

# Askwith Primary School

## Science rationale

Science is a means of discovering and understanding the world around us. It consists of a body of knowledge which attempts to explain phenomena and experiences. It also involves a number of skills and processes by which this knowledge is achieved and applied. Science is also concerned with the development of attitudes concerning scientific activity. Science forms an integral part of our everyday life. It is therefore important for all children to be scientifically literate.

"Children are naturally curious. Science at primary school should nurture this curiosity and allow them to ask questions and develop the skills they need to answer those questions."

Louise Stubberfield

Primary science helps pupils to:

- investigate problems
- learn how science works
- discover why science matters in the world

Our planning, teaching and assessment of the curriculum is informed by the nine principles of cognitive science (Daniel Willingham). This includes the 'must haves' or the end states in the child's mind and the 'could dos' or the teacher behaviours that alter the states in the child's mind. In science, we recognise the 'must haves' as the alteration to long-term memory that allows children to retrieve substantive and disciplinary knowledge fluently, and to have a positive self-image as a learner. We recognise the 'could dos' as sequenced lessons in science of the essential knowledge, the explicit teaching of vocabulary and abstract concepts, retrieval practice for knowledge and interleaving. Our intent is that the children know more, remember more and therefore do more.

Intent	Implementation	Impact: to be reviewed at the end of each year
All knowledge from 2020-2021 is embedded for all year groups.  The planning, teaching and assessment of the science curriculum is informed by the nine principles of cognitive science (Daniel Willingham).	<ul style="list-style-type: none"><li>• All knowledge checks for all pupils include connected knowledge from the previous units of learning in order to ensure there are no gaps or forgotten knowledge</li><li>• All gaps or forgotten knowledge to be addressed prior to teaching new knowledge</li><li>• Blocking allows pupils sufficient time to become fluent in their scientific knowledge</li><li>• Mini knowledge checks and knowledge checks ensure that</li></ul>	

Science is taught through deliberate practice in a supportive environment which enables pupils to improve their fluency leading to mastery and an alteration to their LTM.

Reading is prioritised across the curriculum

this knowledge is embedded in their LTM

- Planning and learning journeys consider the essential knowledge and how to guide the pupils' thinking
- Working memory capacity is considered when planning and teaching
- The acquisition of new vocabulary is key and will be carefully considered when planning and teaching
- Units of work are planned to ensure that they challenge prior knowledge in order to construct a good, new understanding of substantive knowledge. In addition to this, disciplinary knowledge is developed through the understanding of scientific methods, degrees of certainty and conducting investigations
- Pupils articulate how they know more, remember more and therefore do more
- Instil a growth mindset ethos which talks about successes and failures in terms of effort rather than ability
  
- Rolling programmes are carefully planned to show progression in knowledge for each class, and to build knowledge from one class to another
- Pupils given opportunities to deliberately practice newly acquired knowledge
- Prior knowledge to be re-visited before new ideas are introduced. Misconceptions are diagnosed and discussed
- An enquiry based approach is used which focuses on the acquisition of substantive knowledge before 'proving' or inquiring through investigations. (see **Ofsted** research February 2019)
  
- Opportunities are given across all year groups for reading in science. This starts in the early

<p>Vocabulary is built systematically</p>	<p>years by reading labels and captions, exposure to story books, non-fiction text, rhymes and poems and progresses to reading age appropriate non-fiction texts in the later years</p> <ul style="list-style-type: none"> <li>• The acquisition of vocabulary is planned into each unit of essential knowledge, prior vocabulary and current vocabulary is identified</li> </ul>	
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At Askwith Primary School, we believe that **all** children's education begins in Early Years (this includes SEND, EAL, PP and vulnerable children).

'Children develop quickly in the early years and a child's experiences between birth and age five have a major impact on their future life chances.' *EYFS Statutory Framework, 2021*

Our curriculum is aligned to the Early Years Framework and shows the sequential steps of essential knowledge acquired from Reception to Year 6. We have a determined approach that drives us to ensure that all children meet the expected standard in art and have the knowledge required for secondary school. Our intent is that all children know more, remember more and do more.

### **Knowledge and attitudes in science**

At Askwith Primary School, we take every opportunity to explore our locality and make natural links to the curriculum. Fundamental British Values are interwoven throughout the science curriculum in order to enhance the cultural capital of the children.

By the time children leave Askwith Primary School, they have the right knowledge and investigative skills for their secondary education. It is important that they are able to see the relevance of science in their own lives, and imagine future science-related careers based upon it.

Recent research by UCL has highlighted that: "Children's 'science identities' - the extent to which they see science as 'for them' - are formed early and affect their future interests and aspirations. "

### **Knowledge**

Knowledge refers to the theories and concepts making up science, the method of posing questions and carrying out investigations. Although there is no fixed way in which scientists

work, all investigations tend to have aspects of common processes such as observation, classification, hypothesising, data collection, interpretation of data and evaluation.

Scientific knowledge should:

- be based on children's existing or connected knowledge of concepts in science
- arouse curiosity about natural phenomena which stimulates the posing of questions about such phenomena
- be a systematic means of enabling the children to ask and attempt to answer questions arising from observations
- provide models of scientists who have contributed to the field of science
- expose students to the various strands of specialisation but which are still related
- recognise that different students experience science differently

### **Substantive knowledge**

In science, this is the knowledge produced by the academic subject. This involves concepts which form the underpinning structure of the subject, e.g. respiration, evolution and the idea of a force as well as the scientific vocabulary needed. The list of substantive knowledge for science is extensive and must be carefully sequenced over time.

