Curriculum overview: Biology

Key Stage 2

Living things and their habitats:

- Life cycles of a mammal, an amphibian, an insect and a bird
- Reproduction in some plants and animals.
- Classification into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals

Animals:

- Describe changes as humans develop to old age
- 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 bodies function
- Describe the ways in which nutrients and water are transported within animals

Evolution:

- Recognise living things have changes over time (studying fossils)
- Recognise that offspring can vary from their parents
- Identify how birds and animals are adapted to suit their environment

Key skills/content requirements at GCSE

Biological content and understanding

Topics students need to have a good understand of

1. Cells and organisation
2. Relating structure to function and adaptations
3. Movement within cells
4. Principles of digestion
5. Circulatory system and blood
6. Communicable and non communicable diseases
7. Bioenergetics (photosynthesis and respiration)
8. Responding to changes (nervous and endocrine systems)
9. Ecology and natural cycles
10. Biodiversity and factors affecting it
11. Genetics
12. Evolution and extinction

Students will need to know appropriate key terminology in order to describe and explain the biological concepts within each topic and how they interrelate with appropriate academic depth.

Students will need to know a range of required practical's. These require a high level of applied practical knowledge.

Within each topic, good understanding of human biology comes from understanding of how body systems inter-relate with each other. Within environmental biology, students need to be able to explain how plants and animals are

Scientific skills

Development of scientific thinking

- Understand how scientific methods and theories develop over time.
- Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.
- Appreciate the power and limitations of science and consider any ethical issues which may arise.
- Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.
- Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences.
- Recognise the importance of peer review of results and of communicating results to a range of audiences.

Experimental skills and strategies

- Use scientific theories and explanations to develop hypotheses.
- Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
- Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.
- Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.
- Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative
- Make and record observations and measurements using a range of apparatus and methods.
- Evaluate methods and suggest possible improvements and further investigations.

Analysis and Evaluation

- Presenting observations and other data using appropriate methods.
- Translating data from one form to another.
- Carrying out and represent mathematical and statistical analysis.

interdependent upon each other in addition to how humans can affect the natural environment making reference to current environmental issues. The fundamentals of genetics is based upon the appreciation of cell function and cycles. If the role of mutations is full understood, students can explain evolution and extinction with ease. How humans have been able to manipulate DNA and natural processes for their own advantage is paramount to understanding advances in genetic engineering.	▪ Representing distributions of results and make estimations of uncertainty. ▪ Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. ▪ Presenting reasoned explanations including relating data to hypotheses. ▪ Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. ▪ Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms. **Maths skills** ▪ Use scientific vocabulary, terminology and definitions. ▪ Recognise the importance of scientific quantities and understand how they are determined. ▪ Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate. ▪ Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). ▪ Interconvert units. ▪ Use an appropriate number of significant figures in calculation. ▪ Standard form ▪ Estimates and significant figures ▪ Averages ▪ Simple probability ▪ Algebra skills ▪ Graph skills The knowledge and skills in this section apply across the specification, including the required practicals.

Curriculum Overview

Biological content and understanding: Each year students will learn about a range of human, environmental and genetic biology topics to help develop their biological understanding of key content. This portable knowledge is what students are entitled to know if they are to be a well rounded scientist.
Scientific skills: *For each year group specific skills are delivered within topics. Each year skill development will embed and build upon what was learnt in the previous year. Across all year groups, lessons with a practical focus have been integrated into schemes of work to guide students though the process of; selecting apparatus, writing a methodology, working in a systematic manner, analysing data to draw conclusions, making evaluations and improvements.*
Red italics is triple science knowledge only

