Pittville School

Science Intended Curriculum 2022/2023

Year 7

Foundational knowledge *What students needs to know*	Foundational skills *What students needs to be able to do*
1.1 Movement and Cells • Identify the main parts of animal and plant cells, and describe their function. • Name the main bones and joints in the human body and describe their function. 1.2 Variation and human reproduction • State what variation is within a species and describe why this occurs. • Identify and describe the functions of the reproductive organs in the human body. • Describe the main stages of human reproduction, including fertilisation, implantation, and gestation. 1.3 Interdependence and Plant reproduction • Identify the main roles in a food chain and describe how changes in a food chain can have effects on other species. • Identify the make parts of a flower and describe the process of reproduction of a plant. 2.1 Separating mixtures • Use particle theory to describe different states of matter. • State what a mixture is and describe different methods to separate the substances. 2.2Earth Structure • State the main types of rock and describe how they are formed in the rock cycle. • Describe how crude oil is formed. 2.3 Acids, Alkalis and metals. • State what a chemical reactions is. • Describe what acids and alkalis are and describe the process of neutralisation.	• Correctly use common pierces of laboratory equipment. • Conduct experiments safe manner. • Use a microscope to observe cells. • Use a quadrat to take measurements in ecosystems. • Carry out a filtration, distillation and chromatography. • Use different indicators to identify Acids and Alkalis.

• Describe how metals react with different chemicals and state the products. 3.1 Energy • Identify and describe the 5 main energy stores. • Describe and evaluate renewable and non-renewable energy resources. 3.2 Forces • Identify common forces and state if they are contact or non-contact. • Describe the factors that affect drag and friction. • Analyse objects to determine if forces are balanced or not and describe its motion. 3.3 Space • State and describe the main bodies in the solar system. • Explain what days, months, years, and seasons are. • Appreciate the scale of the universe.	

Year 8

Foundational knowledge *What students needs to know*	Foundational skills *What students needs to be able to do*
1.4 A Healthy Body • Describe the process of gas exchange in the lungs. • State common drugs and describe their effect on the body. • Explain the parts of a health diet and how food is digested. 1.5 Respiration and Photosynthesis • State the word equation for aerobic respiration and describe the differences between aerobic and anaerobic respiration. • State the word equation for photosynthesis and explain how plants are adapted for it.	• Balance simple chemical equations. • Construct ray diagrams. • Create independent and dependent variables from a hypothesis. • Display results correctly in a bar chart or line graph. • Choose appropriate intervals and ranges for an investigation. • Conduct a risk assessment for an investigation.

1.6 Inheritance • Describe the process of evolution. • Explain the role of DNA in organisms and the process of selective breeding and genetic modification. 2.4 Elements and the periodic table • Explain what an element is. • Explain what a compound is and identify the atoms that make if from the chemical formulae. • Describe the properties of different groups in the periodic table. 2.5 Types of Reactions • Describe what exothermic and endothermic reactions are. • Name and describe the main types of chemical reactions. • State what factors affect the rate of reaction. 2.6 Earth Chemistry • Explain what acid rain is. • Describe the stages of the water cycles. • Identify the stages of the carbon cycle and explain our effect on them. 3.4 Electricity • Construct circuit diagrams and draw the correct component symbols. • Describe the roles of current, potential difference, and resistance, in a circuit. • Identify the features of series and parallel circuits. 3.5 Waves • Define the main properties of a waves, such as amplitude, wavelength, waves speed and frequency. • Describe the process of reflection and refraction. • Explain what gives objects colour. • Label the main parts of the ear and explain how we hear sounds. 3.6 Heat • Describe the processes of convection, conduction and radiation.	• Identify sources of error in an investigation.

• Explain how different insulators reduce heat loss. • Identify changes of state from heating and cooling curves.	

