SMITH'S WOOD ACADEMY

FAIRFAX MULTI-ACADEMY TRUST

# *Science* 5 Year Curriculum Plan

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ENRICHING LIVES; TRANSFORMING FUTURES

# Trust Curriculum Policy Extract

The Trust curriculum ensures all pupils in the Trust experience a rich, broad and balanced experience, reflecting the FMAT mission of `Enriching lives, transforming futures`. **We want all our pupils to experience the joy and wonder of learning.**

We place a strong emphasis on nurturing the spiritual, moral, social and cultural development of pupils, along with a firm commitment to developing pupils' resilience and character **through the acquisition of life skills**. We are preparing all our pupils to contribute positively to modern British society **and have a suitable career and destination**. All pupils have the entitlement to study a rich and varied curriculum

**The Trust values permeate the curriculum**

**Excellence:** a curriculum of the highest quality to ensure excellent outcomes
**Dedication:** we believe there is dignity in hard work
**Ambition:** we want the very best for all of our students.
**Integrity:** moral purpose will underpin the curriculum decisions we make for our pupils
**Tradition:** British values, literacy and numeracy underpin the curriculum

A well-constructed curriculum will lead to good results because these results will reflect what pupils have learned. The curriculum is the progression model, enabling pupils to **know more, remember more and be able to do more.**

# Teaching and Learning Vision

*Knowledge is power. Information is liberating.*
Kofi Annan

We believe all students, whatever their background, are able to become experts in the disciplines that they study. Their expertise will be achieved through quality teaching and the dissemination of deep knowledge by highly skilled and knowledgeable subject experts – in every classroom, every lesson, every day.

Our students have the right to be introduced to deep knowledge and a wealth of information from the spectrum of subjects that they study. They will be introduced to, and understand, theories and principles that have influenced, continue to influence, and will influence in the future, the world in which they live. They will be prepared to fully engage in academic discussion about their learning.

This learning will secure a successful place in society for our students. They will go further than they ever thought possible.

# Teaching and Learning Vision for the *Science* Department

*The Smith's Wood Academy Science Department aspires to develop students who have a love of scientific knowledge, which is relevant to their experiences, and can solve scientific problems through investigation and enquiry. We will develop the minds of our learners by providing access to courses that will support the creativity, curiosity and, very importantly, the enjoyment of science for all students. By the end of their school career, our students will be capable of applying their scientific knowledge to current issues, making connections between scientific disciplines, and pursuing post-secondary education or careers in the fields of science and engineering of their choosing. We will help them to feel more confident in the decisions they may need to make about their own circumstances, such as family health and nutrition or environmental concerns, through the knowledge and skills which they have gained through studying Science at Smith's Wood Academy.*

## We can turn every learner into an expert in *Science,* at the same time as developing a love for the subject.

## At the end of Year 11 students in *Science* will….

| Know… |
| --- |
| Students will know the key concepts underpinning science which are incorporated into the topics studied in the prescribed 'units of study' (detailed below in the 'curriculum plan'). For example, when students are studying the nature of 'Cells', within the 'Cells and Organisms' 'unit', they would be expected to know that there are many types of cell, each of which has a different structure so that it can perform a specific 'role'. The knowledge which is required in each lesson is stated in the accompanying 'learning journey' document for the 'learning episode' which pertains to that part of the 'unit'. In this way, the specific knowledge which is required, both substantive and disciplinary, is made explicit. The ability to know these concepts will then allow the students to move on to the understanding phase of their learning. |
| **Understand…** |
| The structuring of the curriculum, through the ordering of the 'units of study', will support a flow of ideas through the 5-year Curriculum at Smith's Wood Academy, which, in turn, will support students in building a deep understanding of key scientific concepts. For example, the study of the fundamental properties and functioning of cells, referenced above, is completed before students go on to learn how cells collectively form tissues which fulfil a specific purpose in a living organism. Such tissues may then collectively form organs which serve vital functions within the organism. Finally, organs may together form an 'organ system' which carries out essential life processes. The theoretical ideas are made firmer in the minds of students by applying to examples such as the human heart, which is an organ comprising part of the 'circulatory system'; an organ system which enables blood to be pumped efficiently around the body. Being an example of an organ, the heart is comprised primarily of muscle cells, which group to form tissues and which, in turn, make up the structure of the heart. Similarly, students will encounter the theory of particles before they discover that different types of particle may be associated with different forms of radiation; their understanding of radiation will be consolidated through learning how various types of radiation may be used in industrial applications. A crucial component of the support for the development of student understanding is the identification and explanation in lessons of the links between the different parts of the curriculum and between the Scientific disciplines. For example, the topic of 'Energy', studied as part of Physics in Year 9, will incorporate references to the types of energy transfer which were encountered in Year 7; in a similar manner the theory of 'Atomic Structure' studied as part of Physics in Year 10 will 'cross-link' to the study of 'Atomic Structure' in Chemistry in Year 9. These links will be identified |

and made clear in the associated 'learning journey' documents. The curriculum has been structured in this way so that students will have a clear understanding of the key scientific concepts that underpin Biology, Chemistry and Physics, and the links between them, by the time they leave at the end of Year 11.

