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
HT for Higher tier only

	Term 1	Term 2	Term 3	Portable knowledge	Key vocabulary
Year 7	**Introduction to Working Scientifically** ▪ Lab safety ▪ Risks and hazards ▪ Making observations ▪ Using a Bunsen ▪ Recording data ▪ Interpreting & evaluating data ▪ Command Words **Movement & cells** ▪ Multicellular organisation ▪ Plant & animal cell structure ▪ Human organs & organ systems	**Variation and human reproduction** ▪ Variation ▪ Causes & categories of variation ▪ Female reproductive system ▪ The menstrual cycle ▪ Male reproductive system & fertilisation ▪ How a foetus develops ▪ 7. Factors affecting a developing foetus	**Interpendence and plant reproduction** ▪ Food chains and webs ▪ Pyramids ▪ Predator prey relationships ▪ Competition ▪ Bioaccumulation ▪ Parts of a flower ▪ Pollination and fertilisation ▪ Adaptations of flowers for animal & wind pollination ▪ Seed dispersal methods ▪ Investigating seed dispersal by wind ▪ Pollination & crop production (importance of insects)	Cells- organisation, structure, function and adaption Plant structure Movement between cells and its importance Reproduction of plants and animals Interdependence of plants and animals within ecosystems Relationships and adaptations of organisms Effect of human activity on the environment	Eukaryotic Prokaryotic Nucleus Cytoplasm Cell membrane Mitochondria Ribosomes Chloroplasts Vacuole Xylem Phloem Stomata Guard cells Spongy mesophyll Palisade mesophyll Diffusion Puberty Menstrual cycle

	▪ Microscopes ▪ Observing plant cells ▪ Specialised cells ▪ Unicellular organisms ▪ Diffusion ▪ Skeleton & muscles ▪ Joints & chicken wing dissection ▪ Bone & joint injuries				
					Oesetrogen Progesterone Testosterone Ecosystem Interdependence Adaptations Producer Consumer Predator Prey Pesticides Fungicides

Year 8	**Breathing & Digestion** ▪ Lung structure ▪ Gas exchange ▪ Lung volume ▪ Smoking ▪ Asthma and exercise ▪ Balanced diet & unbalanced diet ▪ Food tests ▪ Digestive system ▪ Enzymes ▪ Enzymes investigation	**Respiration & Photosynthesis** ▪ Aerobic respiration ▪ Anaerobic respiration ▪ Effects of exercise ▪ Fermentation ▪ Photosynthesis and consolidation ▪ Photosynthesis practical ▪ Leaf adaptations ▪ Transpiration ▪ Minerals in plants	**Evolution, Variation & inheritance** ▪ DNA, genes and chromosomes ▪ Variation ▪ Types of variation and data ▪ Biodiversity and consolidation ▪ Natural selection ▪ Evolution ▪ Extinction ▪ Fossils	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 Causes of mutations Genetic engineering processes and advances	Photosynthesis Respiration Limiting factor Quadrat Pollution Global warming Natural selection Evolution Nicotine Addictive Carcinogens Variation Genetic Environmental Ovum Sperm Fertilisation Fusion Hormones Mutation Cloning Modification

Year 9	**Cell biology** ▪ Eukrayotic cells ▪ Stem cells ▪ Using stem cells ▪ Specialised cells ▪ Microscopy ▪ Microscope calcs ▪ Microscopy REQ PRAC ▪ Prokaryotic cells ▪ Cell cycle and mitosis ▪ Culturing bacteria ▪ Diffusion ▪ Osmosis ▪ Osmosis REQ PRAC ▪ Active transport **Organisation** ▪ Multicellular organisation ▪ Nutrients ▪ Food testing - practical ▪ Digestive system ▪ Enzymes ▪ Factors affecting enzymes ▪ Effect of pH on eznymes - Req Prac ▪ Digestive enzymes ▪ Stomach acid & bile	**Organisation** ▪ The heart ▪ Heart disorders & treatments ▪ Blood vessels ▪ Blood ▪ The lungs & consolidation ▪ Adaptations of the lungs ▪ Plant organs & leaf structure ▪ Transpiration ▪ Structure & function of stomata ▪ Plant transport systems ▪ Health & consolidation ▪ Effect of smoking on carcinogens on health ▪ Diet & exercise on health ▪ Cardiovascular disease ▪ Cancer **Infection and response** ▪ First line of defence ▪ second line of defence ▪ Vaccinations ▪ Antibiotics ▪ Bacteria and viruses diseases ▪ Fungi and Protist disease ▪ Discovering drugs ▪ Developing drugs ▪ Non-communicable disease	**Bioenergetics** ▪ Photosynthesis ▪ Uses of glucose ▪ Testing for starch (prac) ▪ Limiting factors ▪ REQ PRAC: Effect of light intensity on photosynthesis ▪ Write up of RPRAC & consolidation task ▪ Maximising photosynthesis (HT) - homework	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. Causes and effects of non-communicable diseases. Plants and factors that affect 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