Year 9

Foundational knowledge *What students needs to know* Foundational skills *What students needs to be able to do*
3.7 Mechanics and Magnetic fields • Plot magnetic fields lines for a material. • Explain how to construct an electromagnet. • State the principle of moments and calculate the turning effect of a force. • Describe how a hydraulic system works and give examples. 4.1Cell biology Prokaryotic and eukaryotic cells • explain how the main sub-cellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are related to their functions, including the nucleus/genetic material, plasmids, mitochondria, chloroplasts and cell membranes • explain how electron microscopy has increased our understanding of sub-cellular structures. Growth and development of cells • describe the process of mitosis in growth, including the cell cycle • explain the importance of cell differentiation • describe cancer as the result of changes in cells that lead to uncontrolled growth and division • describe the function of stem cells in embryonic and adult animals and meristems in plants • discuss potential benefits and risks associated with the use of stem cells in medicine • explain the role of meiotic cell division in halving the chromosome number to form gametes Cell metabolism • explain the mechanism of enzyme action including the active site, enzyme specificity and factors affecting the rate of enzymatic reaction • describe cellular respiration as an exothermic reaction which is continuously occurring in all living cells • compare the processes of aerobic and anaerobic respiration • explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, lipids and proteins 4.2 Transport systems Transport in cells

• explain how substances are transported into and out of cells through diffusion, osmosis and active transport.

Transport systems in multicellular organisms

• explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area:volume ratio
• describe some of the substances transported into and out of a range of organisms in terms of the requirements of those organisms, to include oxygen, carbon dioxide, water, dissolved food molecules, mineral ions and urea

Human circulatory system

• describe the human circulatory system, including the relationship with the gaseous exchange system, and explain how the structure of the heart and the blood vessels are adapted to their functions
• explain how red blood cells, white blood cells, platelets and plasma are adapted to their functions in the blood

Transport systems in plants

• explain how the structure of xylem and phloem are adapted to their functions in the plant
• explain how water and mineral ions are taken up by plants, relating the structure of the root hair cells to their function
• describe the processes of transpiration and translocation, including the structure and function of the stomata 12
• explain the effect of a variety of environmental factors on the rate of water uptake by a plant, to include light intensity, air movement and temperature

4.3 Infection and Response

Health and disease

• describe the relationship between health and disease
• describe different types of diseases (including communicable and noncommunicable diseases)
• describe the interactions between different types of disease

Communicable diseases

• explain how communicable diseases (caused by viruses, bacteria, protists and fungi) are spread in animals and plants
• describe a minimum of one common human infection, one plant disease and sexually transmitted infections in humans, including HIV/AIDS
• describe the non-specific defence systems of the human body against pathogens
• explain the role of the immune system of the human body in defence against disease

Treating, curing and preventing disease

• explain the use of vaccines and medicines in the prevention and treatment of disease
• describe the process of discovery and development of potential new medicines, including preclinical and clinical testing 13
• explain how the spread of communicable diseases may be reduced or prevented in animals and plants, to include a minimum of one common human infection, one plant disease and sexually transmitted infections in humans including HIV/AIDS

Non-communicable diseases in humans

• recall that many non-communicable human diseases are caused by the interaction of a number of factors. To include cardiovascular diseases, many forms of cancer, some lung and liver diseases and diseases influenced by nutrition, including type 2 diabetes
• explain the effect of lifestyle factors, including exercise, diet, alcohol and smoking, on the incidence of non-communicable diseases at local, national and global levels
• evaluate some different treatments for cardiovascular disease

5.1 Atomic structure and the Periodic Table

A simple model of the atom, relative atomic mass, electronic charge and isotopes
• describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus
• recall the typical size (order of magnitude) of atoms and small molecules
• describe how and why the atomic model has changed over time
• recall relative charges and approximate relative masses of protons, neutrons and electrons
• calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes

The modern Periodic Table

• explain how the position of an element in the Periodic Table is related to the arrangement of electrons in its atoms and hence to its atomic number
• explain in terms of isotopes how this changes the arrangement proposed by Mendeleev
• use the names and symbols of the first 20 elements, Groups 1, 7 and 0 and other common elements from a supplied Periodic Table to write formulae and balanced chemical equations where appropriate
• explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number
• recall the simple properties of Groups 1, 7 and 0
• explain how observed simple properties of Groups 1,7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups
• predict possible reactions and probable reactivity of elements from their positions in the Periodic Table 20
• describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties
• explain how the atomic structure of metals and non-metals relates to their position in the Periodic Table

5.2 Structure, bonding and the properties of matter

States of matter and change of state in terms of particle kinetics, energy transfers and the relative strength of chemical bonds and intermolecular forces
• recall and explain the main features of the particle model in terms of the states of matter and change of state, distinguishing between physical and chemical changes
• explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres
• use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur
• use data to predict states of substances under given conditions.

