



HILLCREST SCIENCE DEPARTMENT

Curriculum End Points: **Biology**

By the end of year 7, pupils in Biology will be able to ...
Show an understanding of the life processes, levels of organisation, adolescence, male and female reproductive processes, organ systems, skeletal system and respiratory system. They will be able to observe, describe and explain the differences between simple animal and plant cells, as well as investigate the structure and function of more specialised cells. They will be able to analyse the structure and function of human body systems.
By the end of year 8, pupils in Biology will be able to ...
Show an understanding of nutrients, the digestive system, enzymes, food chains, ecosystems, competition and adaptation. They will be able to critically analyse the effects of different drugs on the human body, including alcohol, tobacco, illegal substances and some prescribed medications. They will be able to communicate the importance of a healthy diet on the human body and the negative consequences of an unhealthy diet. They will be able to critique the importance of stability within ecosystems and how food webs can be disrupted.
By the end of year 9, pupils in Biology will be able to ...
Show an understanding of diffusion, osmosis, active transport, bacteria, unicellular organisms, inheritance, natural selection, evolution, extinction, photosynthesis, chemosynthesis, aerobic respiration and anaerobic respiration. They will be able to describe and explain how substances enter and exit cells through various biological processes. They will be able to critically evaluate how natural selection and inheritance have shaped the Earth's biosphere.
By the end of year 10, pupils in Biology will be able to ...
Show an understanding of cell structure, cell specialisation, cell differentiation, microscopy, cell division, cell transportation systems, animal and plant tissues, animal and plant organs, animal plant organ systems, communicable diseases, vaccination, antibodies, non-communicable diseases, photosynthesis, respiration and metabolism. They will be able to describe and explain how biological processes are linked to one another and critically analyse how decisions that humans make can adversely or positively affect their bodies and the wider ecosystem.
By the end of year 11, pupils in Biology will be able to ...
Show an understanding of homeostasis, human nervous system, human hormonal coordination, plant hormones, reproduction in plants and animals (sexual and asexual), DNA and the genome, genetic inheritance, variation, evolution, genetic engineering, speciation, fossils, classification, adaptations, abiotic factors, biotic factors, interdependence, biodiversity, trophic levels in an ecosystem and competition. They will be able to critically appreciate the interconnectedness of Earth's ecosystem and the influence that internal and external factors have on its success, or otherwise. They will be able to apply prior learning to previously unseen situations.
By the end of year 12, pupils in Biology will be able to ...
Show an understanding of biological molecules, cells, organism exchange systems with their environment, genetic information, variation and relationships between organisms. They will be able to describe and explain the importance of carbohydrates, lipids, proteins nucleic acids for biological life. They will critically appreciate how interactions between different types of cell are involved in disease, recovery from disease and prevention of symptoms occurring at a later date if exposed to the same antigen, or antigen-bearing pathogen. They will be able to apply organism exchange systems in unfamiliar situations and explain the importance of exchange with external environments.
By the end of year 13, pupils in Biology will be able to ...
Show an understanding of energy transfers between organisms, organism response to changes in internal and external environments, genetics, populations, evolution and the control of the gene expression. They will be able to explain the importance that life depends on continuous transfers of energy and that stimuli, both internal and external, are detected and lead to a response within living organisms. They will appreciate the importance that the theory of evolution underpins in modern Biology, and that there will be many medical and technological applications of humans controlling the expression of genes by altering the epigenome, as well as by altering the genomes and proteomes of organisms.