Year 10	**Bioenergetics** ▪ Aerobic respiration ▪ Anerobic respiration ▪ Effects of exercise on the body: PRAC ▪ Metabolism (and the liver - HT) **Homeostasis & response** ▪ Principles of homeostasis ▪ Nervous system ▪ REQ. PRAC: reaction time ▪ Reflexes & synapses.	**Homeostasis & response** ▪ The brain ▪ The eye ▪ Eye disorders and treatments ▪ Thermoregulation ▪ The endocrine system ▪ Control of blood sugar ▪ Diabetes ▪ Osmoregulation ▪ The kidneys ▪ Kidney disease ▪ Hormones & reproduction (menstrual cycle) ▪ Controlling reproduction ▪ Tropisms ▪ REQ PRAC: investigating phototropism ▪ Using plant growth factors in agriculture **Ecology** ▪ Food chains & webs ▪ Interdependence ▪ Abiotic & biotic factors ▪ Sampling ▪ Sampling RPRAC1. Random sampling ▪ Sampling RPRAC2. Transect sampling ▪ 5. Adaptations ▪ Predator-prey cycles ▪ Competition	**Ecology** ▪ Nutrient cycle - decay & water cycle ▪ Rate of decay RPRAC ▪ Biodiversity ▪ Human impacts on the planet ▪ Global warming & climate change ▪ Energy transfers in food chains ▪ Sustainable food production	Respiration and the affect of exercise. How the nervous system and endocrine system respond to external and internal stimuli Role of the endocrine system in mammals	Respiration Limiting factor Aerobic respiration Anaerobic respiration Fermentation Oxygen debt Metabolism 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*

Year 11	**Ecology** ▪ Food chains ▪ Interdependence ▪ Biotic and abiotic factors ▪ Sampling distribution of organisms ▪ Distribution REQ PRAC ▪ Adaptations ▪ Competition ▪ Predator prey cycle ▪ Energy transfer in food chains ▪ Pyramids of number & biomass ▪ Decay & carbon cycle ▪ Rates of decomposition REQ PRAC ▪ Biodiversity and population growth ▪ Global warming ▪ Pollution ▪ Habitat destruction ▪ Maintaining biodiversity ▪ Food security & sustainability ▪ Efficiency of food production **Inheritance & variation** ▪ Types of reproduction ▪ Meiosis ▪ Plant, fungal & parasitic reproduction ▪ The genome and DNA structure & storage ▪ DNA & protein synthesis ▪ Gene expression & mutation ▪ Inheritance (genetic crosses) ▪ Inheritance ratios, family trees & sex determination ▪ History of genetics - Mendel	**Inheritance & variation** ▪ Genetic disorders ▪ Screening for genetic disorders ▪ Variation ▪ Evolution by natural selection ▪ Theories of evolution & acceptance ▪ Evidence for evolution - fossils ▪ Speciation ▪ Controlling variation: Selective breeding & genetic engineering ▪ Cloning & adult cell cloning ▪ Extinction ▪ Classification ▪ Naming species ***Paper 1 Revision*** ▪ Cell biology ▪ Organisation ▪ Disease ▪ Bioenergetics	**Paper 2 Revision** ▪ Homeostasis and Response ▪ Inheritance, variation and evolution ▪ Ecology	Causes of climate change Impact of climate change How humans affect the environment directly and indirectly. The formation of gametes and how traits are inherited. The causes of variation and old and modern techniques to manipulate genes. Organisms and their interactions with each other and the environment. Sampling techniques and human impacts on ecosystems.	Sexual reproduction Asexualreproduction Meiosis DNA Gene Genome Mutation Gametes Allele Dominant Recessive Heterozygos 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.

