to live in hot / cold conditions.</b></p> <ul style="list-style-type: none"> <li>• Be able to list some physical environmental features.</li> <li>• Give specific examples of adaptations, including the size of ears, feet, forward and sideward facing eyes, and defence mechanisms.</li> <li>• Relate adaptations to an organisms need for survival and link to the theory of natural selection.</li> </ul> <p><b>To draw and interpret bar and scatter graphs</b></p> <ul style="list-style-type: none"> <li>• Be able to identify the independent, dependent and control variables in any investigation and plot them on axes.</li> <li>• Accurately draw and label bar and scatter graphs, including lines and curves of best fit</li> <li>• Use the variables to create a descriptive title.</li> <li>• Be able to interpret the trend / pattern shown by different graphs</li> </ul>	Relationship, line of best fit, axis, scale, variable, adaptation, surface area, habitat, ecosystem, community

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 8 term 1: ecosystems	<p><b>How animals and plants are adapted to live in hot / cold conditions.</b></p> <ul style="list-style-type: none"> <li>• Be able to list some physical environmental features.</li> <li>• Give specific examples of adaptations, including the size of ears, feet, forward and sideward facing eyes, and defence mechanisms.</li> <li>• Relate adaptations to an organisms need for survival and link to the theory of natural selection.</li> </ul> <p><b>To draw and interpret bar and scatter graphs</b></p> <ul style="list-style-type: none"> <li>• Be able to identify the independent, dependent and control variables in any investigation and plot them on axes.</li> <li>• Accurately draw and label bar and scatter graphs, including lines and curves of best fit</li> <li>• Use the variables to create a descriptive title.</li> <li>• Be able to interpret the trend / pattern shown by different graphs</li> </ul>	Relationship, line of best fit, axis, scale, variable, adaptation, surface area, habitat, ecosystem, community
Year 8 term 2: breathing and respiration	<p><b>Explain what aerobic respiration is and write the word equation</b></p> <ul style="list-style-type: none"> <li>• Explain what animals and plants use energy for</li> <li>• Differentiate between respiration and breathing.</li> <li>• Explain where glucose and oxygen are obtained from and which organs allow them to get into the body. Recognise that the reactants travel around the body in the blood.</li> </ul> <p><b>Measure peak flow or tidal volume and calculate a mean of results</b></p> <ul style="list-style-type: none"> <li>• Calculate a mean.</li> <li>• Explain anomalous results, how to identify them, and when to omit them.</li> </ul>	Energy, respiration, oxygen, glucose, carbohydrate, reactant, product, estimate, ventilation, peak flow, tidal volume, mean, calculate, trachea, lung, diaphragm, muscles, lactic acid, aerobic respiration, nicotine, tar, carbon monoxide, plasma, tissue fluid.
Year 8 term 3: micro-organisms	<p><b>Explain what diffusion is</b></p> <ul style="list-style-type: none"> <li>• Explain the difference between unicellular and multicellular organisms.</li> <li>• Explain that organisms require substances from their environment in order to survive.</li> <li>• Explain and exemplify diffusion and the factors that affect its rate</li> </ul> <p><b>To carry out an investigation into yeast respiration</b></p> <ul style="list-style-type: none"> <li>• Write the equation for anaerobic respiration in yeast.</li> <li>• Relate the products of this reaction to the uses of yeast – brewing and baking.</li> <li>• Carry out an investigation into the action of yeast to demonstrate its uses and applications in life.</li> </ul>	Yeast, multicellular, budding, asexual reproduction, diffusion, particles, concentration, solute.

## Year 9, 10 and 11 fundamentals

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 9 autumn term: Cell structure and division	<ul style="list-style-type: none"> <li>• Can identify a plant and animal cell from a diagram and label the parts</li> <li>• Can describe what diffusion and osmosis are</li> <li>• Can use a light microscope and calculate magnification</li> <li>• Can state that human body cells have 46 chromosomes and gametes have 23</li> <li>• Can state what a stem cell is and what it can be used for</li> <li>• Can state the meaning of the key terms mitosis, chromosome, gamete, gene</li> <li>• Can tell the difference between tissues, organs and organ systems and give examples</li> <li>•</li> </ul>	Magnification, focus, nucleus, cytoplasm, mitochondria, membrane, chloroplasts, vacuole, eukaryotic, prokaryotic, Differentiate, specialised, sperm, muscle, egg, organ system, tissue Xylem, phloem, diffusion, osmosis, Active Transport, multicellular, Chromosomes, mitosis, meiosis, Stem cells, gamete, gene
Year 9 spring term: Organisation and digestion  Circulation	<ul style="list-style-type: none"> <li>• Can identify some organs of the digestive system and state their functions</li> <li>• Can state what an enzyme does and the factors that affect how well it works</li> <li>• Can state the main components of blood and their function</li> <li>• Can state the main structures and function of the heart</li> <li>• Can list the main structures of the gas exchange system and state what happens in the alveoli</li> </ul>	Cells, tissue, organ Digestion, enzyme, catalysts, denature Stomach, liver, pancreas, small and large intestine, bile. Carbohydrate, sugar, Benedicts, Starch, lipids, protein, amino acids, Biuret Metabolism, substrate, active site Artery, vein, capillary, valve, oxygenated, deoxygenated, double circulatory, atria, ventricle, stent, statins, pacemaker, lungs, alveoli, surface area, gas exchange
Year 9 summer term: Respiration	<ul style="list-style-type: none"> <li>• Can describe aerobic respiration and write the word equation</li> <li>• Can describe anaerobic respiration and state the word equation</li> <li>• Can describe how heart rate, breathing rate and breath volume change with exercise</li> </ul>	Aerobic, anaerobic, contract, breath volume, glycogen, glucose, lactic acid, metabolism, urea

