Progression Map - Science

Curriculum Intent

The secondary curriculum at Bradford Academy intends to:

- Develop individuals who are respectful, responsible and resilient and encourage them to be a shining light in their community.
- Ensure that learners develop knowledge and skills that lead to academic success and future opportunities.
- Create a culture of reading by maximising opportunities to read and broaden vocabulary during the school day and at home.
- Provide a breadth of subjects and experiences so that every individual can find and nurture their strengths and talents.
- Be ambitious for all of our learners by carefully planning for excellent achievement.
- Make use of a sound evidence base to ensure that lessons and teaching techniques are effective.

The Science curriculum at Bradford Academy

Our science curriculum is designed to spark curiosity in and make Science relevant for all learners. The curriculum equips learners with the knowledge and skills required to respectfully question the world around them, critically evaluate information, and find innovative solutions to problems. It encourages learners to be responsible for their actions that impact the planet, future generations and the local environment. During Science lessons, learners are consistently provided with opportunities to develop a wide range of transferable and desirable skills such as evaluating information and testing hypothesise. By doing so, the curriculum produces resilient learners who aren't afraid to rise to a challenge and seek solutions to problems in a modern world. Science opens doors to a wide variety of career pathways and enables the learners to succeed in the choices that they make.

			By the end of Year 7	By the end of Year 8	By the end of Year 9	By the end of Year 10	By the end of Year 11
Knowledge and Skills	**Biology**	**Term 1**	We use microscopes to observe key organelles in plant and animal cells, including specialised cells. The movement in our bodies is studied by learning about the important bones and joints in the skeleton, as well as the antagonistic pairs of muscles we use to make our skeleton move.	We focus on the respiratory and digestive systems, looking at their anatomy (what organs are there? How are they adapted to do their job?) and the physiology (what processes occur here? How? Why?). We make links between lifestyle choices such as smoking or a poor diet and the health impact this can have on these two systems.	We take the opportunity to revisit and recap our knowledge of cells but this is extended by introducing the idea of prokaryotic cells and drawing further parallels. We use microscopes, this time more independently than in Y7. We study cell transport; diffusion, active transport or osmosis. Studying the anatomy and physiology of biological systems continues with a recap of respiratory and digestive systems, as well as introducing the circulatory, nervous and endocrine systems in humans. Further learning includes making comparisons with plant functions.	Back to cells again – checking all of the prior knowledge about eukaryotic and prokaryotic cells. Further details about additional organelles such as ribosomes and the role of the cell surface membrane. Microscope use is assessed as a GCSE required practical, as is the investigation into the osmosis occurring in potato cells. Our cytology studies continue with a study of cell replication (mitosis) and stem cells. In the 'Organisation' topic we look at the processes involved in digestion in detail, including the optimal conditions for enzyme action. We also take a more detailed look at the circulatory system, including the heart, blood vessels and blood itself.	We begin with a recap of the homestasis topic covered at the end of Y10, before moving on to the second biology topic of Y11, which is 'Inheritance, Variation and Evolution'. Here learners draw comparisons between mitosis (studied in Y10) and meiosis, whilst comparing sexual and asexual reproduction. We look at the structure of DNA, and the human genome, as well as using genetic cross diagrams to make predictions about how genetic characteristics are passed from parent to offspring. We study variation within species, selective and genetic engineering, which has both advantages and disadvantages to be evaluated.
		Term 2	We study the relationships between the different organisms in a given ecosystem. From food chains to food webs and pyramids of number, the numbers and interdependence of these organisms is covered, including case studies of predator and prey relationships. We learn how flowering plants reproduce and investigate seed dispersal.	Aerobic respiration is a chemical reaction that takes place in all living cells in order to release energy. We also consider 'anaerobic respiration' which is a bad thing for humans, but an incredibly useful process in microbes such as yeast. Photosynthesis in plants is where plants can absorb sunlight in order to produce their own glucose, which is used in respiration, and stored in seeds and fruits.	An entirely new topic is introduced – looking at the causes of, symptoms of and solutions to disease. We learn about both our external and internal immune defences systems. We look at different medications (including antibiotics) for treating disease, and how vaccines work to prevent disease and keep communities safe. The next Biology topic focuses on plants in more detail, revisiting the process of photosynthesis, and how the plant structure is adapted for optimising this.	Building on the area studied in Y9, we recap causes and common symptoms of diseases, and compare communicable and non – communicable diseases. We learn about the process of phagocytosis and the ability of lymphocytes to produce antibodies or antitoxins as an immune response. As well as a more detailed look at vaccines, we look at the clinical drug design process, starting with computer modelling, double blind trials and the difficulties associated with attaining government approval. We investigate the rates of respiration, photosynthesis and transpiration, calculating rates using	The final biology topic is 'Ecology' building on prior studies to recall the meaning and importance of biodiversity and interdependence between different species in the natural environment. We consider the difference between abiotic and biotic factors and learn about how scientists take samples in the natural world, using quadrats, sweep nets and pooters. We study the water and carbon cycles.

