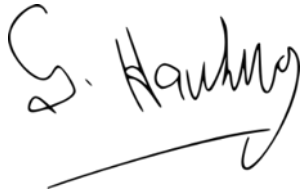
Our Science Curriculum

Newcomen Primary School

"Be brave, be curious, be determined, overcome the odds. It can be done."



Professor Stephen Hawking

NEWCOMEN

scientia potentia est

Intent

Newcomen Primary School is committed to safeguarding and promoting the welfare of children and expects all staff, volunteers and visitors to share this commitment. All children are provided with equal opportunities and equal access to the curriculum. At Newcomen Primary, we are committed to ensuring equality of opportunity for all pupils, staff, parents and carers irrespective of race, gender, disability, belief, sexual orientation, age or socio – economic background. This document is a statement of our Intent for, and the Implementation and Impact of, the teaching and learning of Science skills and knowledge at Newcomen Primary School.

At Newcomen Primary School, we provide all of our children, our most precious asset, with an ambitious and appropriate Science education. Our Science curriculum is knowledge and skills rich and provides the foundations for understanding the world through the specific disciplines of Biology, Chemistry and Physics. Through our bespoke curriculum, which is written with the needs and context of our children at its heart, we recognise the importance of Science in every aspect of children's lives. Furthermore, we aim to inspire children to be inquisitive, life-long learners of Science whilst on their journey through primary education and beyond. Through establishing a body of key knowledge, skills and vocabulary, pupils are encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity in the world around them. Once knowledge is deep and embedded, children are provided with opportunities to work scientifically. In line with our whole-school values, we teach all children to foster curiosity for nature, encourage respect for living organisms and the physical environment and provide opportunities for critical evaluation of evidence.

Our Aims:

- To deliver a logically planned and progressive curriculum which embeds key scientific knowledge, skills and vocabulary
- To follow the key aims of the National Curriculum and customise learning opportunities to meet the needs of our children linked to their locality and demographics
- To embed the development of basic skills throughout our Science curriculum to ensure we address the impact of social disadvantage on our children's literacy and maths skills
- To expose children to an age-appropriate range of scientists beyond those in the National Curriculum and the impact those scientists had on our understanding of the world
- To work scientifically once knowledge is deep and embedded
- To appreciate and respect the natural world around them including natural phenomena
- To promote a passion for life-long learning of Science
- To promote continuity, coherence and challenge across school

- To ensure the highest expectations for and from all
- To be aware that our children are the future of our planet and understand the implications that this has for the impact they can have on the world including climate change
- To equip children with the scientific knowledge required to understand the uses and implications of Science today and for the future
- To be confident and passionate when delivering scientific knowledge and empower children to demonstrate their scientific knowledge, vocabulary and skills through the disciplines of Biology, Chemistry and Physics
- To empower children to be inquisitive and ask well-formulated scientific questions
- To empower children to be brave when formulating a hypothesis and understand how this links with a scientific conclusion
- To be respectful of the natural world
- To be equipped to make sense of phenomena, seek explanations and think critically.

Through studying our progressive Science curriculum, pupils become more expert as they move through school. They accumulate, connect and make 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 are positioned against known and accurate content.

2. **Disciplinary knowledge** – this is knowing how to collect, use, interpret, understand and evaluate the evidence from scientific processes. This is taught discretely. 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.

3. **Scientific analysis** is mapped throughout our Science curriculum developed through:

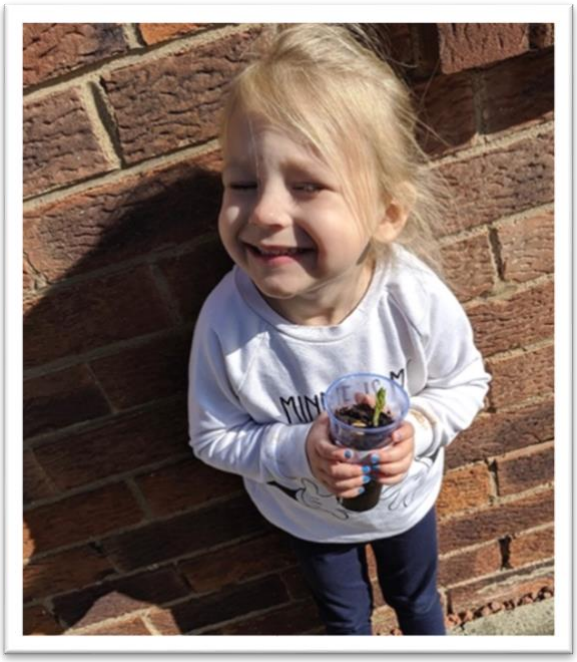
    - identifying and classifying
    - pattern seeking
    - research
    - observing over time
    - fair and comparative testing

4. **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.