Different kinds of chemical bonds: ionic, covalent and metallic bonding

• describe and compare the nature and arrangement of chemical bonds in ionic compounds, simple molecules, giant covalent structures, polymers and metals

• explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons
• construct dot and cross diagrams for simple ionic and covalent substances
• describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two and three dimensional representations
• explain how the bulk properties of materials are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged, recognising that the atoms themselves do not have these properties

Structure and bonding of carbon

• recall that carbon can form four covalent bonds 21
• explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings
• explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding

6.1 Energy

Energy changes in a system, and in the ways energy is stored before and after such changes
• calculate the amounts of energy associated with a moving body, a stretched spring, and an object raised above ground level
• describe and calculate the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces and by work done when a current flows
• explain, with reference to examples, the definition of power as the rate at which energy is transferred
• describe all the changes involved in the way energy is stored when a system changes, for common situations: appropriate examples might be an object projected upwards or up a slope, a moving object hitting an obstacle, an object being accelerated by a constant force, a vehicle slowing down, bringing water to a boil in an electric kettle
• describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use Conservation, dissipation and national and global energy sources
• describe with examples where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only)
• describe, with examples, how in all system changes, energy is dissipated, so that it is stored in less useful ways
• explain ways of reducing unwanted energy transfer e.g. through lubrication,
thermal insulation; describe the effects, on the rate of cooling of a building, of thickness and thermal conductivity of its walls (qualitative only)
• calculate energy efficiency for any energy transfer, and describe ways to increase efficiency
• describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro-electricity, the tides and the Sun), compare the ways in which they are used and distinguish between renewable and nonrenewable sources
• explain patterns and trends in the use of energy resources

6.3 Particle model of matter

Changes of state and the particle model
• define density and explain the differences in density between the different states of matter in terms of the arrangements of the atoms or molecules
• describe how, when substances melt, freeze, evaporate, condense or sublimate, mass is conserved, but that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed

Internal energy, energy transfers and particle motions

• describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state
• define the term specific heat capacity and distinguish between it and the term specific latent heat
• explain how the motion of the molecules in a gas is related both to its temperature and its pressure: hence explain the relation between the temperature of a gas and its pressure at constant volume (qualitative only)

Year 10

Foundational knowledge *What students needs to know* Foundational skills *What students needs to be able to do*
4.4 Photosynthesis Importance of photosynthesis • describe the process of photosynthesis and describe photosynthesis as an endothermic reaction • describe photosynthetic organisms as the main producers of food and therefore biomass for life on Earth • explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis • explain the interaction of these factors in limiting the rate of photosynthesis 4.5 Coordination and control Nervous coordination and control in humans • explain how the structure of the nervous system (including CNS, sensory and motor neurones and sensory receptors) is adapted to its functions • explain how the structure of a reflex arc is related to its function Hormonal coordination and control in humans • describe the principles of hormonal coordination and control by the human endocrine system • explain the roles of thyroxine and adrenaline in the body, including thyroxine as an example of a negative feedback system 14 • describe the roles of hormones in human reproduction, including the menstrual cycle • explain the interactions of FSH, LH, oestrogen and progesterone in the control of the menstrual cycle • explain the use of hormones in contraception and evaluate hormonal and nonhormonal methods of contraception • explain the use of hormones in modern reproductive technologies to treat infertility

Homeostasis in humans

• explain the importance of maintaining a constant internal environment in response to internal and external change
• explain how insulin controls blood sugar levels in the body
• explain how glucagon interacts with insulin to control blood sugar levels in the body
• compare type 1 and type 2 diabetes and explain how they can be treated

4.6 Inheritance, variation and evolution

The genome and gene expression

• describe DNA as a polymer made up of two strands forming a double helix
• describe the genome as the entire genetic material of an organism
• explain the following terms: gamete, chromosome, gene, allele/variant, dominant recessive, homozygous, heterozygous, genotype and phenotype
• describe simply how the genome, and its interaction with the environment, influence the development of the phenotype of an organism
• discuss the potential importance for medicine of our increasing understanding of the human genome