Curriculum End Points: Chemistry

By the end of year 7, pupils in Chemistry will be able to ...
Show an understanding of the particle model, states of matter, melting, freezing, boiling, diffusion, pressure, elements, atoms, compounds, chemical formulae, sedimentary rocks, metamorphic rocks, igneous rocks, and the rock cycle. They will be able to describe and explain how elements and compounds build the physical environment in which they live. They will be able to evaluate how particles and their behaviour alongside the rock cycle contribute to changing physical systems.
By the end of year 8, pupils in Chemistry will be able to ...
Show an understanding of metals, non-metals, groups, periods, reactions involving acids, reactions involving water, reactions involving oxygen, metal displacement reactions, mixtures, solutions, solubility, filtration, evaporation, and distillation. They will be able to compare and contrast the similarities and differences between elements found in the periodic table. They will be able to review, apply and explain simple chemical reactions. They will be able to apply simple separation techniques.
By the end of year 9, pupils in Chemistry will be able to ...
Show an understanding of distillation, fractional distillation, chromatography, reactivity series, extracting minerals, the Earth and its atmosphere, the carbon cycle, climate change, recycling, ceramics, polymers, and composites. They will be able to apply complex separation techniques. They will be able to describe and explain the properties of acids and bases, as well as the associated reactions. They will be able to critically describe Earth processes and humans' impacts on our Earth.
By the end of year 10, pupils in Chemistry will be able to ...
Show an understanding of atoms; elements; compounds; development of the atom; relative atomic mass; electronic structure; the periodic table; properties of transition metals; bonding; structure; bulk properties; surface properties; quantitative chemistry; limiting reactants; concentration; yield; chemical changes; reactions of acids and bases; electrolysis; energy changes; exothermic reactions; endothermic reactions. They will be able to use calculation to evaluate chemical properties. They will be able to describe, explain and apply chemical bonding to the structure of material properties.
By the end of year 11, pupils in Chemistry will be able to ...
Show an understanding of the rate of chemical change; collision theory; activation energy; catalysts; reversible reactions; dynamic equilibrium; organic chemistry; reactions of alkenes and alcohols; carboxylic acids; synthetic and naturally occurring polymers; chemical analysis; purity; identification of ions; composition and evolution of Earth's atmosphere; carbon dioxide and methane as greenhouse gases; global climate change; obtaining potable water; life cycle assessment; using materials; Haber process. They will be able to competently describe and explain the rate and extent of chemical change. They will be able to evaluate how humans use the Earth's resources and can do so in a more sustainable way in the future.
By the end of year 12, pupils in Chemistry will be able to ...
By the end of year, pupils should finish AS specification which is split into Physical, Inorganic and organic sections. In physical chemistry section they will get an opportunity to study details of atomic structure, chemical bonding and complete calculations involving amount of substance. They will be introduced to the concepts of energetics, kinetics, equilibria and redox reactions. In inorganic chemistry section pupils will be able to apply their understanding of periodicity to the properties of group 2 and 7 elements. Organic chemistry section will include introduction to nomenclature and isomerism. They will have a clear understanding of properties of alkanes, alkenes, halogenoalkanes, alcohols and mechanisms involved in their chemical reactions. Pupils will be able to use organic analysis techniques like infrared spectroscopy and mass spectroscopy to identify an organic compound.
By the end of year 13, pupils in Chemistry will be able to ...
By the end of year, pupils will finish Advanced level specification which is built on the foundations laid in AS specification. In physical chemistry section pupils will show a clear understanding of principles of thermodynamics, kinetics, equilibrium in gas phase, electrode potentials and acids bases and buffers. They will critically appreciate that enthalpy change is linked with entropy change enabling the free-energy change to be calculated. They will apply the principle that in rate equations, the mathematical relationship between rate of reaction and concentration gives information about the mechanism of a reaction that may occur in several steps. They will describe and explain how acids and bases are important in domestic, environmental and industrial contexts. In inorganic section students will apply their understanding of periodic table to explain properties of transition metals, reactions of ions in aqueous solution. Organic chemistry section will involve study of optimal isomerism, aldehydes and ketones, carboxylic acids and amines. They will appreciate that organic chemistry is the study of the millions of covalent compounds of the element carbon and describe, explain and apply organic chemical principles. The carbonyl group which is attacked by nucleophiles, includes aldehydes, ketones, carboxylic acids and their derivatives.