	Term 1	Term 2	Term 3	Portable knowledge	Key vocabulary
Year 7	**Organisation** ▪ Plants and animal cells ▪ Microscope invention ▪ The theory of cell biology ▪ Animal tissues and organs ▪ Plant structure and organs ▪ Diffusion ▪ Osmosis	**Body systems** ▪ Digestive System ▪ Balanced Diet and Food Tests ▪ Digestion and enzymes ▪ Theory of enzyme action ▪ Heart and Circulation ▪ Defects of the circulatory system ▪ Lung structure and breathing ▪ Respiration ▪ Effect of exercise on lungs and heart ▪ Diseases of lungs ▪ Nervous System ▪ Skeletal system	**Ecosystems** ▪ Food chains and webs ▪ Pyramids of numbers and biomass ▪ Pesticides, fungicides and effects ▪ Colony collapse disorder in bees ▪ Competition in plants and animals ▪ Predator/prey relationships ▪ Adaptations of animals- hot,dry,cold	Cells- organisation, structure, function and adaption Plant structure Movement between cells and its importance How body systems inter-relate Importance of respiration How the body responds to external stimuli Interdependence of plants and animals within ecosystems Relationships and adaptations of organisms	Eukaryotic Prokaryotic Nucleus Cytoplasm Cell membrane Mitochondria Ribosomes Chloroplasts Vacuole Xylem Phloem Stomata Guard cells Spongy mesophyll Palisade mesophyll Diffusion Osmosis Carbohydrases

					Protease Lipase Aorta Vena cava Pulmonary artery Pulmonary vein Artery Vein Capillary Lungs Trachea Bronchi Bronchioles Glucose Reflexes Senses Stimuli Antagonistic Ecosystem Interdependence Adaptations Producer Consumer Predator Prey Pesticides Fungicides
Year 8	**<u>Environment</u>** ▪ Photosynthesis and limiting factors ▪ Plant adaptations (include leaf and testing for starch) ▪ Deforestation and its effects ▪ Climate change and global warming ▪ Plastics and their impact on the evironment ▪ Evolution and natural selection ▪ Extinction and conservation	**<u>Immunity</u>** ▪ Communicable and non communicable diseases ▪ Pathogens ▪ Non specific immune response ▪ Specific immune responses ▪ History of medicine ▪ Antiseptics, antibiotics and resistance ▪ Vaccination and importance of herd immunity in relation to COVID-19 ▪ Preventing non communicable diseases	**<u>Variation</u>** ▪ Continuous and discontinuous variation ▪ Reproductive organs and cells ▪ Human reproduction ▪ Puberty ▪ DNA and genetic variation ▪ Mutations (Chernobyl) and inherited disorders ▪ Selective breeding ▪ Cloning ▪ Genetic modification and its impacts upon society	As Yr 7 plus: Importance of photosynthesis as part of the carbon cycle How plants are adapted to maximise the rate of photosynthesis How humans can farm to increase the rate of photosynthesis Causes and impact (short and longterm) of climate change How humans affect the environment directly and indirectly Process of natural selection Evolution theories Causes of extinction and what humans can do about it Differences between communicable and non communicable diseases Preventing diseases from spreading- links to COVID-19	Photosynthesis Respiration Limiting factor Quadrat Pollution Global warming Natural selection Evolution Disease Pathogens Antiseptics Antibiotics Resistance Vaccination Nicotine Addictive Carcinogens Variation Genetic Environmental Uterus Fallopian tubes Oviduct

				Human cellular response to disease Importance of scientific discoveries that aid our understanding of cellular immunity Development of drugs (vaccines, antiseptics, antibiotics) Human reproduction Causes of mutations Genetic engineering processes and advances	Ovum Sperm Fertilisation Fusion Hormones Mutation Cloning Modification
Year 9	**Cell biology** ▪ Plant and animal cells ▪ Required practical: microscopy ▪ Eukaryotic and prokaryotic cells ▪ Microscopy ▪ *Culturing microorganisms* ▪ Cell specialisation ▪ Differentiation and stem cells ▪ Mitosis ▪ Diffusion ▪ Required practical: osmosis ▪ Active transport ▪ Exchanging materials	**Organisation** ▪ Principles of organisation ▪ Digestive system ▪ Required practical: chemistry of food ▪ Enzymes ▪ Required practical: enzymes ▪ Efficiency of digestion ▪ Heart and circulation ▪ Blood ▪ Blood vessels ▪ Coronary heart disease ▪ Smoking, alcohol and diet ▪ Lifestyle ▪ Cancer ▪ Lungs and gas exchange ▪ Plants tissues and organs ▪ Transpiration	**Bioenergetics** ▪ Photosynthesis ▪ Limiting factors of photosynthesis ▪ Required practical: light and photosynthesis ▪ Adaptations and using glucose ▪ Respiration ▪ Anaerobic respiration ▪ Exercise ▪ The liver	Cell specialisation Cell cycles Movement between cells and its importance in survival of plants and animals Importance of cellular respiration Role of the respiratory system and circulatory in respiration Factors affecting the circulatory system (heredity and environmental) How exercise affects respiration Plant structure Importance of photosynthesis How plants are adapted to maximise the rate of photosynthesis	Eukaryotic Prokaryotic Sub-cellular structures Nucleus Cytoplasm Cell membrane Mitochondria Ribosomes Chloroplasts Vacuole Differentiation Mitosis Stem cell Diffusion Osmosis Active transport Enzyme Carbohydrases Amylase Protease Lipase Lipids Bile Emulsify Xylem Phloem Meristem Stomata Guard cells Spongy mesophyll Palisade mesophyll Epidermal tissues Aorta Vena cava Pulmonary artery