## Be able to…

Students will be able to take the key topics, which they have studied over the five years of the course, and apply them in many different contexts, allowing students to make links to the environment in which they live. It may be that students use the concepts directly in further study, or in vocational settings through their chosen careers; alternatively, they may have cause to apply the ideas to understanding the science behind current issues in the news or their own circumstances. Specific examples might include the ability to talk about, read and write about scientific principles such as diffusion and collision theory using the correct terminology. They will be able to represent science in its many forms, both mathematically in graphs and tables, and visually through models; an example being the 'particle model' for solids, liquids and gases. They will have the ability to carry out scientific skills, whether it be directly investigating, observing, experimenting or testing out ideas for further study or their chosen careers; or through applying the concept of the 'scientific method' to understanding how progress is often made in the world around them.

## Have been exposed to the following knowledge, theories, texts and experiences that span beyond the GCSE specification

Science lessons at Smith's Wood Academy will contain ideas and themes which frequently reach beyond the scope of the GCSE course, these themes are each referenced at the appropriate stage in the 'learning journey' documentation. Examples of these themes include explanations of the everyday and technological applications of science, a recognition of the importance of peer-review of scientific results and how these are communicated to a range of audiences and, very importantly, an appreciation of both the power and limitations of science and a consideration of the associated ethical issues. Through an exposure to these themes, our students will develop a stronger grasp of how science works in context in our society and how it influences their lives. Examples of theories to which our students are exposed that reach beyond the scope of the GCSE specification, again referenced in the relevant 'learning journey' documents, are concepts building upon 'fission' and 'fusion', and how these lead to our search for 'cold fusion', when studying the 'nuclear physics' topic; in a similar manner, ideas relating to relativity and quantum physics are introduced when discussing the 'laws of motion' and the 'particle model' respectively. Examples of texts which are available in classrooms are 'The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine' by Marty Jopson and 'The Science Book: Big Ideas Simply Explained' by Rob Colson et al. These books are good examples of how scientific themes may be made accessible and relevant to students' experiences.

## Developed their cultural and social capital through the following extra-curricular work

The students at Smith's Wood Academy may arrive, in many cases, with gaps in their cultural and social capital; students from disadvantaged backgrounds may be less likely to have visited museums, for example, or to have engaged in discussions around scientific ideas and consequently have not developed an interest in the natural world. With a view to developing this aspect of the students' lives, thereby better enabling them to access the scientific curriculum, a series of 'drop-down' days are presented which will offer a broad and balanced look at major scientific advances and discoveries which have occurred both recently and historically. The skills and experiences which are gathered during these days will enrich the curriculum and allow our students to progress and achieve. School trips to 'The Big Bang Fair', the largest celebration of science, technology, engineering and maths (STEM) for young people in the UK, at the National Exhibition Centre in Birmingham are organised. Students are also given the opportunity to attend the 'Christmas Science Lectures' at the University of Birmingham. These events allow students to experience scientific ideas and discussions outside of the school environment and are invaluable for developing their scientific cultural capital. Regular opportunities for participating in experiments and investigations outside of the classroom are available through 'Science Club' which will encourage the team-working and communication skills of the students in a less formal setting and often with students from different Year groups. In addition, the opportunity to engage with a different science project for each Year group is encouraged; an example being the design and construction of the students' own 'wind turbines'.

# 5 Year Curriculum Plan

## Year 7 Science at Smith's Wood Academy

The Smith's Wood Academy Year 7 Science curriculum has been designed to ensure that all students make good progress from their individual starting points which are of varying levels due to the profile of the intake of students from surrounding primary schools. At Smith's Wood Academy our intake includes a high proportion of 'low ability learners' and students with special educational needs. Many of our students do not have the luxury of having a 'rich background' in Science or 'rich cultural capital'. Through a logical sequence of knowledge and concepts (detailed below). We have designed the curriculum to be fully inclusive of all backgrounds. For example, an emphasis is placed on providing students with scientific context through 'show and tell' lessons at the beginning of each topic based upon demonstrations which encourage the students to relate the theory of their studies to visual experiences. These allow students who have not had the relevant background experiences to 'catch up' with their peers, as well as serving to stimulate curiosity in the subject matter.

At the start of Year 7, students complete a 'baseline' assessment which allows us to better differentiate the lessons with a knowledge of their 'starting points'. With a view to further addressing the 'Key Stage 2' learning gaps, and improve cultural capital, we have dedicated a 'hook' PowerPoint slide in our lesson resources to make each learning episode relevant to the students' experiences; an example of such a 'hook' for the 'Gravity and the Universe' Unit is a summary of the achievements of Mae Jemison (born October 17, 1956), an American engineer, physician and NASA astronaut who became the first black woman to travel into Space. Differentiated tasks, which use 'choral response' and 'RPD' techniques for key scientific keywords, are employed in our lesson resources, as well as the principles of 'Dual Coding'. During lessons, there is support for our 'Pupil Premium' students through these methods to help close the 'disadvantaged gap'.

We have written 'low stakes' mid-topic and end-of-topic tests called 'celebrations'. These 'celebrations', tailored to our new curriculum, allow us to identify and address knowledge gaps and misconceptions by intervening at an early stage creating an accessible curriculum starting with 'must know' objectives building up to 'securing mastery' goals which provide the ambition and challenge. As a result, we feel that we have developed a challenging yet developmental curriculum that doesn't depend upon prior learning for success. This gives us the best possible chance of ensuring that each student is able to make genuine progress towards understanding higher-order thinking and content regardless of their background. In a local context, which is relatable to the students of our school, the study of the 'Food as Fuels' topic in Year 7 will address students' understanding of the nutritional content in foods, including how nutrients are used and how energy is transferred by the body, allowing them to make better informed 'healthy eating' choices; while studying the 'Energy Costs' topic will enable students to evaluate their own household consumption of non-renewable fuels and allow them to consider the use of renewable examples of resources.

