# Curriculum Science Rationale

Our science scheme of work was reviewed and updated in line with research from the worlds of science education and cognitive science to ensure it meets the requirements of the Education Inspection Framework and National 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

In line with the aims of the National Curriculum, 'the education people' scheme gives pupils the opportunity to learn about the products of science so that they can explain the material world and 'develop a sense of excitement and curiosity about natural phenomena' (National Curriculum). Pupils will also learn about the practices of science so that they know how scientific knowledge becomes established through scientific enquiry. Through this programme of study, pupils will combine these two distinct types of knowledge to ensure their substantive and disciplinary knowledge are building with context and purpose.

Knowledge and skills in this scheme of work have been carefully sequenced across units and years because we know that, 'when knowledge is well structured, it becomes meaningful, flexible and easier to access. This knowledge can then be used to solve complex, and interesting, scientific problems without overloading working memory' (Ofsted research review series: science). Within this scheme of work, therefore, sequential component knowledge is clearly broken down into steps and composite tasks outlined through which pupils will embed that knowledge. Although they are taught together, there is clarity about which knowledge is disciplinary and which is substantive.

Revisiting prior learning and carrying out retrieval practice is an important aspect of learning and will support pupils to commit their knowledge to their long-term memory. This scheme of work, therefore, outlines for each unit the prior knowledge that pupils will need to inform this unit.

'In science, pupils need their knowledge to be organised around the most important scientific concepts, which predict and explain the largest number of phenomena' (Ofsted research review series: science). Therefore, within this scheme, ten big ideas have been identified, underpinned by key concepts. As they move through this scheme of work, pupils will build comprehensive schemata for each of these big ideas so that new knowledge connects with prior knowledge and can be committed to the long-term memory.

This scheme of work makes the distinction between substantive and disciplinary knowledge and ensures that pupils use these side by side to develop expertise, apply and make sense of the knowledge learnt and understand how the knowledge developed and became accepted:
• substantive knowledge (knowledge of the products of science, such as concepts, laws, theories and models): this is referred to as scientific knowledge and conceptual understanding in the national curriculum

**'Let us be concerned for one another, to help one another to show love and do good.' Hebrews 10: 24-26**

• disciplinary knowledge (knowledge of how scientific knowledge is generated and grows): this is specified in the 'working scientifically' sections of the national curriculum and it includes knowing how to carry out practical procedures (Ofsted research review series: science)
This scheme of work acknowledges that acquiring disciplinary knowledge goes beyond practical work. Alongside the opportunity to work scientifically, pupils need to understand the concepts and procedures that scientists use to develop understanding and explanations and seek truth. Therefore, the disciplinary knowledge that will be covered in this scheme of work is:

• knowledge of methods that scientists use to answer questions • knowledge of apparatus and techniques, including measurement
• knowledge of data analysis
• knowledge of how science uses evidence to develop explanations

Combining the substantive and disciplinary knowledge helps pupils to secure conceptual understanding which they can then transfer to procedural knowledge through application. We have considered carefully the best substantive contexts in which to teach the disciplinary concepts and procedures.

Teacher subject knowledge is key to ensuring that pupils build solid scientific understanding and, to this end, this scheme of work comes with teacher knowledge organisers which outline essential substantive and disciplinary knowledge for each unit of work.

This scheme of work takes account of what is taught in mathematics at a similar stage to support a cohesive curriculum across subjects. This includes reading, writing and talking and opportunities have been identified for pupils to learn about the different ways in which scientists engage in their work through reading, talking and writing. This way, pupils will begin to build disciplinary literacy.

Pupils learn best when teachers have identified and prepared for common misconceptions in science because these can form barriers to learning. Common misconceptions are therefore identified for each unit within this scheme of work. It is important to remember that, if a misconception is challenged too early, before pupils have a scientific conception…they may mistakenly identify the misconception as factually correct information' (Ofsted research review series: science). To avoid this, pupils' knowledge should be built incrementally and greater time should be spent on those concepts where misconceptions are likely to be held.

Within this scheme of work you will find suggestions for a range of practical activities. These have been carefully thought about to ensure that they are designed to help pupils learn substantive or disciplinary knowledge. Where the aim of the lesson is for pupils to understand a concept, the learning activity has been focused on the development of understanding about this concept. There may also be times when the activity itself may be the goal e.g. learning how to use a thermometer. Teachers can use alternative activities and tasks as they wish but should ensure this clarity of focus is maintained and that thinking hard is prioritised over task completion. Time should also be dedicated before and after the practical work to interpret and explain.

