St. Peter's C of E Primary & Nursery School

Science Policy

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This policy was formulated to meet the requirements of the Equality Act 2010

Ratification Date: Summer 2023 Review Date: Summer 2027

St. Peter's Mission Statement

At St Peter's C of E Primary School, the growth and development of children and adults is central to everything we do. As a church school, we aim to serve and take care of our community by providing an education, which inspires every child to be the best they can be. This is within a framework, which is rooted in distinctive Christian beliefs and values whilst embracing diversity, respecting other faiths and worshipping together. We encourage an understanding of the meaning and significance of faith and promote Christian values through the experiences we offer to all our school community.

1. Why is Science Important?

At St. Peter's Primary School, we recognise the importance of Science in every aspect of daily life; we encourage children to be inquisitive throughout their time at our school and beyond. The Science curriculum fosters a natural curiosity of the child, encourages respect for living organisms and the physical environment and provides opportunities for critical evaluation of evidence. We believe that science encompasses the acquisition of knowledge, concept, skills and positive attitudes.

Aims of the Science Curriculum

The national curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them • are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.
- develop the essential scientific enquiry skills to deepen their scientific knowledge
- use a range of methods to communicate their scientific information and present it in a systematic, scientific manner, including I.C.T., diagrams, graphs and charts
- develop a respect for the materials and equipment they handle regarding their own, and other children's safety
- develop an enthusiasm and enjoyment of scientific learning and discovery

We also aim to embed the following essential characteristics in our pupils:

- The ability to think independently and raise questions about working scientifically and the knowledge and skills that it brings
- Confidence and competence in the full range of practical skills, taking the initiative in, for example, planning and carrying out scientific investigations
- Excellent scientific knowledge and understanding which is demonstrated in written and verbal explanations, solving challenging problems and reporting scientific findings
- High levels of originality, imagination or innovation in the application of skills
- The ability to undertake practical work in a variety of contexts, including fieldwork.
- A passion for science and its application in past, present and future technologies

2. Scope of Science

At St Peter's, we follow the CUSP (Curriculum Unity Schools Partnership) Science Curriculum, which pays close attention to guidance provided by the National Curriculum sequence and content. It is infused with evidence-led practice and enriched with retrieval studies to ensure long term retention of foundational knowledge. The foundations of CUSP science are cemented in the EYFS through learning within the Natural World, and People, Culture and Communities. CUSP's ambitious interpretation of the National Curriculum places knowledge, vocabulary, working and thinking scientifically at the heart of their principles, structure and practice. CUSP Science precisely follows the units outlined in the National Curriculum.

Our Science curriculum is knowledge and vocabulary rich, ensuring children gain a deep understanding of fundamental scientific knowledge and concepts as well as embedding key science specific vocabulary and terminology (Tier 3 vocabulary). In addition, children are encouraged to develop their scientific curiosity and understanding by working scientifically.

Through studying CUSP science, pupils become more expert as they progress through the curriculum, accumulating, connecting and making sense of the rich substantive and disciplinary knowledge.

1. **Substantive knowledge** - this is the subject knowledge and explicit vocabulary used to learn about the content. Common misconceptions are explicitly revealed as non-examples and positioned against known and accurate content. In CUSP science, an extensive and

connected knowledge base is constructed so that pupils can use these foundations and integrate it with what they already know. Misconceptions are challenged carefully and in the context of the substantive and disciplinary knowledge. In CUSP Science, it is recommended that misconceptions are not introduced too early, as pupils need to construct a mental model in which to position that new knowledge.

2. **Disciplinary knowledge** – this is knowing how to collect, use, interpret, understand and evaluate the evidence from scientific processes. This is taught. It is not assumed that pupils will acquire these skills by luck or hope. Pupils construct understanding by applying substantive knowledge to questioning and planning, observing, performing a range of tests, accurately measuring, comparing through identifying and classifying, using observations and gathering data to help answer questions, explaining and reporting, predicting, concluding, improving, and seeking patterns. We call it 'Working Scientifically.' CUSP science provides Working Scientifically coverage maps to check the balance of provision in KS1, Lower and Upper KS2.

Scientific analysis is developed through **IPROF** criteria. We call it 'Thinking Scientifically.'