Curriculum End Points: **Physics**



By the end of year 7, pupils in Physics will be able to ...
Show an understanding of squashing, stretching, drag forces, friction, contact forces, non-contact forces, balanced forces, longitudinal waves, sound waves, loudness, pitch, echoes, ultrasound, night sky, solar system, mass, weight, the Earth and the Moon. They will be able to describe, explain and apply simple forces to everyday physical systems. They will be able to explain the features of sound waves in terms of a longitudinal wave. They will describe and explain the importance of understanding their physical place within the observable universe.
By the end of year 8, pupils in Physics will be able to ...
Show an understanding of food, fuels, simple energy stores, temperature, conduction, convection, radiation, electrical charge, series circuits, parallel circuits, potential difference, resistance, electromagnets, visible light, transverse waves, reflection, refraction, the eye and colour. They will be able to describe and explain simple energy transfers in closed physical systems. They will be able to describe, explain and apply the features of visible light in terms of a transverse wave. They will be able to construct simple electrical circuits applying simple electrical theories and laws.
By the end of year 9, pupils in Physics will be able to ...
Show an understanding of speed, velocity, acceleration, distance-time graphs, velocity-time graphs, pressure in gasses, pressure in solids, pressure in liquids, turning forces, complex energy stores, energy pathways, energy change calculations, energy dissipation, work, power, efficiency, specific heat capacity, thermal energy changes, national and global energy resources. They will be able to apply earlier understanding of forces to motion. They will be able to evaluate energy changes in complex physical systems through the use of calculation. They will evaluate the importance of different energy resources in meeting rising global demand for energy against a backdrop of climate change.
By the end of year 10, pupils in Physics will be able to ...
Show an understanding of current, potential difference, resistance, resistors, domestic electricity uses and dangers, mains electricity, the National Grid, static electricity, particle model of matter, changes of state, atomic structure, nuclear radiation, nuclear fission, nuclear fusion, scalar and vector quantities, resultant forces, moments, levers, gears, pressure differences in fluids, atmospheric pressure, force and complex motion, Newton's laws and momentum. They will be able to apply electricity models to evaluate complex electrical circuits, using calculation where appropriate. They will be able to explain the particle model of matter and its influence on energy and changes of state. They will be able to describe and explain how our understanding of the atom has changed over time and how radiation is emitted from nuclei. They will be able to evaluate complex systems, linking prior learning of forces and motion, using calculation.
By the end of year 11, pupils in Physics will be able to ...
Show an understanding of transverse waves, longitudinal waves, properties of waves, application of waves, electromagnetic waves, properties of electromagnetic waves, lenses, black body radiation, permanent and induced magnetism, magnetic force and field, the motor effect, Fleming's left hand rule, electric motors, induced potential, transformers, stability of orbital motion, satellites, life cycle of stars, red-shift and the future of the universe. They will be able to evaluate the uses and dangers of electromagnetic waves. They will critically explain the importance of waves on their everyday lives. They will be able to describe and explain how electrical and magnetic fields can be explored and their importance in a variety of physical systems. They will be able to describe how the observable universe formed, how it is currently changing and how it may change or end in the future.
By the end of year 12, pupils in Physics will be able to ...
Show an understanding of measurements and their errors, particles, radiation, waves, mechanics, materials and electricity. They will be able to deploy complex mathematical skills to evaluate complex physical systems. They will be able to deploy specified fundamental (base) units, have awareness of the nature of measurement errors to carry through reasonable estimations. They will be able to apply fundamental properties of matter, and electromagnetic radiation and quantum phenomena. They will be able to mathematically model wave phenomena and explain the characteristics, properties, and applications of travelling waves and stationary waves. They will combine principles of forces, energy and momentum and apply them to material bulk properties and tensile strength. They will critically appreciate the many electrical applications that are important to society and model these through mathematics.
By the end of year 13, pupils in Physics will be able to ...
Show an understanding of periodic motion, thermal physics, gravitational fields, electric fields, capacitance, magnetic fields, radioactivity, induced fission and astrophysics. They will be able to apply earlier understanding of mechanics through a consideration of circular motion and simple harmonic motion (the harmonic oscillator). They will be able to explain thermal properties of materials, the properties and nature of ideal gases, and the molecular kinetic theory. They will appreciate that the concept of field is one of the great unifying ideas in physics and mathematically link the ideas of gravitation, electrostatics and magnetic field theory. They will be able to apply properties of the nucleus to the production of nuclear power through the characteristics of the nucleus, the properties of unstable nuclei, and the link between energy and mass. Apply fundamental physical principles to the study and interpretation of the Universe.

Curriculum End Points: Working Scientifically

During KS3 and KS4, students develop their working scientifically skills simultaneously and in conjunction with the three science subjects. Whilst these skills may be taught more or less predominantly within a particular topic of science, they are complementary and indistinguishable across Biology, Chemistry, and Physics at a Key Stage of learning.

By the end of Year 9, pupils in Biology, Chemistry, and Physics will be able to ...
Identify and plan variables; design and conduct investigations; identify hazards and risks; make predictions; select suitable equipment; understand how theories function; record data; ask relevant questions; propose improvements to experimental methods; interpret data from graphs and tables; apply appropriate mathematical techniques; represent data clearly; draw conclusions from data; identify and use SI units; apply physical equations; communicate ideas effectively; construct clear explanations; justify reasoning; critique claims.
By the end of Year 11, pupils in Biology, Chemistry, and Physics will be able to...
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; 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. Scientific vocabulary, quantities, units, symbols and nomenclature: 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 calculations. Mathematical skills: Recognise and use decimal expressions; recognise and use standard form expressions; employ ratios, fractions, and percentages; estimate the results of simple calculations; use an appropriate number of significant figures; find arithmetic means; construct and interpret frequency tables, diagrams, bar charts, and histograms; understand the principles of sampling as applied to scientific data; grasp simple probability; understand the terms mean, mode, and median; use a scatter diagram to identify a correlation between two variables; make order of magnitude calculations; understand and use the symbols: =, <, <<, >>, >, α, ~; change the subject of an equation; substitute numerical values into algebraic equations using appropriate units for physical quantities; solve simple algebraic equations; translate information between graphical and numeric form; understand that $y = mx + c$ represents a linear relationship; plot two variables from experimental or other data; determine the slope and intercept of a linear graph; draw and interpret the slope of a tangent to a curve as a measure of rate of change; understand the physical significance of the area between a curve and the x-axis and measure it by counting squares as appropriate; use angular measurements in degrees; visualise and represent 2D and 3D forms, including two-dimensional representations of 3D objects; calculate areas of triangles and rectangles, surface areas, and volumes of cubes.