					tangents to curves, and considering what factors have an effect on each.	
	Term 3	Variation in a population is the key to survival, and we study why, looking at the variation in our own classes. We learn about why it is so important to reproduce, and how this process occurs in humans, following the stages from ovulation, through fertilisation, implantation, foetal development and birth.	Revisiting the importance of variation, we look at biodiversity and how this strengthens the interdependence of different habitats. We learn about Charles Darwin and his work on Evolution and Natural Selection, why extinction occurs and how the discovery of DNA has led to many other important scientific discoveries.	After recapping the basics of sexual reproduction, we draw comparisons with asexual reproduction. We learn about DNA in more detail, and have a go at extracting it from fruit. Key terms; allele, dominant and recessive are introduced and Punnett squares are used to make predictions about inherited characteristics. We round off this topic by looking at the evidence for evolution using fossils.	Homeostasis is how the human body maintains a constant internal environment. We look at the nervous system and the endocrine system with a particular focus on reproductive hormones (triple learners will also learn about kidney function).	Revision of paper 1 and 2 biology in preparation for exams.
Chemistry	**Term 1**	In chemistry lessons, we learn about how many household substances can be classified as either 'acids' or 'alkalis', and how we test for these. We investigate neutralisation. We study the geology of Earth, defining and recognising key characteristics of sedimentary, igneous and metamorphic rocks, and how the rock cycle links them altogether.	At last! Learners are introduced to the wonder that is the 'Periodic Table'! Starting with defining elements and compounds, then focusing specifically on groups 1, 7 and 0, we look at similarities and differences and patterns of reactivity. We investigate the structures of different types of materials, including polymers, composites and ceramics.	Recapping and revising the periodic table introduces learners to the deeper intricacies of relative atomic mass and atomic numbers. They learn about the structure of atoms and how isotopes occur. The physical and chemical properties of elements are compared. Returning to acids and alkalis, we clearly define the difference between an alkali and a base. We write word and symbol equations for neutralisation reactions. We also determine the difference between a 'strong' and 'concentrated' acids.	We consider how the ideas of the periodic table and atomic structure came to be throughout history. We explain the patterns of reactivity found down groups 1,7 and 0 of the periodic table using electron configuration. We also learn about isotopes, and calculate the average isotopic mass. In the 'Structure and Bonding topic' we consider how different atoms join together by either sharing, donating or receiving electrons, and how this affects the properties of new substances formed.	Y11 Chemistry starts with investigations into rates of reaction. We investigate factors such as temperature, concentration, surface area, and the effect of catalysts. We also study reversible reactions and at higher tier, we introduced the concept of dynamic equilibrium and consider how we can control the forward or backward rate of reaction in order to achieve the desired product. Organic Chemistry is the study of hydrocarbons. We look at fractional distillation. consider issues with supply and demand, which lead to a need for catalytic cracking. Triple learners also study alcohols, carboxylic acids and compare processes of addition and condensation polymerisation.
	Term 2	The states of matter (solid, liquid and gas) are revisited, and the particle model is introduced, including the process of diffusion.	We start by defining what is actually meant by a 'chemical reaction', and learn to write equations like scientists. We then look at lots of different types of chemical reactions, including exothermic/endothermic reactions, combustion, oxidation, thermal decomposition and catalysed reactions too. We introduce the concept of conservation of mass.	We focus on the reactions of metals – oxidation leading to corrosion, and how metals fit into a list that we call the 'reactivity series'. This can be used to make predictions how different metals are extracted from the Earth. We also discuss the limited availability of high grade ores, and how we can use methods such as phytomining and bioleaching to help deal with the challenges of this.	We have discussed 'conservation of mass' in year 8, and return to this idea in the 'Quantitative Chemistry' topic. We learn simple methods of calculating yields of products based on the starting masses of reactants. The unit of 'mole' is introduced, which chemists use to help make these calculations, including in solutions and in gases for triple learners. After revisiting the reactivity series of metals, using practical examples, we consider how this helps us to explain how different metals are extracted from their ores. We	We consider in detail the composition of the Earth's atmosphere and how it has evolved to have it's current composition. We then think about how the atmosphere is continuing to change. and define the greenhouse effect as either 'natural' or 'human induced', looking at evidence for global warming and climate change. Finally in the 'Atmosphere' topic, we study other air pollutants such as sulfur dioxide. The final chemistry topic looks at everyday, including water and metals. We consider the life cycle assessment of daily objects, looking at 'cradle, use and grave'.