- **i**dentifying and classifying
- **p**attern seeking
- **r**esearch
- **o**bserving over time
- **f**air and comparative testing

3. Substantive concepts include concrete examples, such as 'plant' or more abstract ideas, such as 'biodiversity'. Concepts are taught through explicit vocabulary instruction as well as through the direct content and context of the study.

A guiding principle of CUSP Science is that each study draws upon prior learning. For example, in the EYFS, pupils may learn about The Natural World through daily activities and exploring their locality and immediate environment. This is revisited and positioned so that new and potentially abstract content in Year 1, such as Animals, including humans, is related to what children already know. This makes it easier to cognitively process. This helps to accelerate new learning as children integrate prior understanding.

CUSP Science is organised into three distinct subject domains: biology, physics and chemistry. Where inter-disciplinary concepts are encountered, such as the particle model, these are taught explicitly and connected across science domains.

CUSP Science has sequenced the national curriculum into meaningful and connected 'chunks' of content to reduce the load on the working memory as well as creating coherent and strong long term memories. The sequence of substantive and disciplinary knowledge enables pupils to become 'more expert' with each study and grow an ever broadening and coherent mental model of the subject. This guards against superficial, disconnected and fragmented scientific knowledge and weak disciplinary knowledge. High frequency, multiple meaning words (Tier 2) are taught explicitly and help make sense of subject specific words (Tier 3). Each learning module in science has a vocabulary module with teacher guidance, tasks and resources to enhance and deepen understanding.

CUSP Science is planned so that the retention of knowledge is much more than just 'in the moment knowledge'. The cumulative nature of the curriculum is made memorable by the implementation of Bjork's desirable difficulties, including retrieval and spaced retrieval practice, word building and deliberate practice tasks. This powerful interrelationship between structure and research-led practice is designed to increase substantive knowledge and accelerate learning within and between study modules. That means the foundational knowledge of the curriculum is positioned to ease the load on the working memory: new content is connected to prior learning. The effect of this cumulative model supports opportunities for children to associate and connect significant scientific concepts, over time, and with increasing expertise and knowledge.

CUSP Science deliberately pays attention and values the importance of subject content as well as the context it is taught in. Common scientific misconceptions are identified in all CUSP Science learning modules. These misconceptions are made explicit to pupils. Children draw upon substantive and disciplinary knowledge to reason and practise acquiring the conception, whilst repelling the misconceptions. Examples and non-examples are powerful ways of saying what something is and what something isn't.

CUSP Science values the study of scientists from the past. These studies help us to learn how they used, at that time, their substantive and disciplinary knowledge to develop a conception. This illuminates how misconceptions can permeate substantive knowledge and appear to be a known truth. An example of this is the study of Maria Merion in Year 5, who was born in Germany in 1667. She observed and drew insects going through biochemical metamorphosis. She challenged the misconception that all insects were evil, born from mud and were the work of the devil. Further examples of contextual misconceptions and refinement of conceptions can be seen in the study of Galen's views about blood circulation in AD 157 and William Harvey's findings in 1602.

3. Organisation and Delivery

Early Years

In Early Years, at St. Peter's, Science is taught through Knowledge and Understanding of the World. The children learn about the scientific world around them in their play and adult led activities. Our curriculum is designed to enable children to make sense of their physical world and community. Children are encouraged to be scientists by:

- Finding out about and showing curiosity and interest in features of objects, events and living things
- Describing and talking about what they see, including noticing similarities and differences
- Showing curiosity and asking questions about why things happen and how things work
- Showing understanding of cause-effect relations
- Noticing and commenting on patterns
- Showing an awareness of change
- Explaining their own knowledge and understanding, and asking appropriate questions of others
- Investigating objects and materials by using all of their senses as appropriate

In Key Stage 1 and Key Stage 2, science is taught in mixed-age classes and our curriculum is adapted to accommodate this. Our 2 year rolling programme (Cycle A and Cycle B) ensures that pupils have met the requirements of the NC at the end of KS1 and KS2.

