JOHN PORT SPENCER ACADEMY

Science

Curriculum Overview Science
Key Stage – KS4 Year - 11

Joy Progress Success Act with care, kindness, respect and integrity

Our curriculum is carefully sequenced to ensure cumulative knowledge and progression. Each unit builds on the last,

Location of resources:	**Science Subject Staff – KS4**
Curriculum intent and rationale:	At John Port Spencer we believe in developing a passion for Science. We set high expectations of students to ensure that they can excel in Biology, Chemistry and Physics. In doing so our students are ambitious of what they can achieve. We have an inclusive curriculum in which all students of all abilities have an opportunity to progress at all levels. Our curriculum is designed so that: - Students develop their knowledge and understanding of scientific concepts, building on previous knowledge, so that their understanding deepens over time - Students develop working scientifically skills to that they can predict, plan, carry out, analyse and evaluate their practical scientific investigations - Students are curious about the world around them and are encouraged to ask questions to develop more depth in their understanding. - Students can communicate their ideas, explaining them using the correct scientific language - Students ideas are challenged so that misconceptions are identified and addressed. - Students are inspired to consider a science related career.
National Curriculum Links:	**Biology** - 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. The potential impact of genomics on medicine. 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 Science – key stage 4 10. The evidence for evolution. Developments in biology affecting classification. The importance of selective breeding of plants and animals in agriculture. **Chemistry** - Identification of common gases. Distinguishing between pure and impure substances. Fractional distillation of crude oil and cracking to make more useful materials **Physics** - 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. - Exploring the magnetic fields of permanent and induced magnets, and the Earth's magnetic field, using a compass. Magnetic effects of currents, how solenoids enhance the effect. How transformers are used in the national grid and the reasons for their use. - The main features of the solar system.

What content needs to be covered? Key Knowledge and skills / misconceptions to address (with vocab in bold and spelling underlined)
By the end of the year students will know:

Half Term 1	Half Term 2	Half Term 3	Half Term 4	Half Term 5	Half Term 6
Students will learn key knowledge and skills about: - **Inheritance and selection (Part 1)** - **Waves (Part 1)**	**Students will learn key knowledge and skills about** - **Inheritance and selection (Part 2)** - **Waves (Part 2)** - **Organic and analytical chemistry (Trilogy)** - **Magnets (trilogy)**	**Students will learn key knowledge and skills about** - **Organic chemistry (triple)** - **Analytical chemistry (triple)** - **Magnets (triple)**	**Students will learn key knowledge and skills about** - **Space (triple)** - **Revision (trilogy)**	- **Revision for exams** - **Paper 1 examinations**	- **Paper 2 examinations**