Early Years

Understanding of the World is one of the specific areas of the Early Years Foundation Stage Curriculum. Children are encouraged and guided to use investigation and exploration to develop their understanding of the natural world. Our ambitious Early Years curriculum is designed to enable children to make sense of the physical world around them and their community.

In the Early Years, children are encouraged to be scientists by using their senses to investigate materials, notice and discuss similarities and differences in patterns and observe and describe what they can see. During outdoor learning, in our popular wildlife garden and charming orchard, children observe the natural environment and comment on living things including plants and animals. Emphasis is placed on being curious; children are encouraged to ask questions about why things happen and how things work.



In Early Years, reading plays a crucial role in the teaching and learning of the natural world. Staff model and encourage children to articulate how their experiences are similar to, or different from, what has been read. Furthermore, children are given high-quality experiences for outdoor exploration which helps to broaden their understanding of the world.

Science Connections – EY – KS1

Our Curriculum Check Points	How this is achieved in EYFS	Science in Year 1	Science in Year 2
Communication and Language: • Vocabulary **Personal, Social and Emotional Development:** • health and wellbeing **Physical Development:** • large motor skills **Literacy** • re-read for enjoyment **Mathematics** • count objects, actions and sounds • comparison of measure • pattern **Understanding the World** • materials • natural world • changing seasons **Expressive Arts and Design** • explore	**Opportunities, Provision and Experiences:** • Look at the stages of growing up. • Talk about how we change as we grow. • Make observations about ourselves and others – hair colour, eyes etc. • Simple body parts. • Identifying our senses and what we use them for. • Keeping healthy. • Oral Hygiene. • Observing the changes in seasons. • Talking about the changes in seasons over time. • Exploring the natural world – opportunities for outdoor play and exploration. • Interactions with outdoors – hands on experience with world around them (touch, smell and hear) • Animals from around the world – naming and describing. • Naming and describing some plants. • Natural processes - ice melting, sound, light, shadows, and magnets. • Floating and sinking. • Forces • Sun safety • Baking - exploring changes of state. **What language will children encounter?** CUSP prior vocabulary knowledge: Sun, rain, snow, cloud, day, night Grow, change, myself, body, senses, healthy, teeth, season, nature, outdoors, animal, plant, melt, float, sink, force, sun cream, bake, hygiene	**Plants** • identify and name a variety of common wild and garden plants, including deciduous and evergreen trees • identify and describe the basic structure of a variety of common flowering plants, including trees. **Animals including Humans** • identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals • identify and name a variety of common animals that are carnivores, herbivores and omnivores • describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets) • identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. **Everyday Materials** • distinguish between an object and the material from which it is made • identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock • describe the simple physical properties of a variety of everyday materials • compare and group together a variety of everyday materials on the basis of their simple physical properties. **Seasonal Changes** • observe changes across the four seasons • observe and describe weather associated with the seasons and how day length varies.	**Plants** • observe and describe how seeds and bulbs grow into mature plants • find out and describe how plants need water, light and a suitable temperature to grow and stay healthy. **Living Things and their Habitats** • explore and compare the differences between things that are living, dead, and things that have never been alive • identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other • identify and name a variety of plants and animals in their habitats, including microhabitats • describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food. identify and name a variety of common wild and garden plants, including deciduous and evergreen trees **Animals including Humans** • notice that animals, including humans, have offspring which grow into adults • find out about and describe the basic needs of animals, including humans, for survival (water, food and air) • describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene. **Uses of Everyday Materials** • identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses • find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Cultural Capital

At Newcomen Primary School, we are proud of our shared heritage. Following the discovery of iron ore in the Cleveland Hills in 1850, Teesside has become renowned across the world for its steel and iron industry. In addition, the Tees Valley is one of the most significant integrated industrial economies in the world and produces 30% of the UK's chemical output. At Newcomen, we believe that we must inform and inspire our children with first-hand experiences of STEM (Science, Technology, Engineering and Mathematics) through an enriched Science curriculum including workshops with local industry experts. Visits, both with in the local area and further afield, also enhance the cultural capital offer.

Curriculum Enrichment

Our annual Science curriculum enrichment includes, but is not limited to:

Early Years Foundation Stage

Observing plants and animals regularly and throughout the four seasons within our extensive school grounds (including our thriving bug hotel, hibernacula and wildlife garden), within Locke Park and on Redcar Beach.