Key Stage 5 Curriculum Overview

Subject: Biology

Year 12

Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2	Assessments
Biological Molecules ▪ Carbohydrates and monosaccharides ▪ Disaccharides and polysaccharides ▪ Starch, glycogen and cellulose ▪ Lipids ▪ Proteins ▪ Enzymes Cells ▪ Methods of studying cells ▪ Electron microscope ▪ Microscopic measurements and calculations ▪ Eukaryotic cell structure ▪ Cell specialisation and organisation ▪ Prokaryotic cells and viruses ▪ Mitosis The cell cycle	Nucleic acids ▪ Structure of RNA and DNA ▪ DNA replication ▪ Energy and ATP ▪ Water and its functions Transport across membranes ▪ Structure of the cell surface membrane ▪ Diffusion, osmosis and active transport Co-transport and absorption Cell recognition and immune response ▪ Defence mechanisms ▪ Phagocytosis ▪ T lymphocytes and cell mediated immunity ▪ B lymphocytes and humoral immunity ▪ Antibodies ▪ Vaccination ▪ HIV	Genetic information, variation and relationships between organisms ▪ Genes and the triplet code ▪ DNA and chromosomes ▪ The structure of RNA ▪ Protein synthesis – transcription, splicing and translation Organisms exchange substances with their environment ▪ Gas exchange in single-celled organisms, insects, fish and the leaf ▪ Limiting water loss ▪ Human gas exchange system ▪ Enzymes and digestion ▪ Absorption of the products of digestion	Genetic diversity and Biodiversity ▪ Mutations ▪ Meiosis and genetic variation ▪ Genetic diversity and adaptation ▪ Types of selection ▪ Species and taxonomy ▪ Diversity within a community ▪ Species diversity and human activity ▪ Quantitative investigations of variation Mass Transport ▪ Haemoglobin and the transport of oxygen ▪ Circulatory system of a mammal ▪ Structure of the heart ▪ The cardiac cycle ▪ Blood vessels and their functions ▪ Transport in the xylem and the phloem	Revision; Biological Molecules Cells Organisms exchange substances with their environment Genetic information, variation and relationships between organisms Cell recognition and immune response	Populations and ecosystems ▪ Populations and ecosystems ▪ Variation in phenotype ▪ Natural selection ▪ Selection and evolution ▪ Isolation and speciation	Ongoing CPAC activities Bi-weekly assessments End of unit assessments PPQs homework

Key Stage 5 Curriculum Overview

Subject: Biology

Year 13

Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2	Assessments
Photosynthesis ▪ Photosynthesis: the light dependent reaction and the light independent reaction Respiration ▪ Glycolysis ▪ Link reaction and Krebs cycle ▪ Oxidative phosphorylation ▪ Anaerobic respiration Energy and ecosystems ▪ Food chains and energy transfers ▪ Energy transfer and productivity ▪ Nutrient cycles ▪ Natural and artificial fertilisers ▪ Environemtal issues	Response to stimuli ▪ Survival and response ▪ Plant growth factors ▪ Reflex arc ▪ Receptors Nervous coordination and control ▪ Neurones and nervous coordination ▪ Action potential ▪ Nerve impulse ▪ Synapse ▪ Skeletal muscle Homeostasis ▪ Principles of Homeostasis ▪ Feedback mechanisms ▪ Blood glucose regulation and diabetes ▪ Osmoregulation ▪ Control of heart rate	Inherited change ▪ Monohybrid inheritance ▪ Genetic crosses ▪ Dihybrid inheritance ▪ Codominance and multiple alleles ▪ Sex-linkage ▪ Autosomal linkage ▪ Epistasis ▪ Chi-squared test Population and evolution ▪ Population genetics ▪ Variation in phenotypes ▪ Natural selection ▪ Selection and evolution ▪ Isolation and speciation	The control of gene expression ▪ Stem cells and totipotency ▪ Regulation of transcription and translation ▪ Epigenetic control of gene expression ▪ Cancer ▪ Genome projects ▪ DNA fragments ▪ *In vivo* and *in vitro* cloning ▪ Locating genes, genetic screening, and counselling ▪ Genetic fingerprinting Revision Year 12 content. Biological Molecules Cells Organisms exchange substances with their environment Genetic information, variation and	Revision of skills; Mathematical skills Practical skills Synoptic questions		Ongoing CPAC activities Bi-weekly assessments End of unit assessments PPQs homework

			relationships between organisms Cell recognition and immune response			