The Units in Year 7 are studied in the order listed at the end of the section to provide a logical order of objectives and a 'flow' of scientific ideas through the curriculum. In addition, it provides a good degree of 'interleaving' (as described below) to reinforce the students' learning of the scientific principles; the concepts of the 'big ideas' in science and aspirations of 'mastery goals' are used throughout to equip students for success at GCSE. In Year 7 the students are taught 'practical skills' at the start of the course which focus on the 'How Science Works' framework which underpins science: setting up an effective experiment, safety, taking measurements and making calculations. These principles are taught first to allow all students to be able to safety complete investigations during the year and to be able to understand the key elements of developing an investigation and analysing the results. The 'How Science Works' principles, once introduced at the start of the year, will get more challenging through the Year 7 Key Stage 3 course. The lessons covering these principles will contain aspects such as asking scientific

questions, as well as both presenting and evaluating data. The intention is that these skills of our Year 7 students will be sufficiently developed to prepare them for the investigative aspects of science which run throughout the GCSE course.

Throughout the ordering of the Units in Year 7 lies the principle of 'spiral learning', which is based upon the premise that a student consolidates their understanding of a concept each time it is reviewed or encountered. The scientific knowledge in the Units of the Science curriculum has been organised into the 'big ideas' of science, namely 'Forces', 'Electromagnetism', 'Energy', 'Waves', 'Matter', 'Reactions', 'Earth', 'Organisms', 'Ecosystems' and 'Genes'. Each 'big idea' contains four smaller topics, which are essentially the 'building blocks' for the 'big ideas' and build in complexity. For example, the themes within the 'Matter' idea are ordered from simpler and more 'concrete' topics: 'Particle model' and 'Separating mixtures' (which are taught in Year 7), to more abstract ones: 'Periodic table' and 'Elements' (which are taught in Year 9). The topics have been organised to draw on the various scientific skills, which are presented in different contexts, and the ambition is that it will be easier for students to develop an understanding of a 'big idea' by multiple interactions with the concepts within the idea. Furthermore, by seeing how the simpler ideas connect to more abstract ones, students will be better prepared to apply these concepts when approaching new and unfamiliar topics. The remaining Units in Year 7 (for example 'Energy Costs', 'Metals and Non-Metals' etc) are of a simple and more 'concrete' nature and will then be revisited either in Year 8 or Year 9 (or both) alongside more complex ideas to develop the students' understanding of the ten 'big ideas' which underpin Key Stage 3 science.

A second important principle, that of 'interleaving', has informed the sequence in which Units are taught in Year 7. Following the 'practical skills' section, the first Unit which is taught in Year 7 is the 'Particle Model' which includes lessons on states of matter, melting and freezing and diffusion, among others. The reason for starting with this topic is that the knowledge that all matter is composed of particles, together with an appreciation of how they behave and interact, supports the understanding of many other more challenging topics. It also allows for true 'interleaving' to be implemented in the curriculum, which is more than simply 'spacing out' and returning to aspects of certain topics in a curriculum. Research has shown (e.g. Hannah Hausman and Nate Kornell, 2014), that 'interleaving' is only effective if topics which are being taught 'side by side' are sufficiently related. By moving on to 'Separating Mixtures', which builds on the students' knowledge of the particle model to explain how mixtures can be separated by process such as evaporation and distillation, the themes of the 'particle model' are continued to be taught in the context of the next topic (this technique has been called 'interweaving'; Mark Enser 2019). Similarly, when the next Unit of 'Cells and Organisms' is begun, concepts such as 'gas exchange' and the 'diffusion within cells' may draw on the ideas of the 'particle model' and, indeed, teaching of the concepts of the 'particle model' (and therefore 'interweaving') continues.

| Year 7 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Lab skills (B/C/P) | 6 per BCP |
| Unit 2 | Particle model | 10 |
| Unit 3 | Separating mixtures | 8 |
| Unit 4 | Cells and organisms | 7 |
| Unit 5 | Movement | 6 |
| Unit 6 | Energy transfer | 5 |
| Unit 7 | Energy costs | 4 |
| Unit 8 | Metals and non-metals | 8 |
| Unit 9 | Earth structure | 7 |
| Unit 10 | Variation and human reproduction | 10 |
| Unit 11 | Speed | 5 |
| Unit 12 | Contact forces | 8 |
| Unit 13 | Gravity and the universe | 8 |

# Year 8 Science at Smith's Wood Academy

Once students have completed the first year of the Science curriculum at Smith's Wood Academy, they have experience of a firm 'grounding' in 'practical skills', enabling them to undertake the more sophisticated investigations which are introduced in the second year of the course, as well as an understanding of the simpler 'building blocks' of the 'big ideas' in science. These 'building blocks' are required in Year 8 to access the increasingly complex and more 'abstract' concepts which will be encountered, as the students become more adept at applying their knowledge to unfamiliar contexts.