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Challenge: Asking students to recall their knowledge of dominant and recessive alleles and applying them in Punnett squares. Asking students to distinguish between words that sound very similar such as genotype and phenotype. Questions in which students have to apply their knowledge of the meaning of dominant and recessive to an unknown scenario. Asking students to explain how proteins are made from DNA. Questions in which students have to calculate the wave speed, changing units and rearranging equations. **Misconceptions:** A single gene with always control a single characteristic and that the environment has now influence. Mutations are always bad. That the sex of the baby is determined by the mother. The idea that once a baby is born with a particular sex or characteristic then the chances of that reappearing is less. A common misconception about waves is that they involve the movement of matter from one place to another. Another misconception is that all waves need a medium to travel through; electromagnetic waves (like light) can travel through a vacuum. Additionally, there's confusion about the properties of different types of waves, such as sound and light, and their interactions with matter. **Subject specific terminology:** Sexual, Asexual, Meiosis, gametes, chromosomes, DNA, double helix, nucleotide, base, allele, recessive, dominant, heterozygous,	**Challenge:** Long answer questions that ask them to apply their knowledge to explain how a new species has evolved or been created. Question in which students must explain how an animal was cloned. Constructing lens diagrams for the different types of lenses. Drawing in the magnetic field of magnet when it cannot be seen and so is an abstract concept. **Misconceptions:** A key misconception about natural selection is that it involves organisms "trying" to adapt; instead, it's a process where traits that are advantageous in a given environment are more likely to be passed on due to differential survival and reproduction, not conscious effort. Another common misunderstanding is that natural selection always results in perfect adaptations or that it acts for the good of the species; in reality, it's limited by available genetic variation and can only act on existing traits. Thinking that cloning is a way of improving a species. Some people think that an object's colour is an inherent property of the object itself, regardless of the light source. Students also struggle with naming compounds, especially when determining the longest carbon chain. Additionally, misconceptions arise regarding boiling points of and the role of "hydro" in hydrocarbons. A common misconception when teaching magnets at the GCSE level is that all metals are attracted to magnets. Another misconception is that the north pole of a magnet is magnetically a north pole. Additionally, students often mistakenly believe that if something is attracted to a magnet, it must also be a magnet itself. **Subject specific terminology:** Selective breeding, clone, genetic engineering, fossil, evolution, natural selection, Lamarck, Darwin, Mendel, Speciation. Ionising, absorption, transmission, Infra-red, convex, concave, principal focus, inverted, virtual image, real image, black body, Leslie cube. Hydrocarbon, alkanes, alkenes, bromine water, fractional distillation, boiling point, condenses, pure, formulation. Magnet, electromagnet, plotting compass, north pole, south pole, Fleming left hand rule, motor effect.	- **Revision (trilogy)** **Challenge:** For triple students drawing and recognising organic molecules. For triple students asking them how to identify a mystery compound using all their knowledge from the chemical unit. Questions in which students must explain the motor effect and the generator effect in an unfamiliar context. The transformer equation. Applying knowledge to an application such as a loudspeaker. . **Misconceptions:** Students may not always understand that organic compounds are not only found in living organisms but also in materials like wood and petroleum. The shortest alkene is ethene (C2H4) because it contains the C=C double bond Students may not fully grasp the distinction between a pure substance (containing only one type of element or compound) and a chemically pure compound (a compound with a fixed ratio of elements). That the motor effect and the generator effect are the same thing. That the motor effect generates electricity. **Subject specific terminology:** Alcohol, polymerisation, carboxylic acid, cation, anion. Right hand rule, generator effect	**Challenge:** Asking students to explain abstract concepts like gravity, orbital motion, and the vastness of space, which can be difficult for students to visualize and grasp, especially without hands-on experiences. **Misconceptions:** Space is a complete vacuum; while space is vast and largely empty, it does contain cosmic microwave background radiation and other matter, even in the voids between galaxies. **Subject specific terminology:** Red shift, galaxy, red giant, red super giant, supernova, black hole, neutron star, black body radiation.		

homozygous, cystic fibrosis, Polydactyl. Wave, amplitude, wavelength, frequency, period, reflection, refraction, normal, electromagnetic spectrum, UV, gamma, microwaves, radio waves, visible light, X rays.					

Previous learning that is particularly relevant:

Students will have studied a unit on inheritance in year 8, which would have introduced them to the ideas of inheritance and genes. They would have learnt about light and sound waves at KS3 in year 7.	Students would have learnt some basic chemical tests throughout KS3. They will have learnt about the basic properties of magnets in year 7. Students will have studied the solar system, including the features of the planets, in year 8.	

Future Learning - How content prepares students for future units, Key Stage 4, or Key Stage 5?

Students will be prepared for further studies in genetics and inheritance in A Level Biology. For example, moving from monohybrid inheritance to dihybrid inheritance at A Level.	Students will be prepared for the organic chemistry in A Level chemistry. This means moving into KS5 with more complex molecules, naming them and learning mechanisms.	

Outcomes:
By the end of the year pupils will be able to solve/create/produce/write:

- Answer questions that demonstrate their knowledge and understanding of scientific ideas, scientific techniques and procedures, including multi choice, shorter answer and extended response. (AO1)
- (AO1)
- Demonstrate working scientifically skill in which students can draw graphs, identify variables, plan, conclude and evaluate investigations. Identify the types of error, calculate a mean and uncertainty and identify the resolution of a measuring instrument. Be able to distinguish between the words reliable, repeatable, reproducible and accurate (AO1)
- Answer questions in which they can apply their knowledge to unfamiliar scenarios across topic areas (AO2)
- Answer questions in which they analyse ideas, evaluate, make judgements and draw conclusions. They should be able to make suggestions about how to improve am experimental procedure (AO3)

Assessment Strategy How we know our students are knowing and remembering more –
Data from hunting not fishing, formative and summative assessment/s is used to adapt teaching and provide targeted challenge and intervention, supporting SEND and disadvantaged pupils.