	EYFS Understanding the world	Key Stage 1 Block A	Key Stage One Block B	Lower Key Stage Two Block A	Lower Key Stage Two Block B	Upper Key Stage Two Block A	Upper Key Stage Two Block B
Biology 53% of content	The Natural World Explore the natural world around them, making observations and drawing pictures of animals and plants. Know some similarities and differences between the natural world around them and contrasting environments, drawing on their experiences and what has been read in class. Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter.	Living things and their habitats *(+ revisit modules)* (AT/SprT)			Living things and their habitats (AT)	Living things and their habitats (ST) Life Cycles	Living things and their habitats (AT) Introducing living things and their habitats - Classification
		Animals, including humans (AT) *(+ revisit modules) (SpT / ST))*	Plants (AT / ST))	Animals, including humans (SprT)	Animals, including humans (SprT) Skeletons	Animals, including humans (AT) The circulatory system	Animals, including humans (ST) Changes as humans develop to old age Water Transportation
		Plants (ST)	Animals, including humans (AT) *(+ revisit modules) (SpT / ST))*	Plants (ST)		Evolution and inheritance (ST)	
Physics 29% of content					Light (SpT)		Light (AT)
			Seasonal changes *(+ revisit module) (AT)*		Forces and magnets (ST)		Forces (SpT)
					Electricity (ST)	Electricity (ST)	
				Sound (AT)			
						Earth and space (SpT)	
Chemistry 18% of content		Use of everyday materials (SpT)					Properties and change of materials (AT)
			Everyday materials (ST)	Rocks (AT) *(+ revisit module) (SprT)*			
					States of matter (AT)		

Modular Approach – Knowledge

At St. Peter's, Science is taught across each year group in modules that enable pupils to study in depth key scientific understanding, skills and vocabulary. Each module aims to activate and build upon prior learning to ensure better cognition and retention. Each module is carefully sequenced to enable pupils to purposefully layer learning from previous sessions to facilitate the acquisition and retention of key scientific knowledge. Each module is revisited either later in the year or in the following year as part of a spaced retrieval practice method to ensure pupils retain key knowledge and information.

KEY STAGE 1

Pupils study the Seasons and develop an early conceptual understanding of how day becomes night. An understanding of change, over time connects to the study of Plants, including trees. This focus enables children to associate trees as belonging to the plant kingdom and notice the changes deciduous trees go through connected to the seasons.

Contrasting that study, pupils learn about Animals, including humans. Non-examples of plants are used to contrast the features of an animal.

Pupils are introduced to identifying and classifying materials. Scientific terms, such as transparent, translucent and opaque are taught explicitly through vocabulary instruction and pupils make further sense by applying it to what they know and then to working and thinking scientifically tasks.

This substantive knowledge is enriched by pupils use of disciplinary knowledge through scientific enquiry.

To sophisticate their understanding, Year 1 pupils revisit the study Animals, including humans as a retrieval module and deepen their knowledge through revisiting and thinking hard through increasingly challenging tasks.

As pupils progress through KS1, new knowledge is integrated with pre-existing understanding. For example, in Year 2, the study of Living things and their habitats and Uses of everyday materials, engages pupils to integrate and draw upon their knowledge of Animals, including humans as well as Plants, and the study of Materials. New substantive knowledge is constructed and made sense of through Working and Thinking scientifically tasks.

KEY STAGE 2

In CUSP Science, substantive knowledge is always present and acts as a precursor for pupils' understanding. This will enable them to successfully apply disciplinary knowledge. In KS2 we introduced disciplinary scientific terms, including:

- variable
- independent variable
- dependent variable
- controlled variable

These give structure to working and thinking scientifically tasks in relation to the substantive knowledge taught in that specific study.

"what scientists observe, or choose to control in an experiment, depends on what they know. For example, classifying flowering plants scientifically requires knowledge of floral parts to place specimens in appropriate groups. However, classifying insects requires knowledge of body parts." (Ofsted Research Series: Science, 2021)

In KS2 CUSP Science, we have defined these terms:

- variable - the things that can change in a science experiment
- independent variable - the variable that is changed by the scientist
- dependent variables - are the things that the scientist watches closely for to see how they respond to the change made to the independent variable

- controlled variables - the things that a scientist wants to remain the same and not change so they can see how the independent variable reacts

LOWER KEY STAGE 2

The unit on Rocks is studied and connected with prior knowledge from 'Everyday materials' in KS1. A study of Animals, including humans is built upon from KS1 and contrasts the physical features with the functions they perform, including the skeleton and muscles.
Rocks is revisited again to sophisticate and deepen pupils' knowledge, advancing their understanding.

