Science @ Caedmon

National curriculum in England: Purpose of study

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all students should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, students should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes

Aims of the National curriculum for Science

The national curriculum for science aims to ensure that all students:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Aims of our Caedmon curriculum for Science

At Caedmon College we believe in the following: Science broadens our perspective. Science develops analytical thinking skills. Science improves communication skills. Science develops a love of learning. Knowledge is power. Every day we try to deliver on these principles.

Foundation learning – what the National Curriculum expects students to have studied by the end of KS3

Working scientifically

Through the content across all three disciplines, students should be taught to:

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
- evaluate risks.

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- make predictions using scientific knowledge and understanding
- select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
- use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
- make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements
- apply sampling techniques.

Analysis and evaluation

- apply mathematical concepts and calculate results
- present observations and data using appropriate methods, including tables and graphs
- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- present reasoned explanations, including explaining data in relation to predictions and hypotheses
- evaluate data, showing awareness of potential sources of random and systematic error
- identify further questions arising from their results.

Measurement

- understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- use and derive simple equations and carry out appropriate calculations
- undertake basic data analysis including simple statistical techniques.

Subject content – Biology

Students should be taught about:

Structure and function of living organisms.

Cells and organisation

- cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope
- the functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts
- the similarities and differences between plant and animal cells
- the role of diffusion in the movement of materials in and between cells
- the structural adaptations of some unicellular organisms
- the hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms.

The skeletal and muscular systems

- the structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
- the function of muscles and examples of antagonistic muscles.

Nutrition and digestion

- content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed
- calculations of energy requirements in a healthy daily diet
- the consequences of imbalances in the diet, including obesity, starvation and deficiency diseases
- the tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts)
- the importance of bacteria in the human digestive system
- plants making carbohydrates in their leaves by photosynthesis and gaining mineral nutrients and water from the soil via their roots.

Gas exchange systems

- the structure and functions of the gas exchange system in humans, including adaptations to function
- the mechanism of breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases, including simple measurements of lung volume
- the impact of exercise, asthma and smoking on the human gas exchange system
- the role of leaf stomata in gas exchange in plants.

Reproduction

- reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta

- reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms.

Health

- the effects of recreational drugs (including substance misuse) on behaviour, health and life processes.

Material cycles and energy

Photosynthesis

- the reactants in, and products of, photosynthesis, and a word summary for photosynthesis
- the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere
- the adaptations of leaves for photosynthesis.

Cellular respiration

- aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life
- a word summary for aerobic respiration
- the process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration
- the differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism.

Interactions and interdependencies. Relationships in an ecosystem

- the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- the importance of plant reproduction through insect pollination in human food security
- how organisms affect, and are affected by, their environment, including the accumulation of toxic materials.

Genetics and evolution. Inheritance, chromosomes, DNA and genes

- heredity as the process by which genetic information is transmitted from one generation to the next
- a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model
- differences between species
- the variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation
- the variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection
- changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material

Subject content – Chemistry

Students should be taught about:

The particulate nature of matter

- the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure
- changes of state in terms of the particle model. Atoms, elements and compounds
- a simple (Dalton) atomic model
- differences between atoms, elements and compounds
- chemical symbols and formulae for elements and compounds
- conservation of mass changes of state and chemical reactions.

Pure and impure substances

- the concept of a pure substance
- mixtures, including dissolving
- diffusion in terms of the particle model
- simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography
- the identification of pure substances.

Chemical reactions

- chemical reactions as the rearrangement of atoms
- representing chemical reactions using formulae and using equations
- combustion, thermal decomposition, oxidation and displacement reactions
- defining acids and alkalis in terms of neutralisation reactions
- the pH scale for measuring acidity/alkalinity; and indicators
- reactions of acids with metals to produce a salt plus hydrogen
- reactions of acids with alkalis to produce a salt plus water
- what catalysts do.

Energetics

- energy changes on changes of state (qualitative)
- exothermic and endothermic chemical reactions (qualitative).

The Periodic Table

- the varying physical and chemical properties of different elements
- the principles underpinning the Mendeleev Periodic Table
- the Periodic Table: periods and groups; metals and non-metals
- how patterns in reactions can be predicted with reference to the Periodic Table

- the properties of metals and non-metals
- the chemical properties of metal and non-metal oxides with respect to acidity.