Inheritance

• explain single gene inheritance
• predict the results of single gene crosses
• recall that most phenotypic features are the result of multiple genes rather than single gene inheritance
• describe sex determination in humans

Variation and evolution

• state that there is usually extensive genetic variation within a population of a species
• recall that all variants arise from mutations, and that most have no effect on the phenotype, some influence phenotype and a very few determine phenotype
• describe evolution as a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of new species
• explain how evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment

5.3 Quantitive chemistry Use of amount of substance in relation to masses of pure substances

• recall and use the definitions of the Avogadro constant (in standard form) and of the mole
• explain how the mass of a given substance is related to the amount of that substance in moles and vice versa
• deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant
• use a balanced equation to calculate masses of reactants or products
• explain how the mass of a solute and the volume of the solution is related to the concentration of the solution

5.4 Chemical changes

Chemical symbols, formulae and equations

• use chemical symbols to write the formulae of elements and simple covalent and ionic compounds
• deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa

• use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations and half equations
• use the formulae of common ions to deduce the formula of a compound and write balanced ionic equations
• describe the physical states of products and reactants using state symbols (s, l, g and aq)

Identification of common gases
• describe tests to identify selected gases including oxygen, hydrogen, carbon dioxide and chlorine

Chemistry of acids
• recall that acids react with some metals and with carbonates and write equations predicting products from given reactants
• recall that acids form hydrogen ions when they dissolve in water and solutions of 22 alkalis contain hydroxide ions
• recall that relative acidity and alkalinity are measured by pH
• describe neutralisation as acid reacting with alkali to form a salt plus water
• recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water
• use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids
• recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one
• describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only)

A reactivity series of metals as the tendency of a metal to form its positive ion
• explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion
• deduce an order of reactivity of metals based on experimental results

Electrolysis of various molten ionic liquids and aqueous ionic solutions
• describe electrolysis in terms of the ions present and reactions at the electrodes
• recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes
• predict the products of electrolysis of binary ionic compounds in the molten state
• describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present

Redox reactions (reduction and oxidation)
• explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced
• explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced

5.5 Energy changes in chemistry
Exothermic and endothermic reactions, including reaction profiles
• distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings
• draw and label a reaction profile for an exothermic and an endothermic reaction, identifying activation energy
• explain activation energy as the energy needed for a reaction to occur

• calculate energy changes in a chemical reaction by considering bond making and bond breaking energies

Carbon compounds both as fuels and feedstock

• recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry
• explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource

6.2 Electricity

Current, potential difference and resistance
• recall that current is a rate of flow of charge, that for a charge to flow, a source of potential difference and a closed circuit are needed and that a current has the same value at any point in a single closed loop; recall and use the relationship between quantity of charge, current and time
• recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured; recall and apply the relationship between I, R and V, and explain that for some resistors the value of R remains constant but that in others it can change as the current changes; explain the
design and use of circuits to explore such effects – including for lamps, diodes,
thermistors and LDRs

Series and parallel circuits

• describe the difference between series and parallel circuits, explain why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased (qualitative explanation only)
• calculate the currents, potential differences and resistances in d.c. series circuits, and explain the design and use of such circuits for measurement and testing purposes; represent them with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including diodes, LDRs and thermistors

Domestic uses and safety

• recall that the domestic supply in the UK is a.c., at 50Hz and about 230 volts explain the difference between direct and alternating voltage
• recall the differences in function between the live, neutral and earth mains wires, 34 and the potential differences between these wires; hence explain that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth
Energy transfers
• explain how the power transfer in any circuit device is related to the p.d. across it and the current, and to the energy changes over a given time
• describe how, in different domestic devices, energy is transferred from batteries and the a.c. mains to the energy of motors or of heating devices
• recall that, in the national grid, electrical power is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic use, and explain how this system is an efficient way to transfer energy

6.4 Atomic structure

Nuclear atom and isotopes

• describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus 36

• recall the typical size (order of magnitude) of atoms and small molecules
• describe how and why the atomic model has changed over time
• recall that atomic nuclei are composed of both protons and neutrons, that the nucleus of each element has a characteristic positive charge, but that atoms of the same elements can differ in nuclear mass by having different numbers of neutrons
• relate differences between isotopes to differences in conventional representations of their identities, charges and masses