As in Year 7, the principle of the 'big ideas' in science, and the associated opportunities for 'spiral learning', are at the 'heart' of the science curriculum which has been developed at Smith's Wood Academy. The students learn to see the world analytically through the generalisations, principles and models which connect the concepts of the 'big ideas'. The ability to explain phenomena and make predictions are skills which they will require for the next stage of their educational journey. The differing backgrounds of the students are again compensated for through the spirit of 'show and tell' lessons to enrich the experiences of the students. The use of 'hooks' in lessons, rooted in the 'local context', and 'choral response' techniques such as 'RPD' for keywords and 'Dual Coding' techniques are again employed. Topics are made relevant to students' own experiences wherever possible; for example, the 'Earth's Resources' lesson in Year 8 invites students to evaluate their own household's recycling to encourage a more 'sustainable' way of life. Another example arises in the 'Digestion' topic In this year, in which statistics are presented relating to eating habits in the local community; similarly the lesson on 'Breathing and Circulation' which references 'smoking' will enable pupils to make better informed life choices and provoke discussion of the wider socio-economic impacts associated with drug use.

The Units in Year 8 (listed at the end of the section) are again ordered to provide a logical sequence of objectives, to support 'spiral learning', as outlined above, and to allow for 'interweaving' of the ideas which is described in more detail below. There is again an emphasis on 'practical skills' at the start of the year, structured around the 'How Science Works' principles of handling data: rearranging formulae, calculating the 'mean' for a set of data and evaluating errors. These principles are taught at the start of the year to enable students to understand the key aspects of how to analyse and interpret the results from investigations. As the year progresses, more challenging aspects of the 'How Science Works' framework will be encountered, including aspects such as 'asking scientific questions', 'presenting data' and 'evaluating data'. The ambition is that students will develop the skills and knowledge which are needed to successfully master the 'investigative' aspects of the GCSE course.

Following the 'practical skills' teaching at the beginning of the year, the first Unit which is taught in Year 8 is the 'Digestion' Unit which includes lessons on 'food tests', 'unhealthy diets', 'the digestive system' and 'enzymes in digestion' among others. The reason for starting with this topic is because this Unit builds upon the Units of 'Cells and Organisms' and 'Movement' which were taught in Year 7 (found within the 'Organisms' 'big idea'). This is followed by 'Breathing and Circulation' which further develops the students' learning from the 'Organisms' 'big idea' since it requires knowledge of specialised 'red blood cells' and the 'diffusion of gases'. An opportunity for 'interweaving' of the topics is afforded by teaching the Units in this sequence, since the functions of 'food groups' are first taught in the 'Digestion' Unit and then their transportation around the body is explored in the 'Breathing and Circulation' Unit; while allowing for a continuation of the teaching of the nature of the 'food groups' in the context of the 'Breathing and Circulation' Unit. Similarly, 'Acids and Alkalis' is taught prior to 'Earth's Resources' so that students understand 'chemical reactions' and 'reactivity' which can be linked to how chemical reactions are used to obtain pure metals in the latter Unit. Furthermore, the 'Earth's Resources' Unit is taught before the 'Climate' Unit so that students appreciate the importance of using the Earth's resources and how their extraction impacts the environment; throughout these sequences, opportunities exist to 'interweave' the topics by continuing to teach the former in the context of the latter.

In keeping with the principle of 'spiral learning', the Units in Year 8 all relate to simpler ideas which were taught in Year 7 and lead into more complex ideas in Year 9, allowing for multiple interactions with the simpler concepts which exist within each 'big idea'. For example, within the 'big idea' of 'Reactions' the 'Metals and Non-metals' Unit was taught in Year 7 and leads onto both the 'Acids and Alkalis' and 'Chemical Energy' Units in Year 8; in turn this will provide the foundation for the 'Types of Reaction' Unit in Year 9. In each case, the simpler concepts within the 'big idea' are revisited, on multiple occasions, in different contexts.

| Year 8 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Lab skills/data handling/HSW | 6 per BCP |
| Unit 2 | Digestion | 8 |
| Unit 3 | Breathing and circulation | 8 |
| Unit 4 | Acids and alkalis | 8 |
| Unit 5 | Chemical energy | 5 |
| Unit 6 | Heating and cooling | 6 |
| Unit 7 | Work | 4 |
| Unit 8 | Interdependence | 8 |
| Unit 9 | Plant reproduction | 4 |
| Unit 10 | Earth's resources | 4 |
| Unit 11 | Climate | 5 |
| Unit 12 | Magnetism | 3 |
| Unit 13 | Pressure | 6 |
| Unit 14 | Waves | 6 |

# Year 9 Science at Smith's Wood Academy

Upon moving into Year 9, students have already been exposed to a range of 'practical' activities in order to develop their investigative skills as well as many of the concepts underlying the 'big ideas' in science. These generalisations, principles and models which run through our curriculum connect the concepts and prepare students for the more complex ideas which will now be encountered in Year 9.

A focus upon 'practical skills' is once again established at the outset of the year, bringing with it an opportunity for the students to develop their abilities to perform effective investigations, analyse results and draw conclusions as well as engaging in 'critical thinking'; allowing them to deepen their appreciation of the 'How Science Works' framework which underpins scientific enquiry. There is a continued emphasis upon the 'big ideas' of science throughout Year 9, in accordance with the principle of 'spiral learning', in which many of the 'building blocks' encountered in Years 7 and 8 are now revisited in different contexts and used as support for developing an understanding of the more sophisticated themes in Year 9. Not all of the students will have made sufficient progress in Years 7 and 8 and there is a further need to show the students the scientific demonstrations which will enrich their experience and understanding of the scientific principles, as well as using differentiated resources which make use of 'hooks' in lessons, 'RPD' techniques for remembering the 'scientific keywords' and 'Dual Coding' techniques. Furthermore, it is imperative that the scientific content continues to be made relevant to the students' own experiences and backgrounds. The 'Recreational Drugs' Unit will provoke discussion and wider thinking associated with the issues of drugs and their use, allowing students to make better-informed life choices as they become responsible adults. The study of 'Inheritance' in Year 9 will provide students with the opportunity to reflect upon their own inherited features and how these are passed on to children through the 'genetic code'.