As outlined in the Ofsted Research Review for science, high-quality science education may have the following features which teachers should take into account when using this scheme of work:

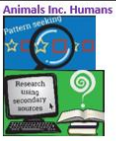
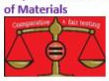
• Activities are carefully chosen so that they match specific curriculum intent.
• Teachers use systematic teaching approaches, where learning is scaffolded using carefully sequenced explanations, models, analogies and other representations to help pupils to acquire, organise and remember scientific knowledge.
• Teaching takes account of the limited working-memory capacity of their pupils when planning lessons.

• Pupils are not expected to arrive at scientific explanations by themselves without sufficient prior knowledge.
• Systematic approaches, alongside carefully selected texts, are used to teach the most important vocabulary in science.
• Pupils have regular opportunities in the early years and primary classrooms to learn vocabulary through story and non-fiction books, rhymes, songs and oral rehearsal. (Ofsted research review series: science)


**'Let us be concerned for one another, to help one another to show love and do good.' Hebrews 10: 24-26**

# Long-term Plan

**Our Science curriculum 2024**

| Year group | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
|---|---|---|---|---|---|---|
| **Year 3** | Plants  | Animals inc Humans  | Rocks  | Forces & magnets  | Light  | Plants revisited  |
| **Amazing People** | Rachel Carson | Charles Darwin | Mary Anning | Isaac Newton | | **Rachel Carson revisited** |
| **Year 4** | Living Things and their Habitats  | States of Matter  | Sound  | Animas inc Humans  | Electricity  | Applying and Consolidating<br>Possibility to revisit any of the 5x types of scientific enquiry |
| **Amazing People** | Percy Julian (Global Black Achievers) | Alfred Nobel*<br>Marie Curie | | Charles Darwin | Lewis Latimer Howard* | |
| **Year 5** | Animals Inc. Humans  | Forces  | Properties and Changes of Materials  | Living Things and their Habitats  | Earth and Space  | Applying and Consolidating<br>Possibility to revisit any of the 5x types of scientific enquiry |
| **Amazing People** | Howard Florey | Isaac Newton revisited* | Beulah Louise Henry | Charles Darwin* | Hidden Figures*<br>Katherine Jenkins<br>Wang Zhenyi<br>Maggie Aderin Pocock | |
| **Year 6** | Light  | Electricity  | Evolution  | Living Things and their Habitats  | Animals Inc. Humans | Applying and Consolidating<br>Possibility to revisit any of the 5x types of scientific enquiry |
| **Amazing People** | Dmitri Mendeleev | Thomas Edison | Charles Darwin revisited<br>Stephen Hawking<br>(celebrate amazing disabled people) | | Elizabeth Blackwell | |

## Significant contributors within the field of science

Research into primary science has shown that when pupils learn about the work of specific scientists that link closely to the content they are learning at the time, this helps them to develop an accurate and genuine understanding of science: for example knowing that scientific research is not just carried out by men in white coats working in laboratories (Ofsted, 2023).

Within each unit there is specific reference to two significant individuals - one beyond living memory and one within living memory. These have been carefully selected to illustrate how scientific knowledge within the topic has developed over time and continues to shape new discoveries and innovations to this day. There has been careful consideration to ensure representation across the globe and around the different protected characteristics as defined by The Equality Act, 2010.


Please note that it is not the intention for pupils to remember each of the significant individuals or their specific achievements referenced throughout the units of work. As stated above, these have been included to provide context and build a sense of capital within the subject.

**'Let us be concerned for one another, to help one another to show love and do good.' Hebrews 10: 24-26**

# Significant contributors within the field of science

## Year 3

| Forces and Magnets | | Light | | Rocks | | Plants | | Animals, including humans | |
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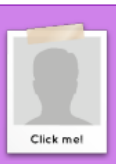
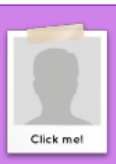
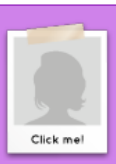
|  |  |  |  |  |  |  |  |  |  |
| Leonardi Da Vinci | Masato Sagawa | Thomas Edison | Isamu Akasaki | Mary Anning | Sanjeev Gupta | George W. Carver | Luciano Scandian | Louis Pasteur | Charlotte Armah |
| Italian inventor and first known person to plan and carry out tests on friction | Japanese creator of the strongest permanent magnet in wide scale use today. | American inventor who created the first working electric light bulb | Japanese engineer & joint inventor of LEDs used in energy-saving lighting | English fossil hunter who discovered several dinosaur specimens. | Indian-born geologist who explores different landscapes on Earth & beyond | American scientist who promoted ways to prevent soil depletion | Italian research technician at the Laboratory of Apiculture and Social Insects | French microbiologist who is renowned for his discovery of pasteurisation | British-Ghanaian scientist who tests how food can help protect us from diseases |