Forces and magnets are introduced and connect with KS1 materials, including twisting, bending and squashing. Contact and non-contact forces are taught and understanding applied through Working and Thinking Scientifically. The abstract concept of Light is made concrete through knowing about light sources and shadows. Plants are studied to develop a more sophisticated understanding of their parts and functions, including pollination.

A study of Living things and their habitats pays close attention to classification and is directly taught using prior knowledge to ensure conceptual frameworks are secure. Explicit vocabulary instruction supports pupils to deconstruct words for their component meaning, for example invertebrate. Animals, plants and environments are connected in this study with a summary focusing on positive and negative change.

Electricity is introduced. Substantive knowledge is taught so that pupils acquire understanding about electrical sources, safety and components of a single loop circuit. Practical tasks give pupils the opportunity to think using disciplinary knowledge in the context of variables. Pupils make sense of what they know by testing, proving and disproving hypotheses.

Animals, including humans focuses on the sequence of digestion, from the mouth to excretion. Misconceptions, such as digestion begins in the stomach, are pre-empted, limited and represented as non-examples.

States of matter and Sound are taught using knowledge of the particle theory. Acquiring substantive knowledge about 'states' of matter supports pupils to understand how solids, liquids and gases behave. This knowledge is connected further to geographical studies of the Water cycle and life processes. Practical scientific tasks and tests help pupils build a coherent understanding of the particle theory by applying what they know through structured scientific enquiry.

Misconceptions, such as 'liquid particles are slightly more separated than gas and less compacted than solids are addressed.

UPPER KEY STAGE 2

In the study of Properties and changes of materials, it is important that pupils reuse and draw upon their understanding of states of matter. This prior content eases the load on the working memory to process and make sense of new knowledge, including solutions, mixtures, reversible and irreversible changes.

Change is also studied within Animals, including humans, focusing on growth and development of humans and animals.

Earth in Space develops the conceptual understanding of our place in the universe. This study unwraps misconceptions, including the Moon changing shape, the Sun moving across the sky and how seasons occur.

A study of Forces sophisticates the substantive knowledge acquired in KS1 and LKS2. New content, including air resistance and water resistance is studied. Force multipliers, such as levers are studied to understand how we can be efficient with effort. For example, a spanner with a long handle multiplies the force and makes it easier to turn a bolt than spanner with a shorter handle. Simple machines, such as pulleys are also studied as force multipliers – they move the load through a greater distance with the same energy being used. Enhancing this study of Forces, pupils learn about Galileo Galilei 1564 - 1642 (considered the father of modern science).

Living things and their habitats focuses on differences in life cycles of living things and how they reproduce. This study also contrasts previous scientific thinking. Pupils contrast how people in the past thought and constructed understanding, in the absence of scientific evidence, to explain things they didn't understand. Maria Merion is the significant scientist studied, she observed closely and carefully drew insects undergoing biochemical metamorphosis. David Attenborough describes Maria Marion as one of the most important contributors to the field of entomology.

A further study of Living things and their habitats enables pupils in UKS2 to revisit and add to their understanding of classification through the taxonomy created by Carl Linnaeus. More complex animals are studied, including invertebrates such as Myriapods and Echinodermata (starfish and Sea urchins) as well as Arthropods such as Crustacea, Arachnids, and Insects.

Light is revisited and taught with advanced substantive knowledge. This is physics study with a focus on the properties of light, not the biology of the eye.

The study of Animals, including humans enables pupils to add new knowledge to their mental models of biological systems. Circulation, the components of blood and the mechanism of the heart is connected to healthy living through diet and exercise. Many of these science studies are enriched and conceptual frameworks extended through the deliberate curriculum choice to study charts and graphs in Maths, food in Design Technology or reuse and retrieve substantive knowledge in other contexts, such as in writing.
Further retrieval learning modules are deployed, so that pupil knowledge can be advanced and sophisticated to increase their depth of understanding.

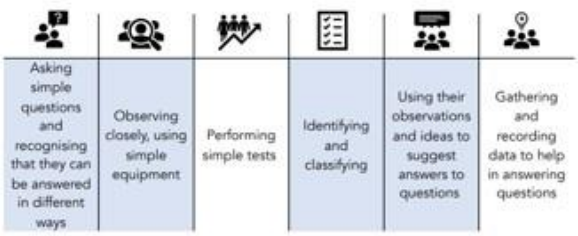
Electricity is enhanced with an advanced study of electrical circuits. New substantive knowledge is acquired in the context the particle theory, which was previously studied. Working and Thinking scientifically tasks help to deepen and make sense of new learning, such as the concept of electricity and the way we explain it using terms such as charge, potential difference and flow.

