Science Programme of Study – Albany Academy

Engage Springboard Pathway

<table>
<tr><th colspan="5">SCIENCE
PROGRAMME OF STUDY – ENGAGE SPRINGBOARD PATHWAY - ALBANY ACADEMY</th></tr>
<tr><td>Prior learning: KS3</td><td colspan="4">The principal focus of science teaching in key stage 3 is to develop a deeper understanding of a range of scientific ideas in the subject disciplines of biology, chemistry and physics. Pupils should begin to see the connections between these subject areas and become aware of some of the big ideas underpinning scientific knowledge and understanding. Examples of these big ideas are the links between structure and function in living organisms, the particulate model as the key to understanding the properties and interactions of matter in all its forms, and the resources and means of transfer of energy as key determinants of all these interactions. They should be encouraged to relate scientific explanations to phenomena in the world around them and start to use modelling and abstract ideas to develop and evaluate explanations.</td></tr>
<tr><td></td><td>Working Scientifically:
- Scientific attitudes
- Experimental skills and investigations
- Analysis and evaluation
- Measurement</td><td>Biology:

Structure and function of living organisms
- Cells and organisation
- The skeletal and muscular systems
- Nutrition and digestion
- Gas exchange system
- Reproduction
- Health</td><td>Chemistry:

The particular nature of matter

Atoms, elements and compounds

Pure and impure substances

Chemical reactions

Energetics</td><td>Physics:

Energy
- Calculation of fuel uses and costs in the domestic context
- Energy changes and transfers
- Changes in systems

Motion and forces
- Describing motion
- Forces</td></tr>
</table>

Science Programme of Study – Albany Academy

Engage Springboard Pathway

		Material cycles and energy - Photosynthesis - Cellular respiration **Interactions and interdependencies** - Relationships in an ecosystem **Genetics and evolution** - Inheritance, chromosomes, DNA and genes	**The period table** **Materials** **Earth and Atmosphere**	- Pressure in fluids - Balanced forces - Forces and motion **Waves** - Observed waves - Sound waves - Energy and waves - Light waves **Electricity and electromagnetism** - Current electricity - Static electricity - Magnetism **Matter** - Physical changes - Particle model - Energy in matter **Space Physics**
KS4	Science is changing 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. They should be helped to			

Science Programme of Study – Albany Academy

Engage Springboard Pathway

Taught Content: Knowledge/Skills	appreciate the achievements of science in showing how the complex and diverse phenomena of the natural world can be described in terms of several key ideas relating to the sciences which are inter-linked, and which are of universal application. These key ideas include: • the use of conceptual models and theories to make sense of the observed diversity of natural phenomena • the assumption that every effect has one or more cause • that change is driven by interactions between different objects and systems and that many such interactions occur over a distance and over time • that science progresses through a cycle of hypothesis, practical experimentation, observation, theory development and review • that quantitative analysis is a central element both of many theories and of scientific methods of inquiry. This Programme of Study should comprise approximately equal proportions of biology, chemistry and physics. The relevant mathematical skills required are covered in the programme of study for mathematics and should be embedded in the science context.
Working Scientifically	Through the content across all three disciplines, students should be taught so that they develop understanding and first-hand experience of: 1. **The development of scientific thinking** • the ways in which scientific methods and theories develop over time • using a variety of concepts and models to develop scientific explanations and understanding • appreciating the power and limitations of science and considering ethical issues which may arise

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments • evaluating risks both in practical science and the wider societal context, including perception of risk • recognising the importance of peer review of results and of communication of results to a range of audiences. 2. **Experimental skills and strategies** • using scientific theories and explanations to develop hypotheses • planning experiments to make observations, test hypotheses or explore phenomena • applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments • carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations • recognising when to apply a knowledge of sampling techniques to ensure any samples collected are representative • making and recording observations and measurements using a range of apparatus and methods • evaluating methods and suggesting possible improvements and further investigations. 3. **Analysis and evaluation** • applying the cycle of collecting, presenting and analysing data, including: • presenting observations and other data using appropriate methods • translating data from one form to another • carrying out and representing mathematical and statistical analysis • representing distributions of results and making estimations of uncertainty