Key Stage One

Developing their understanding of animals including humans at Kirkleatham Owl Centre, visiting RSPB Nature Reserve at Saltholm to observe a range of wildlife in its natural habitat and a Science Club run by Mrs Wing the Science Leader.

Lower Key Stage Two

Identifying and classifying rocks at Teesmouth Field Centre, workshops with Ian Hobday (STEM Ambassador) on how industry changes wind power into electricity and a Woman in Science webinar run by Professor Carole Haswell (former pupil of Newcomen Primary School and Head of Astrophysics at the Open University).

Upper Key Stage Two

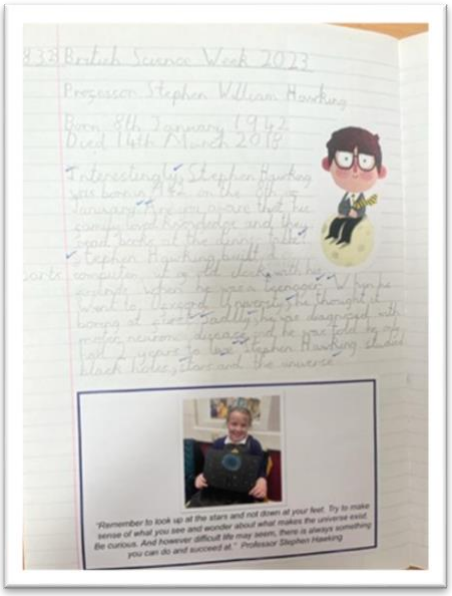
An interview with, and Space Workshops run by, Professor Carole Haswell, Science Transition Workshops at Outwood Academy Redcar and an Evolution, Adaptation and the Art of Nature workshop at Kirkleatham Museum.

Studying Key Scientists

As there is a firm emphasis on knowledge at Newcomen Primary School, it is vital that children understand a range of scientists and their impact on our view of the world. Without great minds such as Charles Macintosh and David Attenborough, our knowledge and understanding of the world may be completely different! At Newcomen, we go beyond the expectations of the National Curriculum by studying additional inspirational scientists chosen by our beloved School Council and governor Mrs Hobday. Our Head Boy explained that they are all, "*Men and women that **our** children will find the most inspiring.*" These scientists are from a range of cultures, races and backgrounds.This really ignites a passion for Science in our children and highlights the fact the endless opportunities that scientific knowledge, skills and vocabulary opens up for them.

Early Years Foundation Stage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
						
David Attenborough	Katherine Johnson	Marie Curie	Isaac Newton	Stephen Hawking	Professor Carole Haswell	Charles Darwin

In addition to more well-known scientists, Newcomen Primary School also has links with current scientists such as Professor Carole Haswell (Professor of Astrophysics and Head of Astronomy at the Open University). Professor Haswell works alongside the Science Team to plan and deliver enrichment opportunities for our children such as our Women in Science Webinar and a cross-curricular Space and Art workshop.



Implementation

Our curriculum is underpinned by evidence, research and cognitive science. Our exciting and informative modules are deliberately sequenced for robust progression. There is an emphasis on oracy and vocabulary acquisition, retention and use to break down learning barriers and accelerate progress. A rich diet of language and vocabulary is deliberately planned for and specific skills are discreetly taught and practised so that they become transferrable. The sequenced modules activate prior learning, build on skills and deepen knowledge *and* understanding. Learning, vocabulary and content is cumulative; content is learned, retrieved and built upon. We firmly believe that this is the strongest approach for a curriculum to meet the needs of our children.