Evolution and inheritance introduce two significant scientists - Charles Darwin and Alfred Wallace as pioneers of scientific thinking in the field of evolution. This study draws on how misconceptions may have been arrived at to explain the past and how theories explain significant change, over time. Substantive concepts, including adaption and variation are taught explicitly through vocabulary and clarity is achieved through worked examples. This supports pupils to use this substantive knowledge in a disciplinary way.

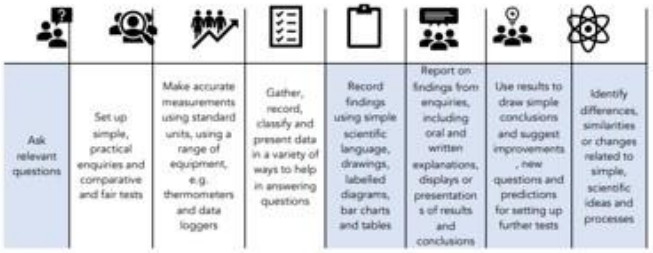
Development of Scientific Skills

As well as ensuring pupils are taught key knowledge, each module is designed to offer pupils the opportunity to undertake scientific enquiries and develop their skills as a Scientist in asking questions, planning and carrying out experiments, collecting and analysing information and drawing conclusions. At St. Peter's, the working scientifically objectives are clearly displayed on each of our science modules for both Key Stage 1 and Key Stage 2. It is clear which of the objectives are being taught throughout a specific module which ensures full coverage and allows for skills to be built upon.

Example of a Year 1 – Animals including humans



Example of a Year 4 – Animals including humans – Teeth, digestion and food chains.



Minimum Lesson Expectations

All science lessons will incorporate the following elements:

- Explicit teaching of vocabulary
- Revisiting of prior learning
- Use of scientific vocabulary in learning
- Reading
- Working scientifically
- Evidence of learning in pupil's books

Tailoring for SEND

At St. Peter's, we aim for all science lessons and learning questions to be accessible to all pupils. Pre-teaching of scientific vocabulary provides all children with the opportunity to demonstrate an understanding of subject specific language. The use of dual coded Knowledge Notes and Organisers provide visuals to aid understanding and recall. In addition, knowledge notes are utilised in all lessons to minimise cognitive overload, so children can use and apply their knowledge more easily. Sentence stems can be used where necessary to aid with written evidence.

3. Resources

CUSP is a fully online resource, enabling all teachers in all classes to have instant and continuous access to all the resources they need to teach whichever lesson they choose.

4. Assessment of Pupil Learning & Progression

Assessment is both formative and at the point of learning as well as summative to feed forward to the next point of contact pupils will have. Feedback, quizzes, thinking hard tasks and structured assessment tasks all contribute towards the bigger picture of how well pupils retain and remember the content. Assessment at St. Peter's takes many forms:

- Formative outcomes from cumulative quizzing
- Summative outcomes from cumulative quizzing
- Pupil Book Study (a highly acclaimed and evidence-led evaluation of long-term learning through precise and structured conversations)

CUSP Assessment Grids

There is a grid for recording quiz results which will allow teachers to monitor what pupils can remember. The purpose is to support future planning and retrieval practise. Below is an example of grid to quiz outcomes.

KS1 Study Summary Assessment:

Knowledge and vocabulary acquired

Test / quiz assessment	End of Unit		
	Low >60%	Mid 60 -75%	High <75 - 100%
%			
Pupil names			

5. Monitoring and Evaluation

Monitoring takes place regularly through teacher assessment, pupil voice and book scrutiny by the science subject leader. The Subject Leader and class teacher will together monitor the learning and progression made by pupils across the key stage. Governors are involved in monitoring during bi-annual Governor's Monitoring Week through learning walks, discussion with subject lead and work scrutiny.

6. Safeguarding and Health and Safety

- Safeguarding procedures will be followed to ensure the well-being of students during science lessons and trips

- Risk assessments will be conducted prior to any activities, ensuring the safety of students and staff