The Units in Year 9 have been carefully sequenced, in the manner which is listed at the end of the section, in order to provide a logical progression of objectives, as well as providing opportunities for 'spiral learning', as identified above, and to allow for an element of 'interweaving' of the topics. The first Unit which is taught in Year 9, following the 'practical skills' lessons, is the 'Respiration and Photosynthesis' Unit which includes lessons on 'aerobic respiration', 'biotechnology', 'leaves' and the 'stem' among others. The reason for starting with this topic is that this Unit builds upon the learning developed in the Units of 'Interdependence' and 'Plant reproduction' which were taught in Year 8 as part of the 'Ecosystems' 'big idea'. The next Unit is 'Electricity', which enables an understanding of the concepts of 'electric currents', 'circuits' and their 'components' and lays the foundations for the next Unit of 'Electromagnetism'; this allows for an 'interweaving' of the two topics by continuing to teach aspects of the former Unit in the context of the latter. The 'Electromagnetism' Unit also builds upon the 'Magnetism' Unit which is taught in Year 8, this is consistent with the principle of 'spiral learning' through which multiple interactions occur with the 'building blocks' of the 'big ideas' in science. A further example of 'interweaving' the teaching of topics in Year 9 occurs in the placing of the 'Evolution' Unit before that of 'Inheritance', such that students learn how organisms change over time, and the associated evidence for this, before the genetics behind the changes which occur are introduced; this allowing for a continuation of the teaching of some aspects of the topic of 'evolution' once the studies of the genetic foundation for 'inheritance' has begun.

In the summer term of Year 9 the 'Cells' Unit of 'Key Stage 4' Biology is taught. The sequencing of this Unit is planned by firstly teaching 'animal and plant cells', which then enables access to the topics of 'specialised cells', 'stem cells' and 'microscopes'. Once these have been taught a 'mid-topic' assessment is carried out which will assess the understanding of these key ideas. After this has been completed we move on to 'cell division' ('mitosis') and 'transport across cell membranes' since these all require aspects of the knowledge in the prior lessons, without which the concepts would be difficult to grasp. Once the content from the 'Cells' Unit has been delivered, a 'full-topic' assessment is set.

With respect to 'Key Stage 4' Chemistry, the first Unit with which we begin at the end of Year 9 is 'Atomic Structure'. This Unit builds upon prior learning and provides much of the foundation knowledge which is required for the 'Bonding' Unit in Year 10, in the sense that students need to understand the arrangements of electrons in atoms in order to more fully appreciate how these arrangements change during chemical reactions and bonding. It also provides knowledge which is required to develop an understanding of the 'model of the atom', its link to the 'periodic table' and its influence on trends in 'chemical reactivity' and 'physical properties'. Through these links between Units, further opportunities for 'spiral learning' occur.

In preference to teaching the first 'Key Stage 4' Unit of 'Energy' in the summer term, it has been decided to deliver this Unit at the beginning of Year 10. The reason for this decision is that many of our students at Smith's Wood Academy are still developing their 'cultural capital' and scientific vocabulary at the end of Year 9 and will require enough time to master the 'Cells' Unit, which has an appreciable quantity of content and 'required practical' demands, as well as the fundamental 'Atomic Structure' Unit. The 'Energy' Unit for Physics has a considerable number of equations for the students to both remember and apply, which will be better suited to the abilities of the students at the beginning of Year 10.

| Year 9 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Lab skills/data handling/HSW - BCP skills | 6 per BCP |
| Unit 2 | Respiration and photosynthesis | 8 |
| Unit 3 | Electricity | 6 |
| Unit 4 | Electromagnetism | 4 |
| Unit 5 | Elements and the periodic table | 12 |
| Unit 6 | Types of reaction | 6 |
| Unit 7 | Uses of waves | 10 |
| Unit 8 | Evolution | 6 |
| Unit 9 | Inheritance | 6 |
| Unit 10 | Recreational drugs | 4 |
| Unit 11 | GCSE biology transition - Cells | 21 |
| Unit 12 | GCSE chemistry transition – Atomic structure | 23 |

# Year 10 Biology at Smith's Wood Academy

The Year 10 Biology curriculum at Smith's Wood Academy is designed to allow students to build their knowledge and understanding of the 'key concepts' in Biology and begin to prepare for the examinations ahead. These concepts, such as 'circulation' and 'immunity', are studied in a sequence of Units which establishes a clear and logical progression in knowledge and challenge across the subject matter required for examination on the 'AQA' 'Combined Science' or 'Separate Science' course.

Following the study of the 'Cells' Unit at the end of Year 9, the 'Organisation' Unit which is encountered at the start of Year 10 builds upon, and links back to, the knowledge which was gained in the former Unit. By studying how 'tissues' are comprised of 'cells', which in turn form the basis of 'organs' and 'organ systems', students can see how this 'hierarchy' of structure in living organisms is constructed. This enables revisiting of the topics of the 'Cells' Unit, thereby consolidating the ideas concerned. Once again, we have a 'mid-topic' assessment on content from the 'animal' aspect and a second assessment on the 'plant' aspect which allows us to assess the students' knowledge in appropriately-divided compartments.