Ofsted view **substantive** knowledge as: 'knowledge of the products of science, such as, concepts, laws, theories and models'. This is specified as the scientific knowledge and conceptual understanding in the National curriculum.

**Ofsted Research review series: science 2021**

### **Disciplinary knowledge**

In science, this is the knowledge needed to collect, understand and evaluate scientific evidence. It's the scientific method, i.e. changing one variable whilst keeping everything else the same - and seeing what happens. It is the ability to develop cognitive skills related to science such as acquiring scientific language, making observations, taking measurements, gathering, analysing and interpreting data, making generalisations, creating models, communicating and carrying out investigations.

We use this knowledge every day. An example of this in everyday life is your TV remote. When it stops working, first you bang it, then you wipe the sensor, finally you change the battery. Each time you change one variable (the independent variable) before measuring its effect (the dependent variable) whilst keeping everything else the same (the control variables).

Ofsted view **disciplinary** knowledge as: 'knowledge of how scientific knowledge is generated and grows'. This includes pupils knowing how to carry out practical procedures but goes beyond simply doing practical work or collecting data.

## **Connectivity**

New knowledge should be integrated with existing connected knowledge. The relationship between scientific concepts should be taught 'over multiple years, without working memory being overloaded' thus building on existing knowledge whilst revisiting connected knowledge. Deliberate practise ensures that learned knowledge is accessible and not forgotten. The ultimate goal is an alteration in the pupils' long term memory enabling the children to know more, remember more and therefore do more.

Connections between different subject areas (particularly maths) should also be identified so that pupils can be taught how to transfer mathematical knowledge in to a scientific context.

## **Attitudes**

Attitudes are concerned with the way in which scientific knowledge and its application is evaluated and appreciated together with an understanding of its limitations.

Science teaching should enable the children to:

- challenge the perception that science can provide absolute truth and provide a solution to all problems
- appreciate the scientific process as one way of appreciating life
- appreciate the importance of science in everyday life
- appreciate the influence of science on society
- develop a positive critical attitude towards scientific developments
- recognise the limitations of science
- be ready to engage in science and scientific methodology
- appreciate that everyone benefits from the positive results of science

## **Why this, why now?**

The rolling programme of units of knowledge allows for mixed year classes to acquire essential knowledge over two years (year A and year B). Repeated units, for example light in year 3 and 4 (year A) will be spaced accordingly and taught in year A in year 5 and 6. Where appropriate, natural links will be made with other areas of the curriculum and the associated unit of knowledge will be taught prior to this. For example, in year 1 and 2, materials (autumn 1 year A) will be taught prior to 'Toys' in history (autumn term 2 year A). This provides the opportunity to deliberately practise the knowledge acquired.

## **The purpose of practical work**

The purpose of high-quality practical work is to 'connect scientific concepts and procedures to the phenomena and methods being used'.

High-quality practical work should only take place after the pupils have enough connected knowledge to interpret or explain their observations and measurements thus linking theory to observation. 'If this prior knowledge is not available, pupils will be participating in discovery learning, and **not** scientific enquiry.'

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### **Challenging the more able**

Children who are working at the expected standard with greater depth are given opportunities to deepen their understanding of the substantive knowledge and abstract concepts and apply this knowledge to build their disciplinary knowledge. In science, this may include asking fundamental questions that promote deep learning e.g. where do the stars go during the day? This enables children to apply their existing knowledge to an unknown scenario. Challenge may also include less structured, open-ended investigations where the children are required to make more sophisticated links between their current substantive knowledge. How the more able children are challenged will depend on the outcomes of knowledge check 1.

### **Creativity in science**

If children are to have the necessary skills and capabilities to face an ever-changing future, they need to become innovative and critical thinkers. Our approach to science fosters the children's natural curiosities whilst encouraging independent enquiry.

Being creative in science includes:

- thinking about things in different or unexpected ways
- making connections between new ideas/experiences and old ones
- finding new solutions to problems
- testing out new ideas which enable the children to learn from their mistakes

### **Assessment**

Tracking children's progress throughout their school life is vital in order to establish their acquisition of knowledge. At Askwith Primary School, learning always starts with the children's prior knowledge and any misconceptions that they may have. This can be ascertained in several different ways; teachers decide upon the most appropriate, age-related way of obtaining the children's prior knowledge which also enables the children to demonstrate any connected knowledge held in their long term memory. This connectivity provides the children with an opportunity to remember; it is important that any new knowledge is connected to existing knowledge. Units of work are then personalised to the needs of all groups of learners.

Any misconceptions that arise throughout the unit are identified and addressed appropriately. Children continue to recall their knowledge throughout a unit using mini knowledge checks in order to ensure an alteration in long term memory and to ensure that all children reach their endpoints so that they know more, remember more and do more.

In the academic year 2021-2022, all relevant knowledge from the previous year's learning will be included in current knowledge checks. Any misconceptions or gaps in knowledge will be addressed in order to mitigate any lost learning due to COVID-19. Recalls will then be repeated six and twelve weeks later to ensure that the knowledge has been embedded and an alteration to LTM has occurred.

End of topic assessment (knowledge check) takes place approximately two weeks after the end of the topic. Two further recalls take place approximately six weeks and then twelve weeks later in order to ensure that the knowledge is embedded in the children's long term memory.

Work from each year group will be moderated by staff (following the same process as the 'No More Marking' system in English) to ensure that there is a progression in knowledge and that children are meeting their appropriate end goal.

**Reviewed: September 2021**