					study the blast furnace for the extraction of iron or copper, and electrolysis of aluminium.	Higher tier learners learn about alternative methods of metal extraction from low grade ores, and Triple learners also learn about composite materials and polymers. Finally, triple learners cover the different types of minerals that are essential for healthy plant growth.
	Term 3	Materials are defined as 'soluble' or 'insoluble', and different methods of purification are studied, including filtration, distillation and chromatography.	The Earth's atmosphere and how human activities are affecting it are covered by learning about the composition of the atmosphere, and studying the carbon cycle. The realities of the greenhouse effect and climate change are reviewed using scientific evidence. We move onto considering metals as a non-renewable resource, and learn how different types of metals are extracted and why it is so important to recycle our metals.	We recap the composition of the Earth's atmosphere, and consider how the Earth's atmosphere has evolved from the high levels of carbon dioxide and water vapour it used to have. We compare the natural and human enhanced greenhouse effects and consider other forms of air pollution that could lead to acid rain. We focus on energy changes in reactions, recapping key terms 'exothermic' and 'endothermic', and drawing energy profile diagrams for the different types of reaction. We consider the effect of catalysts on reactions. We introduce a new topic – Organic Chemistry. We learn about the formation of crude oil, and how it consists of a mixture of hydrocarbon molecules called alkanes, some of which need further processing through cracking in order to be made into more in-demand fuels.	Acids and alkalis are a familiar topic, but this time we look at the ions that make them behave in this way (hydrogen ions for acids and hydroxide ions for alkalis). We define the difference between strong and weak acids and carry our numerous neutralisation reactions, including titration for the triple learners.	Revision of paper 1 and 2 chemistry in preparation for exams.