Formative:	**Summative (& cumulative)**	**Opportunities to revisit past learning:**
White boards are 'on hand' in every lessons and are used routinely in every lesson to check understanding at each point of the learning journey of the lesson. Teachers circulate to make sure that students understand what they are doing and assess the understanding, re teaching within the lesson where needed. Exit tickets are used to check students understanding at the end of the lesson.	Unit assessments in • Inheritance and selection • Waves • Organic chemistry • Analytical chemistry • Magnets • Space (triple only)	The starter questions are designed for students to recall from the current topic and past topics. The development lesson after the assessment students revisit and relearn the sections of the topic that they don't understand. There is a revision schedule built into the curriculum leading up to mock exams and examinations.

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		There are 'spaced' learning lessons where the teacher goes back to previous topics. **Opportunities for homework (including apps):** Students complete their Sparx homework which consolidates what they have done in lesson and questions on topics they struggle with. The insights tool helps teachers focus on areas their classes are getting wrong. For each topic students complete an exam question homework which is then self-assessed in class.

How is the curriculum adapted to meet the needs of SEND and disadvantaged pupils, while maintaining high expectations?

Many of the concepts in science involve abstract ideas. We use visuals and physical models the help students understand fundamental theories like the particle model – a threshold concept which allows them to understand further phenomena. We also use dual coding to help students visualise what it looks like and help them retain this into their long term memory.

There is lots of subject specific vocabulary which is pre taught at the beginning of the lesson. A focus of repeating these key words and returning to them is used to help students retain these in their long term memory.

We use scaffolding techniques to help SEN students make progress. This may be sentence starters, key words to use in order in individual support in starting the task.

These are main strategies we use in Science with our disadvantaged students

- They experience success in every lesson, increasing confidence and a belief in themselves
- Demonstrating excellence to them so that they understand what they are aiming for to increase the expectation of what they can achieve
- Support with resources at home. Many of our disadvantaged students have lower attendance, sometimes through no fault of their own. Having a workbook and revision guides, knowing what sections to complete if they are away helps support their learning and means that they can understand the lesson when they return.
- Priority seating and first for feedback in live marking.

Wider Curriculum and Enrichment – cultural capital and real world application -

Enriching experiences: Science support on specific topics are offered each week after school. **Our curriculum supports the school value of:**	**Literacy, Oracy and disciplinary language:** **Reading:** Students read and comprehend scientific texts, including textbooks and articles, to grasp concepts and information. **Writing** Writing practical methods and conclusions, extended response in which they have to sequence a series of ideas in a logical sequence. Explain, and summaries, in which students to articulate their understanding clearly and accurately using the correct scientific terminology. **Listening**	**Cross-Curricular opportunities / Opportunities to develop 'character':** **History:** How scientists collected evidence and developed theories e.g. Theory of natural selection Darwin, Lamarck, Mendel, Newton. **Maths:** Athematic and number, handling data, algebra, graphs, geometry and trigonometry. **English:** Constructing an evaluation with different viewpoints. Expressing and explaining ideas and theories using written communication. **PRE:** Ethical viewpoints that scientist have to consider **Our curriculum supports personal development by:**

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Joy | Progress | Success | Act with care, kindness, respect and integrity