## Year 4

| Sound | | States of matter | | Electricity | | Animals, including humans | | Living things and their habitats | |
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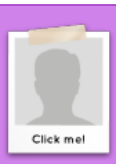
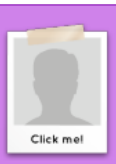
|  |  |  |  |  |  |  |  |  |  |
| Alexander G. Bell | Jaap Haartsen | Anders Celsius | Heston Blumenthal | Benjamin Franklin | Erik Bystrup | Pierre Fauchard | Zhaoming Liu | Carl Linnaeus | Vanessa Nakate |
| Scottish-American inventor who patented the first telephone | Dutch inventor who contributed to the specification of Bluetooth | Swedish astronomer who created the temperature scale, 'degrees' | British chef and pioneer of multi-sensory cooking and experimental techniques | American scientist who proved lightening was a form of electricity | Danish designer of a new T-shape pylon being installed by the UK National Grid | French physician, credited as being a pioneer and the 'father of modern dentistry' | Chinese doctor and researcher into the reproduction of tooth enamel | Swedish botanist who came up with a method for classifying all living things | Ugandan climate justice activist who campaigned to save the Congo rainforest |

## Year 5

| Animals, including humans | | Earth and Space | | Forces | | Properties and changes of materials | | Living things and their habitats | |
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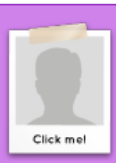
|  |  |  |  |  |  |  |  |  |  |
| Alexander Fleming | Rosalind Franklin | Nicolaus Copernicus | Tim Peake | Isaac Newton | Elon Musk | Albert Einstein | Hugh Bradner | Gregor Mendel | Jane Goodall |
| Scottish scientist who discovered the first anti-biotic drug, penicillin | British chemist whose work led to discovery of DNA structure | Polish astronomer who developed idea of a 'heliocentric universe' | First British astronaut to walk in space in over 20 years. | English physicist who established 3 laws of motion & law of gravity | South-African born physicist and entrepreneur - founder of Space X & Tesla | German physicist who showed matter can be turned into energy and back | American physicist who invented the first modern neoprene wetsuit | Austrian botanist who discovered how features are passed down in different plants | English primatologist famous for her work with chimpanzees |

## Year 6

| Living things and their habitats | | Evolution and inheritance | | Electricity | | Light | | Animals including humans | |
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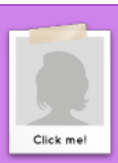
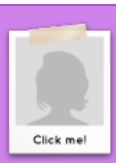
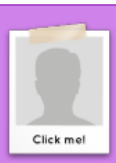
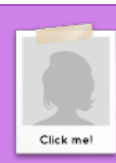
|  |  |  |  |  |  |  |  |  |  |
| Carl Linnaeus | Tanisha Williams | Charles Darwin | Sylvia Earle | Nikola Tesla | M. Stanley Whittingham | Ibn al-Haytham | Jo Shien Ng | William Harvey | Donald Palmer |
| Swedish botanist who came up with a method for classifying all living things | Native American botanist who studies how plants respond to climate change | English naturalist who showed how animals changed over generations (aka evolution) | American marine biologist, activist & world record holder for deepest sea walk | Serbian inventor famous for contributions to the AC electricity supply system | British chemist & Nobel Prize winner for the evolution of the lithium-ion battery | Arabian physicist & mathematician who proved light travels in straight lines | Malaysian professor whose research helps to develop electro light detection | English physician known for describing the circulation of blood in the body | British-Jamaican scientist who researches the human immune system |

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# Using the planning materials

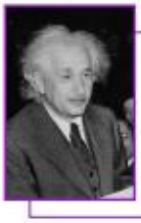
Black text - this is guidance for teachers that aims to support lesson design and delivery

Pink text - this highlights prior knowledge and gives ideas for retrieving previous learning

**Bold text** - this is the tier 2 and 3 **substantive vocabulary** pupils need to know

Purple text - this shows the **disciplinary vocabulary** pupils need to know

Green text - this inidcates what pupils need to do or record as part of the enquiry



Orange text - this provides an opportunity for links to be made with a significant person

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