Physics	**Term 1**	We move from studying the Earth to studying outer space – the planets in our solar system, Earth's place within it (including why we have day and night, and the seasons).	We introduce the topic of 'Waves' by looking at how sound travels, including definitions of amplitude, intensity, frequency and pitch, as well as understanding how our ears work and why different animals use sound in different ways. We make comparisons with light, investigating reflection and refraction, as well as studying different shaped lenses and explaining how we see colour. The Electricity topic covers how current and voltage are affected in series and parallel circuits, and how we can use different models to explain this. Learners also use the 'ESRA' technique to calculate resistance in a circuit.	The eight energy stores identified in Y7, are studied in much greater depth, with a special focus on kinetic, elastic potential, gravitational potential and thermal energy, and calculations linked to these energy transfers. We round off this topic with a detailed study of renewable and non-renewable energy resources. After a brief recap of forces, learners are introduced to Newton's laws of motion and the impact on resultant forces. They will calculate speed, acceleration and momentum, draw speed-time graphs and consider the factors affecting the stopping distance of a vehicle.	We have a quick refresher of the eight energy stores and 4 major pathways used to transfer between them. We move onto calculating the energy transfers and making links between the different energy stores. We introduce the idea of specific heat capacity, and use a practical investigation to analyse the specific heat capacity of different metals.	We start by refreshing our knowledge of contact and non-contact forces, before moving on to calculating speed and acceleration, and analysing both distance -time and speed- time graphs. We define terminal velocity and calculate the stopping distance of a moving vehicle, as well as considering factors that affect it. Higher tier learners will also learn about momentum. In the 'Waves' topic, we start by considering the two categories of waves – transverse and longitudinal. We calculate wavelength using a ripple tank, and study all parts of the electromagnetic spectrum. We consider practical uses for each type of radiation, and specifically carry out investigations into IR and visible light. Triple learners also look at lenses, ultrasound and seismic waves.
	Term 2	The Energy topic looks at how energy is classified into a series of 'stores', focusing on kinetic (moving), thermal (heat), chemical (fuels, food and batteries), elastic potential (a stretched elastic band or spring), and gravitational potential (something having the potential to fall down). We calculate 'work done', measure the energy present in our food and round off with a comparison of renewable and non-renewable energy resources.	Forces can be classified into contact and non-contact forces. We investigate Hooke's Law, as well as investigating the effects of friction and drag. We calculate pressure, and consider how this changes in fluids, but also how it is made useful in hydraulic systems. Another huge area of physics is 'Energy', and we look at 'work done', as well as using levers. Heat transfers are covered by looking at conduction, convection and radiation, and how each of these is prevented using different forms of insulation.	We return to the particle model and recall how a substance can be made to change state. We calculate the density of both regular and irregularly shaped objects, and look at properties of liquids and gases. Electrical circuits are briefly revisited, before moving on to investigating resistance and factors affecting this. We discuss the importance of earth wires, and think about where our electricity comes from, in terms of renewable and non-renewable sources as well as the issues surrounding increasing reliance on batteries.	After a quick recap of series and parallel circuits, we learn about the relationship between current and potential difference, as affected by different components. We calculate electrical power and look at what happens when we put resistors into series and parallel circuits. We also study how domestic electricity is generated from power stations and how it gets to our homes safely via the National Grid network. We move onto looking at energy changes in state transfers by calculating specific latent heat. We revisit ideas about specific heat capacity as well as plotting heating and cooling curves.	Magnets are revisited with a comparison of permanent and induced magnets, as well as plotting magnetic fields. We have a required practical investigating factors affecting the magnetic field strength. Higher tier learners also learn about how the components of electromagnets can be used in electric motors. Triple learners apply their knowledge to explain how loudspeakers and microphones work, as well as a mathematical explanation of how step-up and step-down transformers work. Finally for triple learners, they look out towards space, studying the life cycles of stars, the orbital motion of celestial bodies, and the use of red-shift to provide evidence to support the Big-Bang Theory.