Materials

- the order of metals and carbon in the reactivity series
- the use of carbon in obtaining metals from metal oxides
- properties of ceramics, polymers and composites (qualitative).
- Earth and atmosphere
- the composition of the Earth
- the structure of the Earth
- the rock cycle and the formation of igneous, sedimentary and metamorphic rocks

Earth as a source of limited resources and the efficacy of recycling

- the carbon cycle
- the composition of the atmosphere
- the production of carbon dioxide by human activity and the impact on climate

Subject content – Physics

Students should be taught about:

Energy

Calculation of fuel uses and costs in the domestic context

- comparing energy values of different foods (from labels) (kJ)
- comparing power ratings of appliances in watts (W, kW)
- comparing amounts of energy transferred (J, kJ, kW hour)
- domestic fuel bills, fuel use and costs
- fuels and energy resources.

Energy changes and transfers

- simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged
- heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators
- other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels.

Changes in systems

- energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change
- comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions
- using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes.

Motion and forces

Describing motion

- speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)
- the representation of a journey on a distance-time graph
- relative motion: trains and cars passing one another.

Forces

- forces as pushes or pulls, arising from the interaction between two objects
- using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces
- moment as the turning effect of a force

- forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water
- forces measured in newtons, measurements of stretch or compression as force is changed
- force-extension linear relation; Hooke's Law as a special case
- work done and energy changes on deformation
- non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity.

Pressure in fluids

- atmospheric pressure, decreases with increase of height as weight of air above decreases with height
- pressure in liquids, increasing with depth; upthrust effects, floating and sinking
- pressure measured by ratio of force over area – acting normal to any surface.

Balanced forces

opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface.

Forces and motion

- forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only)
- change depending on direction of force and its size.

Waves

Observed waves

- waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel – superposition.

Sound waves

- frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound
- sound needs a medium to travel, the speed of sound in air, in water, in solids
- sound produced by vibrations of objects, in loud speakers, detected by their effects on microphone diaphragm and the ear drum; sound waves are longitudinal
- auditory range of humans and animals.

Energy and waves

- pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone.

Light waves

- the similarities and differences between light waves and waves in matter
- light waves travelling through a vacuum; speed of light

- the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface
- use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye
- light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras
- colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.

Electricity and electromagnetism

Current electricity

- electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge
- potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current
- differences in resistance between conducting and insulating components (quantitative).

Static electricity

- separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects
- the idea of electric field, forces acting across the space between objects not in contact.

Magnetism

- magnetic poles, attraction and repulsion
- magnetic fields by plotting with compass, representation by field lines
- Earth's magnetism, compass and navigation
- the magnetic effect of a current, electromagnets, D.C. motors (principles only).

Matter

Physical changes

- conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving
- similarities and differences, including density differences, between solids, liquids and gases
- Brownian motion in gases
- diffusion in liquids and gases driven by differences in concentration
- the difference between chemical and physical changes.

Particle model

- the differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice-water transition
- atoms and molecules as particles.

Energy in matter

- changes with temperature in motion and spacing of particles
- internal energy stored in materials.

Space physics

- gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only)
- our Sun as a star, other stars in our galaxy, other galaxies
- the seasons and the Earth's tilt, day length at different times of year, in different hemispheres
- the light year as a unit of astronomical distance

Year 7 Science @ Caedmon

Our aim in Year 7 science is to ensure students have a robust introduction to the Scientific method, in particular conducting safe investigations. We spend the whole of the first half term studying experimental variables, as well as methods for displaying results and assessing reliability and repeatability. We want to the students to enjoy Science and expect them to plan and carry out investigations to test hypotheses, and then reflect and amend those hypotheses using data. The rest of the year sees Year 7 students studying the basic introductory units in Biology, Chemistry and Physics as they explore the differences between each scientific discipline, this pattern continues into year 8. Independent study in Year 7 is all about learning how to succeed on tasks at home without support from others. We spend time teaching techniques and strategies to help students achieve this resilience.

	Topics, themes and skills covered	Assessment
Autumn 1	Working Scientifically	Working Scientifically Test. 30min
Autumn 2	B1 Living Systems C1 Particulate nature of matter	
Spring 1	P1 Forces and Motion B2 Diet and Health	B1 C1 P1 Test 45min
Spring 2	C2 Atoms, elements and compounds P2 Levers, moments and Pressure	
Summer 1	B3 Genetics and evolution C3 Periodic Table and reactivity	C2 B2 P2 Test 45min
Summer 2	P3 Electricity and Electromagnetism	

Year 8 Science @ Caedmon

In year 8 Science we build upon the skills acquired last year and add more key content in each of the science areas. Science has changed our lives for the better, and we want to inspire our learners to become a part of future change. A good understanding of Science is vital to the world's future prosperity and to ensuring that our planet is able to support life for many generations to come. Our vision is that students develop a sense of excitement and curiosity about natural phenomena and understand how Science can be used to explain what is happening in the world around us. Independent study in year 8 is a mixture of skills and knowledge acquisition, in preparation for the big step up to GCSE content in Year 9.