A choice was made to teach the 'Bioenergetics' Unit next, since this follows a clear progression from the 'Organisation' Unit by building upon the students' understanding of 'plant cells' and 'organ systems' when studying 'photosynthesis'. The 'respiration' component of the 'Bioenergetics' Unit requires application of the students' knowledge of 'the heart' and 'mitochondria', which are again ideas which are encountered in the 'Organisation' Unit. This Unit is assessed by an 'end of topic' test.

The next Unit is 'Infection and Response'. This Unit builds upon the students' knowledge of 'bacteria', which was studied in the 'Cells' Unit, and enables a 'revisiting' of the earlier ideas, which is consistent with the principle of 'spiral learning'. There is also an opportunity for 'interweaving' the topics here, as further aspects of the 'Cells' Unit may continue to be taught in the context of the present Unit. The lessons within the 'Infection and Response' Unit each build upon the last. For example, students learn about the nature of 'pathogens' before they discover how these may be treated; finally, students see how the treatments themselves are developed. This Unit incorporates one assessment.

The Units which are studied in the 'Separate Science' Biology course are, in general, the same as those Units which are studied on the 'Combined Science' course, with the addition of supplementary content in many cases. For example, the 'Infection and Response' Unit contains additional content in the 'Separate Science' course which relates to 'Monoclonal Antibodies', which is also 'Higher Tier' only, and 'Plant Disease'. The additional content and depth of understanding required is reflected in the differing numbers of lessons which are allocated to the Units in the 'Separate Science' course.

| Year 10 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Organisation | 27 (14 Combined Science) |
| Unit 2 | Bioenergetics | 15 (9 Combined Science) |
| Unit 3 | Infection and response | 15 (12 Combined Science) |

# Year 11Biology at Smith's Wood Academy

In Year 11 at Smiths Wood Academy, the Biology curriculum allows students to gain an understanding of the remaining Units, consolidate the previously-studied ideas and prepare for their examinations. Key concepts, such as 'Inheritance' and 'Adaptations' are introduced at GSCE level and linked back to the 'big ideas' which students studied in Years 7 to 9. By following the Units as sequenced, a logical and natural progression through the scientific concepts is experienced and the subject matter is covered in the level of detail which is required for the 'AQA' 'Combined Science' or 'Separate Science' course.

The first Unit which is encountered in Year 11 is 'Homeostasis and Response' which requires an understanding of the previous 'Cells' Unit, but also more complex and sophisticated ideas which additionally require a significant degree of subject knowledge retention. By this stage of the course, learners at Smith's Wood Academy have developed the scientific background which is needed to approach these topics with suitable confidence and understanding. Due to the relatively high demand for knowledge in this topic there is a 'mid-topic' ('Nervous System') and 'end of topic' ('Hormonal coordination') test which enables teachers to gather valuable formative assessment data before moving on to the next stage of the sequence.

The next Unit to be taught in Year 11 is 'Inheritance, Variation and Evolution', which is often considered to be the most challenging and rewarding of the Units which are studied in Biology and, by this point, the students have significantly refined their skills and knowledge to support them in the development and understanding of this topic. Each lesson is sequenced to build on prior knowledge from the last, for example we start the topic with 'sexual and asexual reproduction' which then leads onto 'meiosis' (the production of 'gametes'). Two assessments are used to accompany this Unit.

The final Unit which is studied in Biology is 'Ecology', which, in some components of the Unit, allows the teacher to make better use of the weather by enabling students to complete 'population sampling' investigations outside on the school fields. One assessment is carried out with this Unit to check the understanding of the students. Since the 'Ecology' Unit is generally considered to be less challenging than the previous 'Inheritance, Variation and Evolution' Unit, it allows students to focus in parallel upon revision for the GCSE examinations.

As in Year 10, there is some additional content in the 'Separate Science' Biology course in Year 11 when compared with the 'Combined Science' course. Examples of this additional content include the study of 'the brain' and 'the eye' as part of the 'Homeostasis and Response' Unit. These differences are, again, reflected in the numbers of lessons which are allocated to the Units in the respective courses.

| Year 11 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Homeostasis and response | 24 (15 Combined Science) |
| Unit 2 | Inheritance, variation and evolution | 27 (21 Combined Science) |
| Unit 3 | Ecology | 21 (12 Combined Science) |

# Year 10 Chemistry at Smith's Wood Academy

The Year 10 Chemistry curriculum at Smith's Wood Academy allows students to gain knowledge and a conceptual understanding of 'key concepts' in Chemistry such as 'ionic and covalent bonding' in a clear and logical order which enables the students to use ideas encountered in a previous topic to be applied to new and more challenging contexts. By following the Units in the prescribed order, the necessary subject matter for the 'AQA' 'Combined Science' or 'Separate Science' course is covered in a manner which allows concepts to be developed as successive Units are completed.