		Term 3	The 'Forces' topic is introduced by thinking about speed, through investigative work and calculations. We look at Distance-Time Graphs as well as the effect of gravity on Earth and in other parts of space.	We begin with a recap of magnets and magnetic materials, but quickly progress onto plotting magnetic fields and understanding how the Earth is a giant magnet. We learn the components of an electromagnet, and how these are different and used differently to a bar magnet. At the end of the year, we come full circle back to waves again, focusing on ultrasound in more detail, pressure waves and an introduction to the electromagnetic spectrum looking at some different types of light.	We revisit ideas of the Earth in space, considering the sheer vastness of space. We also consider the different objects in space, with a particular focus on the life cycle of stars. After a brief introduction to the electromagnetic spectrum in Y8, we look at the full range of wavelengths, including radio waves, microwaves, infra-red, visible light, ultra violet, x-rays and gamma rays. We also learn about how earthquakes occur in terms of P and S waves	We recap our knowledge of isotopes and learn about the differences between alpha, beta and gamma radiation, and the products formed when a radioactive isotope undergoes one or more types of these decays. We plot graphs to calculate half life, and consider what this means in terms of long-term hazards of radioactive waste.	Revision of paper 1 and 2 physics in preparation for exams.
	Working Scientifically	**Term 1**	Introduction to key skills in science, including method writing, identifying variables, risk assessments and labelling, handling and applications of laboratory equipment. We have a focus on making and also learn how to make observations in a scientific way, using microscopes and chemical changes.	Revisiting and building upon science skills covered in earlier years, including variables and presentation of data. This includes preparing results tables independently, and picking the correct type of graph to present our data. We analyse patterns of data, and discuss errors in our data, including how to manage these.	Scientific skills are not taught as explicit stand-alone lessons in Y9, but are an intrinsic part of every topic. All practical work will have an aspect of the skills learned in Y7&8, so depending on the set task, they could be expected to plan their own investigation e.g. identify variables - alternatively prepare their own results table. In other cases, they will record their data and present it in the best graphical format.	Throughout the GCSE program, learners carry out regular practical work, with a considerable number of them being classed as 'required practicals'. These are experiments/ investigative tasks that require them to use specialist equipment to measure length, volume, mass, potential difference, current, resistance, and temperature. Alongside the practical work, exam questions about the required practicals expect learners to be able to; identify independent, dependent and control variables, analyse data, construct line graphs and bar charts, draw conclusions, evaluate quality of data and to respect the importance of peer review. Numeracy skills such as calculating the mean, median, mode, range, area and volume; using mathematical symbols, using standard form, correct significant figures or decimal places and further graph work is covered through Biology, Chemistry and Physics at GCSE.	Throughout the GCSE program, learners carry out regular practical work, with a considerable number of them being classed as 'required practicals'. These are experiments/ investigative tasks that require them to use specialist equipment to measure length, volume, mass, potential difference, current, resistance, and temperature. Alongside the practical work, exam questions about the required practicals expect learners to be able to; identify independent, dependent and control variables, analyse data, construct line graphs and bar charts, draw conclusions, evaluate quality of data and to respect the importance of peer review. Numeracy skills such as calculating the mean, median, mode, range, area and volume; using mathematical symbols, using standard form, correct significant figures or decimal places and further graph work is covered through Biology, Chemistry and Physics at GCSE.
		Term 2	Numeracy skills are improved with a focus on line graphs and bar charts, as well as calculating a mean and identifying anomalies in patterns of scientific data.	So now we know our data is good, we start to think about drawing conclusions from given data, and critiquing claims of conclusions made by others. We can use data and our scientific knowledge to justify opinions and examine consequences.			
		Term 3	'ESRA' (Equation, Substitute, Rearrange, Answer) is introduced as a step-by-step guide to higher level calculations used by scientists. To conclude the year, we look at how to draw conclusions and the importance or correlation and cause.	Revisiting planning, including variables and making a hypothesis, also considering how to risk assess a situation effectively.			

	Assessment		As well as the GL assessments that take place in September and July, we have three summative written test assessments that take place throughout Y7.	As well as the GL assessments that take place in September and July, we have three summative written test assessments that take place throughout Y8.	As well as the GL assessments that take place in September and July, we have three summative written test assessments that take place throughout Y9.	Assessment takes place half termly, with the questions following a pattern as set by the assessment objectives used by the AQA exam board. Actual past paper questions are used in both lessons and assessments as practice of applications of knowledge and understanding the key command words as set by the exam board. Revision for assessment is explicitly taught as a skill, and feedback lessons after every assessment allows learners to revisit weaker areas and clarify misconceptions.	The first round of GCSE 'Mock Exams' takes place in the exam hall in September. These are full versions of Paper 1 in Biology, Chemistry and Physics and these are marked by class teachers. Feedback takes place after the Mock Results Day, which gives learners a taste of the how the real thing will feel. These mock grades are extremely important as they will be presented to sixth form centres as part of the application for Post-16 studies. Regular formative assessment of paper 2 topics takes place (roughly every 6 weeks), with the paper 2 Mock Exam session occurring in February.
	Knowledge and Skills Revisited		Many topic areas are designed to build upon and revisit knowledge from Key Stage 2.	Y8 Science lessons begin with a recap of key ideas and skills – including practical laboratory skills – from Y7. Cells, Particle Model, Reproduction and lab safety are all covered. Most topic areas a building on areas introduced in KS2.	Year 9 Science is the cross-over link between KS 1, 2, 3 Science and GCSE Science. The key strands of cells, organisms, chemical reactions, matter, energy, electricity and forces are all revisited and core knowledge is recapped and deeply embedded. It is also extended and learners have the opportunity to experience a taste of how these topic areas are taught and assessed at GCSE level.	Success in GCSE Sciences is heavily dependent on having a strong foundation established throughout key stages 2 and 3. The key strands of cells, organisms, chemical reactions, matter, energy, electricity and forces are continued and broadened and deepened, with a focus on application to real life situations.	Success in GCSE Sciences is heavily dependent on having a strong foundation established throughout key stages 2 and 3. The key strands of cells, organisms, chemical reactions, matter, energy, electricity and forces are continued and broadened and deepened, with a focus on application to real life situations