					Pulmonary vein Valves Artery Vein Capillary Coronary heart disease (CHD) Stents Statins Risk factor Benign tumour Malignant tumour Photosynthesis Respiration Limiting factor Aerobic respiration Anaerobic respiration Fermentation Oxygen debt Metabolism
Year 10	**Infection & Response** ▪ Communicable diseases ▪ Protist diseases – malaria ▪ First line of defence ▪ Second line of defence ▪ Vaccination ▪ MRSA ▪ Antibiotics and painkillers ▪ Discovery and development of drugs • *Development and use of monoclonal antibodies* • *Detection and identification of plant disease* • *Plant defence response*	**Homeostasis & Response** ▪ The importance of homeostasis ▪ The nervous system ▪ Reflex actions ▪ *The brain* ▪ *The eye* ▪ *Thermoregulation* ▪ Endocrine system and negative feedback ▪ Blood glucose ▪ Reproductive hormones ▪ *Blood glucose* ▪ *Osmoregulation* ▪ *Reproductive hormones* ▪ *Plant hormones*	**Ecology** ▪ Classification ▪ Ecology ▪ Biotic and abiotic factors ▪ Distribution of organisms ▪ Required practical: distribution of organisms ▪ Adaptations ▪ Levels of organisation in a food chain ▪ *Decomposition* ▪ *Impact of environmental change* ▪ Predator/prey cycles ▪ Carbon cycle and water cycle ▪ Biodiversity ▪ Population growth/water pollution ▪ Air pollution ▪ Land use ▪ Deforestation ▪ Maintaining biodiversity ▪ *Trophic levels in an ecosystem* ▪ *Food production*	Role of vectors in spreading disease Cellular response to pathogens Development of drugs (vaccines, painkiller, antiseptics, antibiotics) How the nervous system and endocrine system respond to external and internal stimuli Role of the endocrine system in mammals Interdependence of plants and animals within ecosystems Relationships and adaptations of organisms Causes of climate change Impact of climate change How humans affect the environment directly and indirectly	Communicable Pathogen Measles HIV Tobacco mosaic virus (TMV) Salmonella Gonorrhoea Rose black spot Malaria Vector Phagocytosis Antibodies Vaccination Antibiotics Placebo Double-blind trial *Monoclonal antibodies* *Hybridoma* *Nitrate deficiency* *Magnesium deficiency* *Physical* *Chemical* *Mechanical* Homeostasis Stimulus Receptors Coordination centres Effectors Reflex action Endocrine system

					Insulin Glucagon Type 1 diabetes Type 2 diabetes Oestrogen Follicle stimulating hormone (FSH) Lutenising hormone (LH) In vitro fertilisation (IVF) *Cerebral cortex* *Medulla* *Cerebellum* *MRI* *Accommodation* *Myopia* *Hyperopia* *Vasodilation* *Vasoconstriction* *Deamination* *Selective reabsorption* *ADH* *Thyroxine* Binomial system Ecosystem Interdependence Abiotic factors Biotic factors Adaptations Producer Quadrat Transect Predator Carbon cycle Water cycle Biodiversity Pollution Decomposers Pyramids of biomass Food security Mycoprotein
Year 11	**<u>Inheritance, variation & Evolution</u>** ▪ Sexual and asexual reproduction ▪ Meiosis ▪ DNA structure ▪ *Protein synthesis* ▪ *Gene expression and mutation* ▪ Inheritance – test cross			Cell cycles DNA structure Mechanisms of inheritance Genetic engineering processes Process of natural selection Evolution theories Causes of extinction	Sexual reproduction Asexual reproduction Meiosis DNA Gene Genome Mutation Gametes Allele Dominant