The first Unit which is studied in Year 10, that of 'Bonding', requires an understanding of the structure of atoms, which is studied at the end of Year 9. In keeping with the principle of 'spiral learning', many of the concepts encountered in the 'Atomic Structure' Unit at the end of Year 9 are revisited here and will be revisited again in the 'Energy Changes' Unit later in the year. 'Quantitative Chemistry', which is studied next, provides the fundamental basis for performing calculations in Chemistry. Similar calculations will also be required in the 'Chemical Changes' Unit ('titration calculations') and the 'Energy Changes' Unit (calculating 'energy changes of reactions') and so the skills developed in this Unit are developed in those which follow. An opportunity for 'interweaving' the skills presents itself here, as calculations such as the 'concentration of a solution' can be revisited and taught further in the context of 'titrations' for example. As stated, the 'Chemical Changes' Unit employs the calculation skills of the students in places while also requiring concepts from the previously-studied 'Atomic Structure' and 'Bonding' Units. Finally, as previously stated, the 'Energy Changes' Unit builds upon the 'Bonding' Unit which is taught at the beginning of the year and provides some of the ideas which will be used in Year 11. An example of the latter occurs in the 'Rate and Extent of Chemical Change' Unit at the beginning of Year 11 when discussing the effects of a 'catalyst' upon 'reaction rate', whereupon the associated 'reaction profile' is described. Again, such 'revisiting' of concepts is consistent with the 'spiral learning' approach.

Although the Units studied in the 'Separate Science' course are the same as those which are needed for the 'Combined Science' course, there is some additional content to cover in the case of the former. For example, the 'Quantitative Chemistry' Unit requires the 'yield and atom economy of chemical reactions' to be taught only for the 'Separate Science' course. As a result, there are some differences in the numbers of lessons assigned to the various Units.

| Year 10 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Bonding | 10 (9 Combined Science) |
| Unit 2 | Quantitative Chemistry | 17 (9 Combined Science) |
| Unit 3 | Chemical Changes | 17 (14 Combined Science) |
| Unit 4 | Energy changes | 8 (5 Combined Science) |

# Year 11Chemistry at Smith's Wood Academy

In Year 11 at Smith's Wood Academy, the Chemistry component of the curriculum introduces 'key ideas' such as 'fractional distillation' and the science in relation to 'global warming'. Following the Units in the order which is described allows a clear path to be followed through the concepts and understanding which is required to prepare the students for the 'AQA' 'Combined Science' or 'Separate Science' examinations.

At the start of Year 11, the first Chemistry Unit to be taught is 'The Rate and Extent of Chemical Change' which builds upon 'big ideas' which are encountered at 'Key Stage 3' level and the concepts which are studied in the 'Atomic Structure' Unit at the end of Year 9. It provides knowledge of 'reaction kinetics' and how the rate of a chemical reaction may be influenced, as well as linking to 'reaction profiles' and the use of 'catalysts'. In the later part of the topic, the concept of a 'chemical equilibrium' is introduced. The next Unit is 'Organic chemistry, which again draws on several of the 'big ideas', including those covered in the 'Separating Mixtures' Unit in Year 7 and the 'Bonding' Unit in Year 10. It provides knowledge of 'crude oil' and basic 'hydrocarbons', leading on to more advanced 'organic compounds' such as 'polymers', 'esters' and 'polyesters'. This Unit is followed by 'Chemical Analysis', which requires revisiting areas of the 'Atomic Structure' Unit such as the 'alkali metals', the 'transition metals' and 'halogens'; thereby lending a 'spiral learning' element to the curriculum. The final Unit is a conjunction of the 'Using Resources' Unit, which revisits areas of the 'Chemical Changes', 'Energy Changes' and 'Organic Chemistry' Units, and the 'Chemistry of the Atmosphere' Unit, which also returns to several concepts of these three earlier Units.

There is additional content to cover for the 'Separate Science' course in relation to that required for 'Combined Science'. For example, the 'reactions of alkenes and alcohols' section of the 'Organic Chemistry' Unit is only required for 'Separate Science' Chemistry and is reflected in the numbers of lessons which are allocated to the Units in the respective courses.

| Year 11 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | The rate and extent of chemical change | 8 (5 Combined Science) |
| Unit 2 | Organic chemistry | 17 (8 Combined Science) |
| Unit 3 | Chemical analysis | 14 (7 Combined Science) |
| Unit 4 | Using resources AND atmosphere | 14 (11 Combined Science) |

# Year 10 Physics at Smith's Wood Academy

The Year 10 Physics curriculum at Smith's Wood Academy, as for Biology and Chemistry, is designed to allow students to gain the subject knowledge and skills required in relation to the 'key ideas' and more sophisticated ideas which are necessary to begin to prepare the students for their examinations ahead. Fundamental concepts such as 'energy' and 'electricity' are covered this year, which set the foundations for a sound understanding of the 'cornerstones' of Physics and provide the subject matter required for the 'AQA' 'Combined Science' or 'Separate Science' courses.

The first Unit to be covered in Year 10 is 'Energy', which is a fundamental theme running throughout Physics and links in a 'spiral learning' manner to the 'big ideas' surrounding 'energy' which were studied at 'Key Stage 3'. Specific types of 'energy' are explored, along with the mechanisms by which 'heat' and other forms of energy are transferred. One assessment is carried out in conjunction with this Unit. The next Unit to be studied is 'Electricity' which encompasses the design of 'electrical circuits' and the nature of their components, as well as more 'abstract' themes including 'charge', 'current' and 'potential difference'. There is an opportunity for 'interweaving' the topics through the concept of 'energy transfer' within an 'electrical circuit', which allows for the teaching of the concepts of 'energy' and its transfer to be developed and continued within the context of the 'Electricity' Unit. The 'Particle Model of Matter' Unit, which is studied next, links back to 'energy transfer' within the 'Energy' Unit in the explanations of the 'changes of state', the 'motion of particles' and 'pressure'; in addition, this 'Unit' leads naturally on to the next Unit of 'Atomic Structure' in which the constituent particles of an 'atom', and their behaviour, are explored. The study of 'nuclear decay' and the history of the development of the model of the 'atom' are also covered in the 'Atomic Structure' Unit, before moving on to the 'Magnetism and Electromagnetism' Unit. This final Unit in Year 10 revisits several ideas from the 'Electricity' Unit and builds firmly upon the 'big ideas' which were experienced in the 'Magnetism' Unit studied in Year 8.