Absorption and emission of ionizing radiations and of electrons and nuclear particles
• recall that in each atom its electrons are arranged at different distances from the nucleus, that such arrangements may change with absorption or emission of electromagnetic radiation and that atoms can become ions by loss of outer electrons
• recall that some nuclei are unstable and may emit alpha particles, beta particles, or neutrons, and electromagnetic radiation as gamma rays; relate these emissions to possible changes in the mass or the charge of the nucleus, or both
• use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay
• explain the concept of half-life and how this is related to the random nature of radioactive decay
• recall the differences in the penetration properties of alpha-particles, beta-particles and gamma-rays
• recall the differences between contamination and irradiation effects and compare the hazards associated with these two

6.6 Light and electromagnetic waves
Frequency range of the spectrum
• recall that light is an electromagnetic wave
• recall that electromagnetic waves are transverse, are transmitted through space where all have the same velocity, and explain, with examples, that they transfer energy from source to absorber
• describe the main groupings of the spectrum – radio, microwave, infra-red, visible (red to violet), ultra-violet, X-rays and gamma-rays, that these range from long to short wavelengths and from low to high frequencies, and that our eyes can only detect a limited range

Interactions of electromagnetic radiation with matter and their applications
• recall that different substances may absorb, transmit, refract, or reflect these waves in ways that vary with wavelength; explain how some effects are related to differences in the velocity of the waves in different substances
• recall that radio waves can be produced by or can themselves induce oscillations in electrical circuits 33
• recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range
• give examples of some practical uses of electromagnetic waves in the radio, micro-wave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions and describe how ultra-violet waves, X-rays and gamma-rays can have hazardous effects, notably on human bodily tissues

Foundational knowledge
What students needs to know
Foundational skills
What students needs to be able to do

4.7 Ecology

Levels of organisation within an ecosystem

• describe different levels of organisation in an ecosystem from individual organisms to the whole ecosystem
• explain how some abiotic and biotic factors affect communities
• describe the importance of interdependence and competition in a community

The principle of material cycling

• recall that many different materials cycle through the abiotic and biotic components of an ecosystem
• explain the importance of the carbon cycle and the water cycle to living organisms
• explain the role of microorganisms in the cycling of materials through an ecosystem

Biodiversity

• describe how to carry out a field investigation into the distribution and abundance of organisms in an ecosystem and explain how to determine their numbers in a given area
• describe both positive and negative human interactions within ecosystems and explain their impact on biodiversity
• explain some of the benefits and challenges of maintaining local and global biodiversity

5.6 The rate and extent of chemical change

Factors that influence the rate of reaction, including catalysts

• suggest practical methods for determining the rate of a given reaction
• interpret rate of reaction graphs
• describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction
• explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles
• explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio
• describe the characteristics of catalysts and their effect on rates of reaction
• identify catalysts in reactions
• explain catalytic action in terms of activation energy
• recall that enzymes act as catalysts in biological systems

Reversible reactions and the concept of dynamic equilibrium

• recall that some reactions may be reversed by altering the reaction conditions
• recall that dynamic equilibrium occurs when the rates of forward and reverse reactions are equal
• predict the effect of changing reaction conditions (concentration, temperature and pressure) on equilibrium position and suggest appropriate conditions to produce a particular product

5.8 Chemical analysis

Assessing purity and separating mixtures

• explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’

• explain that many useful materials are formulations of mixtures
• describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation
• recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases
• interpret chromatograms, including measuring Rf values
• suggest suitable purification techniques given information about the substances involved
• use melting point data to distinguish pure from impure substances
• suggest chromatographic methods for distinguishing pure from impure substances

Conservation of mass and the quantitative interpretation of balanced equations
• recall and use the law of conservation of mass
• explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model
• calculate relative formula masses of species separately and in a balanced chemical equation

5.9 Chemistry of the Atmosphere
Life cycle assessment and recycling
• describe the basic principles in carrying out a life-cycle assessment of a material or product
• interpret data from a life-cycle assessment of a material or product
• describe a process where a material or product is recycled for a different use, and explain why this is viable
• evaluate factors that affect decisions on recycling