	Topics, themes and skills covered	Assessment
Autumn 1	B4 Photosynthesis and C4 Chemical reactions	
Autumn 2	P4 Energy B5 Reproduction	B4 C4 P4 Test 45min
Spring 1	C5 Scientific Enquiry P5 Waves	
Spring 2	B6 Eco-systems	
Summer 1	C6 The Earth	B5 C5 P5 test 45min
Summer 2	P6 Earth within the solar system	

Year 9 Science @ Caedmon

Year 9 is all about broadening horizons and instilling learners with some depth on familier topics from KS3. We cover the basic building blocks of the three sciences, learning cells and organisation in Biology, atomic structure and bonding in Chemistry and energy and electricity in Physics. A grasp of these fundamental ideas is key to really embracing the rest of the KS4 curriculum and ultimately to success in the science GCSEs. Independent study in year 9 is all about building knowledge with regular quizzing and knowledge recall been paramount.

	Topics, themes and skills covered	Assessment
Autumn 1	Start of GCSE work in all three sciences. Biology: Cell Structure and Transport Chemistry: Atomic Structure Physics: Conservation and dissipation of energy	
Autumn 2	Biology: Cell structure and Transport Chemistry: Atomic Structure Physics: Conservation and dissipation of energy	Monitoring Assessment 1 - all three sciences covered thus far.
Spring 1	Biology: Cell Division Chemistry: Periodic table Physics: Energy transfer by heating	
Spring 2	Biology: Organisation and Digestive system Chemistry: Periodic table Physics: Energy resources	
Summer 1	Biology: Organisation and Digestive system Chemistry: Structure and Bonding Physics: Electric circuits	Monitoring assessment 2 - all three sciences covered thus far.
Summer 2	Biology: Organising plants and animals Chemistry: Structure and Bonding Physics: Electricity in the home	

Year 10 Science @ Caedmon

Year 10 is all about building knowledge. We build on the foundations laid in Year 9 in each of the three sciences, covering over 70% of content before the end of the year. Year 10 is also the time to learn exam technique with increasingly important assessments through the year. Independent study in year 10 focusses on low stakes tests and retrieval practice to really drive the keys facts home.

	Topics, themes and skills covered	Assessment
Autumn 1	Biology: Communicable Diseases Chemistry: Chemical calculations Physics: Molecules and matter	
Autumn 2	Biology: Preventing and treating disease and non-Communicable diseases Chemistry: Chemical change Physics: Radioactivity	Monitoring assessment 3 to cover topics covered in each science.
Spring 1	Biology: Photosynthesis and respiration Chemistry: Electrolysis Physics: Forces in balance	
Spring 2	Biology: Human Nervous system Chemistry: Energy changes Physics: Motion	
Summer 1	Biology: Hormonal coordination Chemistry: Rates and equilibrium Physics: Forces and motion	Monitoring assessment 4 to cover topics covered in each science.
Summer 2	Biology: Homeostasis in action Chemistry: Rates and equilibrium Physics: Force and pressure	

Year 11 Science @ Caedmon

Year 11 is split into two sections, pre-Christmas the knowledge building from year 10 continues, with content been finished as near to Christmas as possible. Post-Christmas is revision of key ideas and preparation for the GCSE exams. Independent study focusses on revision from the start, with plenty of past paper questions to build confidence.

	Topics, themes and skills covered	Assessment
Autumn 1	Biology: Reproduction, variation and evolution Chemistry: Crude oil and fuels Chemistry: Organic reactions Physics: Wave properties and electromagnetic waves.	Trial Exam 1 - Paper 1 content
Autumn 2	Biology: Genetics, evolution and adaptation, Biology: Interdependence and competition Chemistry: Polymers Chemistry: Chemical analysis Physics Light Physics Electromagnetism	
Spring 1	Biology Organising an ecosystem and biodiversity and ecosystem Chemistry: The Earth's atmosphere and Earth's resources Chemistry Using our resources Physics: Space	Trial Exam 2 - Paper 2 content
Spring 2	Revision	
Summer 1	Revision/Exams	
Summer 2	Exams	