	▪ Inheritance – other examples ▪ Sex determination ▪ Genetic engineering ▪ Variation ▪ Selective breeding ▪ *Cloning* ▪ *Adult cell cloning* ▪ *History of genetics* ▪ *Theories of evolution* ▪ *Darwinian theory* ▪ *Evolution and speciation* ▪ Evolution – natural selection ▪ Evolution of antibiotic resistant bacteria ▪ Evidence for evolution – fossils ▪ Extinction				Recessive Heterozygous Homozygous Genotype Phenotype Cystic fibrosis Polydactyly Variation Evolution Natural selection Selective breeding Genetic engineering Fossils Extinction *Nucleotide* *Tissue culture* *Cuttings* *Embryo transplants* *Adult cell cloning* *Speciation*

GCSE External assessment:

Combined science is assessed by six written examinations, each exam lasting 1 hour and 15 minutes. All examinations are taken at the end of Year 11. Two grades are awarded as described in the table.

	Weighting	
Biology paper 1	16.7%	The qualification will be graded on a 17-point scale: 1 – 1 to 9 – 9, where 9 – 9 is the best grade. This counts as two GCSE grades**.**
Biology paper 2	16.7%	
Chemistry paper 1	16.7%	
Chemistry paper 2	16.7%	
Physics paper 1	16.7%	
Physics paper 2	16.7%	

Students studying the separate sciences will achieve three science GCSEs at the end of Year 11. These will be in the following subjects

- GCSE biology
- GCSE chemistry
- GCSE physics

All content is examined at the end of Year 11. All of the GCSE science courses are split into two units:

	Weighting	
Biology Paper 1	50%	A GCSE grade in Biology from grade 9 to grade 1
Biology Paper 2	50%	
Chemistry Paper 1	50%	A GCSE grade in Chemistry from grade 9 to grade 1
Chemistry Paper 2	50%	
Physics Paper 1	50%	A GCSE grade in Physics from grade 9 to grade 1
Physics Paper 2	50%	

Each examination is available at two tiers. Teachers will use internal class assessments to decide which tier is most appropriate for you.

Tier	**Available Grades**
Higher	4-9 if studying the separate sciences 4-4 to 9-9 if studying combined science
Foundation	4- 5 if studying the separate sciences 1-1 to 5-5 if studying combined science

In addition to acquiring knowledge and understanding, students learn a range of practical and investigative skills that are assessed in each of the 6 examinations.

SMSC in science:

Spiritual development in science

In the science department we look to maintain a neutral approach as we study issues and ideas which are sometimes a source of tension in our society today. The modern world is full of potential areas for conflict, when scientific and spiritual ideas come together. Students will study topics such as evolution and the universe's origins using an evidence-based approach. This means scientific theories can be introduced then evaluated from an unbiased perspective. From this students often see how it is possible for spiritual and scientific theories to exist alongside each other, and how this may lead to more tolerance of different viewpoints.

Moral development in science

Rapid advances in science have given us the opportunity to influence and change the world in which we live, often with positive outcomes. However, the new powers given to society by science have also led to moral issues arising, and in lots of cases vigorous debate surrounds these ideas, for example with genetically modified organisms. We give students the opportunity to engage with some of the most significant scientific developments and to weigh up the evidence to form their own conclusions on some moral issues facing society today. This is not only a key exam skill, but a vital skill for all students as they develop as young adults.

Social development in science

The impact of science on society is extremely significant. Medical advances in particular are changing the way we live, with a continued increase in global population and longer life expectancy. Students will study the scientific advances that have led to this, the problems caused and possible solutions to them, whilst being encouraged to deepen their own understanding and form and support views using scientific fact. Through this approach students will gain a wider perspective on the changing society that surrounds them.

Cultural development in science

Achievement in the field of science is truly global, and promoting cultural awareness is an intrinsic part of the science curriculum. From the Russian origins of the periodic table to the discovery of radioactivity by the French physicist Henri Becquerel, progress in all areas of scientific study is a consequence of a worldwide commitment to continuing discovery.