Fractional distillation of crude oil and cracking
• describe and explain the separation of crude oil by fractional distillation
• describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series
• describe the production of materials that are more useful by cracking

Different methods of extracting and purifying metals with reference to a reactivity series with oxygen and the position of carbon within it
• explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including extraction of a non-ferrous metal
• explain why and how electrolysis is used to extract some metals from their ores
• evaluate alternative biological methods of metal extraction (bacterial and phytoextraction)

Earth and atmospheric science
The composition and evolution of the Earth's atmosphere since its formation
• interpret evidence for how it is thought the atmosphere was originally formed
• describe how it is thought an oxygen-rich atmosphere developed over time

Carbon dioxide and methane as greenhouse gases
• describe the greenhouse effect in terms of the interaction of radiation with matter
• evaluate the evidence for additional anthropogenic causes of climate change, including the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels, and describe the uncertainties in the evidence base
• describe the potential effects of increased levels of carbon dioxide and methane on the Earth's climate and how these effects may be mitigated, including consideration of scale, risk and environmental implications

Common atmospheric pollutants and their sources

• describe the major sources of carbon monoxide, sulfur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances

The Earth's water resources and obtaining potable water

• describe the principal methods for increasing the availability of potable water in terms of the separation techniques used, including ease of treatment of waste, ground and salt water

6.5 Forces

Forces and their interactions

• recall examples of ways in which objects interact: by gravity, electrostatics, magnetism and by contact (including normal contact force and friction), and describe how such examples involve interactions between pairs of objects which produce a force on each object; represent such forces as vectors

• define weight, describe how it is measured and describe the relationship between the weight of that body and the gravitational field strength

• describe examples of the forces acting on an isolated solid object or system; describe, using free body diagrams, examples where several forces lead to a resultant force on an object and the special case of balanced forces when the resultant force is zero (qualitative only)

• explain, with examples, that to stretch, bend or compress an object, more than one force has to be applied

• describe the difference between elastic and inelastic distortions caused by stretching forces; calculate the work done in stretching; describe the relationship between force and extension for a spring and other simple systems; describe the difference between linear and non-linear relationships between force and extension, and calculate a spring constant in linear cases

Work done as force x distance, energy transfer

• use the relationship between work done, force, and distance moved along the line of action of the force and describe the energy transfer involved

Forces and motion

Speed and velocity, speed as distance over time; acceleration; distance-time and velocity-time graphs

• explain the vector-scalar distinction as it applies to displacement, distance, velocity and speed

• recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems; recall the acceleration in free fall and estimate the magnitudes of everyday accelerations

• explain with examples that motion in a circular orbit involves constant speed but changing velocity (qualitative only)

• make measurements of distances and times, calculate speeds, and make and use graphs of these to determine the speeds and accelerations involved

Forces, accelerations and Newton's laws of motion

• apply Newton's First Law to explain the motion of objects moving with uniform velocity and also objects where the speed and/or direction change

• apply Newton's Second Law in calculations relating forces, masses and accelerations

• explain that inertial mass is a measure of how difficult it is to change the velocity of an object and that it is defined as the ratio of force over acceleration

• recall Newton's Third Law and apply it to examples of equilibrium situations

• define momentum and describe examples of momentum in collisions

Safety in public transport

• explain methods of measuring human reaction times and recall typical results
• explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety
• explain the dangers caused by large decelerations

6.7 Magnetism and electromagnetism

Permanent and induced magnetism, magnetic forces and fields

• describe the attraction and repulsion between unlike and like poles for permanent magnets and describe the difference between permanent and induced magnets
• describe the characteristics of the magnetic field of a magnet, showing how strength and direction change from one point to another
• explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic

Magnetic effects of currents and the motor effect

• describe how to show that a current can create a magnetic effect and describe the directions of the magnetic field around a conducting wire
• recall that the strength of the field depends on the current and the distance from the conductor, and explain how solenoid arrangements can enhance the magnetic
effect
• describe how a magnet and a current-carrying conductor exert a force on one another and show that Fleming's left-hand rule represents the relative orientations of the force, the conductor and the magnetic field
• apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to calculate the forces involved
• explain how this force is used to cause rotation in electric motors