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Joy	*Foster enthusiasm and engagement by* Engaging experiments, allowing students to actively participate and use these to understand concepts. Opportunities to take science outside, particularly with the Ecology unit. Model building and hands on activities to help with abstract concepts. Games and quizzes to make the learning interactive. A wide range of variety so lessons, although the same format, lessons are not all the same. Working in pairs and groups on activities to engage students with their peers.
Progress	*We monitor and support progress through* Every lesson teachers monitoring the progress of the students (see formative assessment). The results from each topic tests are monitored to ensure students are making progress towards their target grade.
Success	*We celebrate success* by Praise used with students in lessons in the moment. Use of other students work on the visualizer to celebrate a student's success publically. Following a unit test result students can receive a 'personal best' certificate or 'top of the class' certificate. At the end of each half term students are nominated for being a science superstar and these are given out with small prizes. Excellent student work in displayed in the faculty.
Act with care, kindness, respect, and integrity	*We build meaningful connections with our students by* Giving students the opportunity to work in groups in which they are expected to respect each other to be an effective team. Encouraging students to speak to be kind to each other. Students work with integrity during practical work, following instructions, being safe and recording results accurately.

Students take part in active listening as this is essential for understanding scientific concepts presented by teachers and peers, and for engaging in meaningful discussions.

Speaking

Students say the subject specific vocabulary so that they can explain scientific ideas accurately and are more likely to use these words in their written work.

The teaching of science to Year 11 develops a range of these literacy skills which include

- Writing out a step by step written method
- Completing extended response questions
- Reading out loud from text books and articles
- Watching a video and answering questions while they do this
- Comprehension exercises
- Matching words to their definitions
- Looking up the meaning of words in a glossary
- Selecting the correct word to use from a list of choices

Discussion of different viewpoints and empathy for those making these choices. The ability to understand and evaluate what they read in the news that links to what they are learning. They may then use this information to make their own life choices in the future.
An understand of 'fake news' which may not be from a reliable source.

Careers / Employability skills:
How does the curriculum link to the following employability skills:

Listening – Active listening, which involves focused attention and understanding of what others are saying. This is essential for effective communication, collaboration, and problem-solving. Active listening demonstrates respect, builds rapport, and helps individuals grasp information accurately and efficiently.

Speaking – Speaking skills are crucial for science professionals as they enable effective communication of complex information, collaboration in teams, and successful presentation of research findings. These skills are essential for securing and excelling in scientific careers, encompassing clear and concise communication.

Problem solving – Problem-solving is a crucial employability skill, particularly in science fields, as it involves identifying and analysing problems, developing solutions, and evaluating their effectiveness. Scientific problem-solving relies on critical thinking, creativity, and a systematic approach to finding solutions. Employers highly value candidates who demonstrate strong problem-solving abilities, as these skills are transferable to various work situations and contribute to career success.

Aiming high – Setting ambitious goals, developing relevant skills, and actively seeking opportunities for growth and advancement. It involves proactive planning, a positive attitude towards challenges, and the ability to learn from setbacks. This approach is crucial for success in scientific careers, as it enables individuals to tackle complex problems, collaborate effectively, and contribute to innovation.

Critical thinking – Critical thinking is a crucial employability skill, particularly valuable in science-related fields. It involves actively analysing information, evaluating evidence, and solving problems using reasoned judgment. For science graduates, critical thinking is essential for data analysis, research design, and navigating complex scientific concepts

Staying positive – Staying positive and developing a growth mind-set are crucial for success in science-related careers. A positive attitude, resilience, and adaptability are valuable employability skills that can be cultivated through self-reflection, practice, and seeking support. These qualities enhance problem-solving, foster innovation,

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Leadership – Leadership skills, in particular, demonstrate an individual's ability to motivate, manage, and influence others, making them valuable assets to any science team.

Teamwork – Teamwork is a crucial employability skill involving working effectively with others to achieve a shared goal. It encompasses various sub-skills like communication, problem-solving, active listening, and conflict resolution. Developing these skills enhances collaboration, efficiency, and overall productivity

Creativity – Creativity is a highly valued employability skill across all fields, including science and technology. It enables individuals to approach problems with innovative solutions, adapt to change, and contribute to advancements.

Employment Sectors discussed include:

Geneticist
Embryology research
Biotechnology
Forensic science
Space exploration

Curriculum impact is evaluated through pupil study, work scrutiny, and progress data. Findings inform regular curriculum review to ensure continuous improvement.

When was this curriculum last reviewed? Include date	What changes were made and why?	How is ongoing improvement ensured?
22/07/2025	More opportunities for revision so that students have more time to get guidance on how to answer specific types of questions.	