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• interpreting observations and other data, 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, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations. 4. **Vocabulary, units, symbols and nomenclature** • developing their use of scientific vocabulary and nomenclature • recognising the importance of scientific quantities and understanding how they are determined • using SI units and IUPAC chemical nomenclature unless inappropriate • using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano) • interconverting units • using an appropriate number of significant figures in calculations.
Biology	**Cell biology** • cells as the basic structural unit of all organisms; adaptations of cells related to their functions; the main sub-cellular structures of eukaryotic and prokaryotic cells • stem cells in animals and meristems in plants • enzymes • factors affecting the rate of enzymatic reactions • the importance of cellular respiration; the processes of aerobic and anaerobic respiration • carbohydrates, proteins, nucleic acids and lipids as key biological molecules.

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	Transport systems • the need for transport systems in multicellular organisms, including plants • the relationship between the structure and functions of the human circulatory system. Health, disease and the development of medicines • the relationship between health and disease • communicable diseases including sexually transmitted infections in humans (including HIV/AIDs) • non-communicable diseases • bacteria, viruses and fungi as pathogens in animals and plants • body defences against pathogens and the role of the immune system against disease • reducing and preventing the spread of infectious diseases in animals • the impact of lifestyle factors on the incidence of non-communicable diseases. **Coordination and control** • principles of nervous coordination and control in humans • the relationship between the structure and function of the human nervous system • the relationship between structure and function in a reflex arc • principles of hormonal coordination and control in humans • hormones in human reproduction, hormonal and non-hormonal methods of contraception • homeostasis. **Photosynthesis** • photosynthesis • the process of photosynthesis • factors affecting the rate of photosynthesis.

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	Ecosystems • levels of organisation within an ecosystem • some abiotic and biotic factors which affect communities; the importance of interactions between organisms in a community • how materials cycle through abiotic and biotic components of ecosystems • the role of microorganisms (decomposers) in the cycling of materials through an ecosystem • organisms are interdependent and are adapted to their environment • the importance of biodiversity • methods of identifying species and measuring distribution, frequency and abundance of species within a habitat • positive and negative human interactions with ecosystems. **Evolution, inheritance and variation** • the genome as the entire genetic material of an organism • how the genome, and its interaction with the environment, influence the development of the phenotype of an organism • most phenotypic features being the result of multiple, rather than single, genes • single gene inheritance and single gene crosses with dominant and recessive phenotypes • sex determination in humans • genetic variation in populations of a species • the process of natural selection leading to evolution • the evidence for evolution • developments in biology affecting classification • the importance of selective breeding of plants and animals e.g. in agriculture

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• the uses of modern biotechnology including gene technology; some of the practical and ethical considerations of modern biotechnology.
Chemistry	**Atomic structure and the Periodic Table** • a simple model of the atom consisting of the nucleus and electrons, relative atomic mass, electronic charge and isotopes • the number of particles in a given mass of a substance • the modern Periodic Table, showing elements arranged in order of atomic number • position of elements in the Periodic Table in relation to their atomic structure and arrangement of outer electrons • properties and trends in properties of elements in the same group • characteristic properties of metals and non-metals • chemical reactivity of elements in relation to their position in the Periodic Table. **Structure, bonding and the properties of matter** • changes of state of matter in terms of particle kinetics, energy transfers and the relative strength of chemical bonds and intermolecular forces • types of chemical bonding: ionic, covalent, and metallic • bonding of carbon leading to the vast array of natural and synthetic organic compounds that occur due to the ability of carbon to form families of similar compounds, chains and rings • structures, bonding and properties of diamond, graphite, fullerenes and graphene. **Chemical changes** • determination of empirical formulae from the ratio of atoms of different kinds • balanced chemical equations, ionic equations and state symbols