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 10 autumn term: Disease and medicine	<ul style="list-style-type: none"> <li>• Can state what a pathogen is and the ways it can spread disease</li> <li>• Can state some ways in which the body defends itself against the entry of pathogens</li> <li>• Can describe some signs of plant disease and state some examples of plant defence responses</li> <li>• Can describe why people are vaccinated and state what vaccines contain</li> <li>• Can describe what an antibiotic is and decide whether a painkiller or an antibiotic should be used to treat an illness</li> </ul>	Pathogen, communicable, bacteria, virus, fungi, protest, toxins, vector, isolate, vaccine, antigen, antibody, immune, HIV, salmonella, malaria, barrier, ingest  Vaccinate, antibiotics, placebo, double blind

Respiration	<ul style="list-style-type: none"> <li>• Can describe aerobic respiration and write the word equation</li> <li>• Can describe anaerobic respiration and state the word equation</li> </ul> <p>Can describe how heart rate, breathing rate and breath volume change with exercise</p>	Aerobic, anaerobic, contract, breath volume, glycogen, glucose, lactic acid, metabolism, urea
Year 10 spring term: Photosynthesis	<ul style="list-style-type: none"> <li>• Can state what photosynthesis is and write the word equation</li> <li>• Can list factors that affect the rate of photosynthesis and the effect they have</li> </ul>	Endothermic, chloroplast, glucose, light intensity, chlorophyll, algal cells, starch, cell walls, amino acids, limiting factor
The nervous system	<ul style="list-style-type: none"> <li>• Can name some human internal conditions that need to be controlled</li> <li>• Can order the events involved in a reflex action and state what a neurone and a nerve are</li> </ul>	Homeostasis, blood glucose, automatic, receptor, effector, impulse, CNS, sensory, relay, motor, medulla
Year 10 summer term:	<ul style="list-style-type: none"> <li>• Can state what hormones are and what they do</li> <li>• Can state that blood glucose concentrations are controlled by insulin from the pancreas</li> <li>• Can identify the reproductive hormones in women and men and</li> <li>• Can describe what happens during the menstrual cycle</li> </ul>	Endocrine, gland, pituitary, target organ, pancreas, thyroid, ovaries, testes, feedback, glucagon, insulin, diabetes Testosterone, oestrogen, FSH, LH, contraceptive, IVF

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 11 autumn term: Digestion and organisation  Cells and cell division	<ul style="list-style-type: none"> <li>• Can tell the difference between tissues, organs and organ systems and give examples</li> <li>• Can identify some organs of the digestive system and state their functions</li> <li>• Can state what an enzyme does and the factors that affect how well it works</li> <li>• Can identify a plant and animal cell from a diagram and label the parts</li> <li>• Can describe what diffusion and osmosis are</li> <li>• Can use a light microscope and calculate magnification</li> <li>• Can state that human body cells have 46 chromosomes and gametes have 23</li> <li>• Can state what a stem cell is and what it can be used for</li> <li>• Can state the meaning of the key terms mitosis, chromosome, gamete, gene</li> <li>•</li> </ul>	<p>Cells, tissue, organ Digestion, enzyme, catalysts, denature Stomach, liver, pancreas, small and large intestine, bile. Carbohydrate, sugar, Benedicts, Starch, lipids, protein, amino acids, Biuret Metabolism, substrate, active site Magnification, focus, nucleus, cytoplasm, mitochondria, membrane, chloroplasts, vacuole, eukaryotic, prokaryotic, Differentiate, specialised, sperm, muscle, egg, organ system, tissue Xylem, phloem, diffusion, osmosis, Active Transport, multicellular, Chromosomes, mitosis, meiosis, Stem cells, gamete, gene</p>

<p>Year 11 spring term: Adaptations, interdependence and competition Organising an ecosystem Biodiversity</p>	<ul style="list-style-type: none"> <li>• Can state what is meant by population, community and ecosystem</li> <li>• Can identify biotic or abiotic factors</li> <li>• Can state examples of animal and plant adaptations and say why they are important</li> <li>• Can describe the events in the water cycle</li> <li>• Can use a diagram of the carbon cycle to describe the main processes involved</li> <li>• Can state why biodiversity means</li> <li>• Can state some ways that air, land and water are polluted and their effects</li> <li>• Can state the meaning of producer, consumer, predator, prey and identify them in a food chain</li> <li>• Can state what causes global warming and state one biological consequence of it</li> </ul>	<p>Ecosystem, abiotic, community, species, biotic, predator, prey, competitor, transect, mean, median, mode, quadrat, extremophile, adaptations, functional, behavioural Consumers, carbon cycle, biodiversity, landfill, pyramids of biomass, producers,</p>
<p>Year 11 summer term:</p>	<ul style="list-style-type: none"> <li>• Exams</li> </ul>	