In common with the Biology and Chemistry components, there is additional content to cover in the 'Separate Science' course compared with that for 'Combined Science' which is reflected in the numbers of lessons which are allocated to the Units. For example, the 'Magnetism and Electromagnetism' Unit requires 'loudspeakers' to be taught to 'Separate Science' students only; much of the content in this Unit is also only applicable to 'Higher Tier' students.

| Year 10 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Energy | 20 (20 Combined Science) |
| Unit 2 | Electricity | 18 (18 Combined Science) |
| Unit 3 | Particle model of matter | 9 (9 Combined Science) |
| Unit 4 | Atomic structure | 11 (11 Combined Science) |
| Unit 5 | Magnetism and Electromagnetism | 9 (4 Combined Science) |

# Year 11 Physics at Smith's Wood Academy

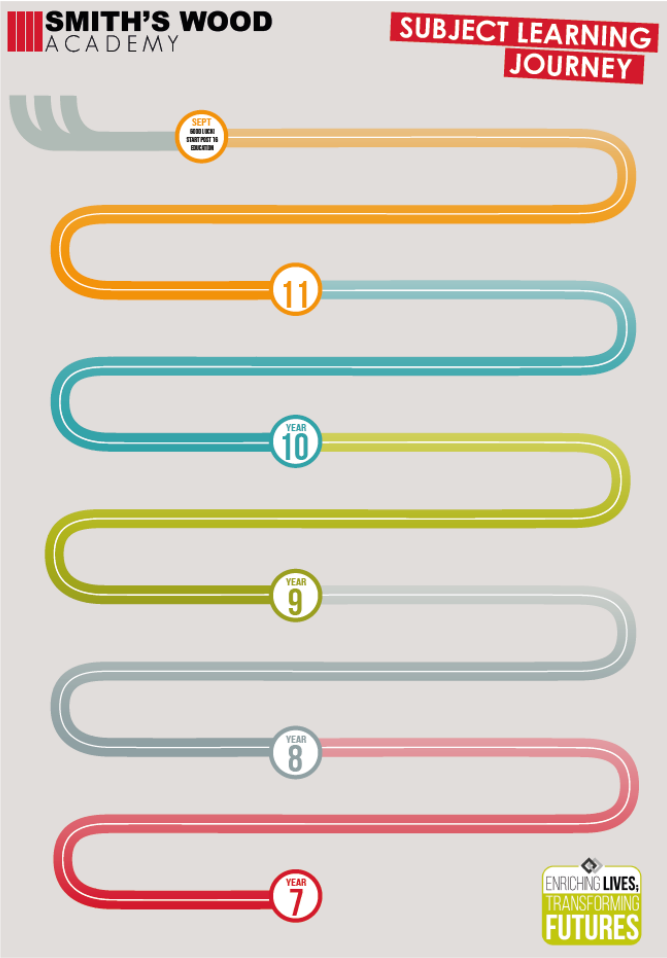
In year 11 at Smith's Wood Academy, as is the case for Biology and Chemistry, the Physics curriculum is designed to allow students to gain a firm understanding of the remaining Units and subject matter, as well as consolidating ideas from previously-studied Units and facilitating preparation of the students for their examinations in either the 'AQA' 'Combined Science' or 'Separate Science' course. The 'key concepts' which are covered are 'forces' and 'waves' and, for 'Separate Science' students only, 'Space physics'.

The first Unit which is taught in Year 11 is 'Forces' which draws on ideas from the 'Energy' Unit through the concept of 'work done'. In addition, concepts from the 'Particle Model of Matter' Unit, which is taught in Year 10, are required, as well as 'spiral learning' revisiting of ideas from the 'Pressure' Unit in Year 8. The next Unit, which covers 'waves' and their behaviour, builds upon ideas from the 'Energy' Unit, while the 'electromagnetic waves' component of this Unit links to the themes which have been covered in the 'Magnetism and Electromagnetism' Unit in Year 10.

The final Unit, 'Space Physics' is required only in full for 'Separate Science' students; however, the introductory elements of the Unit are also taught to the 'Combined Science' students in order to lend breadth and 'cultural capital' to their education rather than simply teaching the students to prepare for examinations. The other Units in Year 11 also contain differences depending upon which course is being followed; for example, the 'Waves' Unit has components, such as the 'reflection of waves', which are only studied by 'Separate Science' students and this is reflected in the number of lessons which are allocated to the Units for each course.

| Year 11 Units of Study | | Length of unit |
|---|---|---|
| Unit 1 | Forces | 25 (17 Combined Science) |
| Unit 2 | Waves | 20 (16 Combined Science) |
| Unit 3 | Space physics | 4 (2 Combined Science) |

The *Subject* Department Learning Journey at a glance




*To include – topics, purpose of study and assessment points. To show how and why the curriculum is sequenced in the way in which it is.*

***To be completed***