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• identification of common gases • the chemistry of acids; reactions with some metals and carbonates • pH as a measure of hydrogen ion concentration and its numerical scale • electrolysis of molten ionic liquids and aqueous ionic solutions • reduction and oxidation in terms of loss or gain of oxygen. **Energy changes in chemistry** • measurement of energy changes in chemical reactions (qualitative) • bond breaking, bond making, activation energy and reaction profiles (qualitative). Science – key stage 4 13 Rate and extent of chemical change • factors that influence the rate of reaction: varying temperature or concentration, changing the surface area of a solid reactant or by adding a catalyst • factors affecting reversible reactions. **Chemical analysis** • distinguishing between pure and impure substances • separation techniques for mixtures of substances: filtration, crystallisation, chromatography, simple and fractional distillation • quantitative interpretation of balanced equations • concentrations of solutions in relation to mass of solute and volume of solvent. **Chemical and allied industries** • life cycle assessment and recycling to assess environmental impacts associated with all the stages of a product's life • the viability of recycling of certain materials

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• carbon compounds, both as fuels and feedstock, and the competing demands for limited resources • fractional distillation of crude oil and cracking to make more useful materials • extraction and purification of metals related to the position of carbon in a reactivity series. **Earth and atmospheric science** • evidence for composition and evolution of the Earth's atmosphere since its formation • evidence, and uncertainties in evidence, for additional anthropogenic causes of climate change • potential effects of, and mitigation of, increased levels of carbon dioxide and methane on the Earth's climate • common atmospheric pollutants: sulphur dioxide, oxides of nitrogen, particulates and their sources • the Earth's water resources and obtaining potable water.
Physics	**Energy** • energy changes in a system involving heating, doing work using forces, or doing work using an electric current: calculating the stored energies and energy changes involved • power as the rate of transfer of energy • conservation of energy in a closed system, dissipation • calculating energy efficiency for any energy transfers • renewable and non-renewable energy sources used on Earth, changes in how these are used. **Forces** • forces and fields: electrostatic, magnetic, gravity • forces as vectors • calculating work done as force x distance; elastic and inelastic stretching

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• pressure in fluids acts in all directions: variation in Earth's atmosphere with height, with depth for liquids, up-thrust force (qualitative). **Forces and motion** • speed of sound, estimating speeds and accelerations in everyday contexts • interpreting quantitatively graphs of distance, time, and speed • acceleration caused by forces; Newton's First Law • weight and gravitational field strength • decelerations and braking distances involved on roads, safety **Wave motion** • amplitude, wavelength, frequency, relating velocity to frequency and wavelength • transverse and longitudinal waves • electromagnetic waves, velocity in vacuum; waves transferring energy; wavelengths and frequencies from radio to gamma-rays • velocities differing between media: absorption, reflection, refraction effects • production and detection, by electrical circuits, or by changes in atoms and nuclei • uses in the radio, microwave, infra-red, visible, ultra-violet, X-ray and gamma ray regions, hazardous effects on bodily tissues. **Electricity** • measuring resistance using p.d. and current measurements • exploring current, resistance and voltage relationships for different circuit elements; including their graphical representations • quantity of charge flowing as the product of current and time

Science Programme of Study – Albany Academy

Engage Springboard Pathway

	• drawing circuit diagrams; exploring equivalent resistance for resistors in series • the domestic a.c. supply; live, neutral and earth mains wires, safety measures • power transfer related to p.d. and current, or current and resistance.
Subsequent learning	*Post 16+* This programme of study is designed to allow progression within other GCSE courses and to support continuation and potential entry for GCSE or Level 1 or 2 qualifications at Dual Placement schools. This programme of study could lead to supporting with skills required for a range of Level 2 and Level 3 qualifications, other vocational qualifications or apprenticeships. This programme of study supports students to transition to adult life.