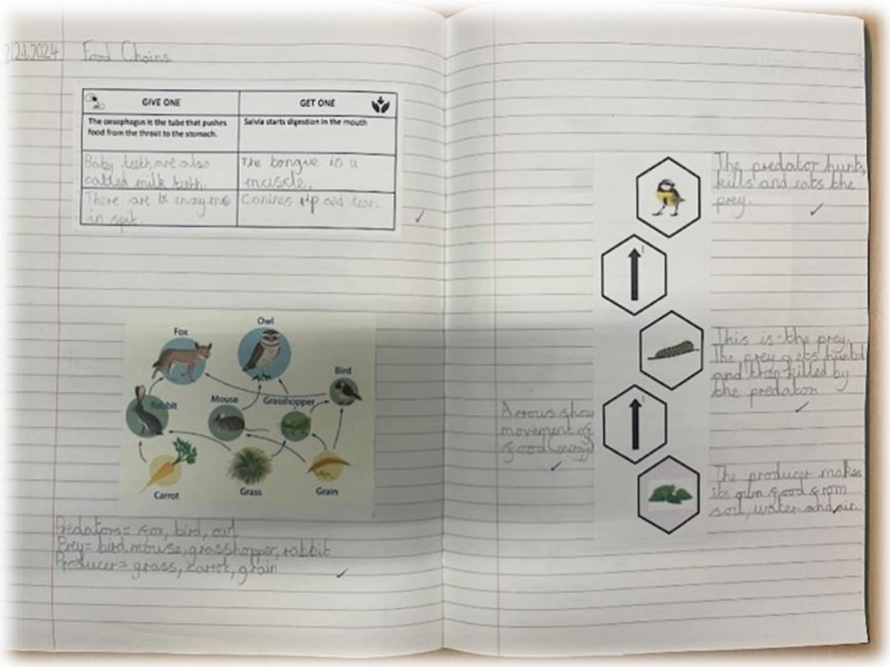
Modular Approach – Knowledge

At Newcomen Primary, Science in Key Stage One and Two is taught across each year group in modules that enable pupils to study key scientific understanding, skills and vocabulary. Each module activates and builds upon prior learning, including the Early Years Foundation Stage, to ensure better cognition, retention and confidence. 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. This enables our children to retain key knowledge and information. Within each lesson, previous learning must be reviewed and activated for strong links in the long-term memory to be built.

Cumulative Quizzing (Supporting Cognitive Load)

Cumulative quizzing forms a vital part of our curriculum offer and take place at the beginning of each Science lesson. This approach allows pupils to utilise effective cognitive load and ensure retention. In Key Stage One, weekly quizzing is oral. In Key Stage Two, children's record their quiz into their Knowledge Assessment books each lesson and mark it immediately. This directly informs teacher's planning to ensure that secure knowledge is built upon during this lesson. Furthermore, it empowers children to understand what is in their long-term memory and what needs to be reinforced. Planning is fluid to accommodate this vital Assessment for Learning opportunity. At the end of the module, pupils take a final quiz to check their understanding and knowledge. Year One children use bespoke age-appropriate resources, Year Two children orally complete a multiple-choice quiz and Key Stage Two children recorded a multiple-choice quiz into their Science books. Our children relish the opportunity to demonstrate and celebrate their successes!

Planning



All modules have a sequenced overview outlining recommended number of sessions, key concepts, knowledge and vocabulary to be taught. Planning is always adapted in order to meet the needs of our children. Furthermore, it incorporates cooperative learning techniques, key vocabulary and core concepts to enable all teaching staff to effectively plan and support the needs of all pupils in the classroom which ensures all children are able to flourish; children love to articulate their knowledge. Knowledge is power!

Knowledge Organisers and Knowledge Notes are referenced throughout each module. Furthermore, pupils can access key learning platforms at home that are used in school such as Curriculum Visions which provides a wealth of high-quality texts divided into year groups and topics.

Our Science Lessons

Carefully constructed to build on previous learning, our Science curriculum incorporates all principles of instruction consistent with Rosenshine's Principles of Learning to ensure success. Tier two and three vocabulary is explicitly taught and reinforced at the beginning of, and throughout, each lesson. Children always discuss and articulate their prior learning so that connections to new learning are strong and the likelihood of knowledge being transferred to the long term memory is increased. Teachers position and frame substantive concepts within the context of the 'bigger picture' of biology, chemistry or physics. For example, the Year Four substantive concept of 'digestion' is taught within the bigger picture of 'biology' and links back to the human skeleton and muscles unit in Year Three. A cumulative quiz is undertaken at the beginning of each lesson which is a vital assessment for learning opportunity. Immediately, pupils understand and celebrate what they have remembered, reinforcement and clarification are given where necessary and more able pupils are challenged. Misconceptions are revealed as non-examples and positioned against known and accurate knowledge. For example, it is a misconception that digestion starts in the stomach. Instead, teeth, bolus and saliva start the process of digestion in the mouth (Year Four). Knowledge Notes form the foundations of the content of each module and are adaptable to meet the needs of the children; they limit cognitive load and support vocabulary and concept acquisition through a well-structured sequence that is cumulative. Each Knowledge Note focusses on key content to be learnt and understood. The Knowledge Note scaffolds the learning in small steps and new learning is guided carefully by teachers. Deliberate practice takes place, for example my turn your turn, to enable pupils to rehearse and make sense of their learning and feedback is given to diagnose, intervene and evaluate learning. Knowledge Organisers and Knowledge Notes are dual coded to provide pupils with visual calls to aid understanding and recall. Once new knowledge is secure and children are ready, knowledge is independently applied. Where appropriate, children have opportunities to work scientifically which they love to do. More

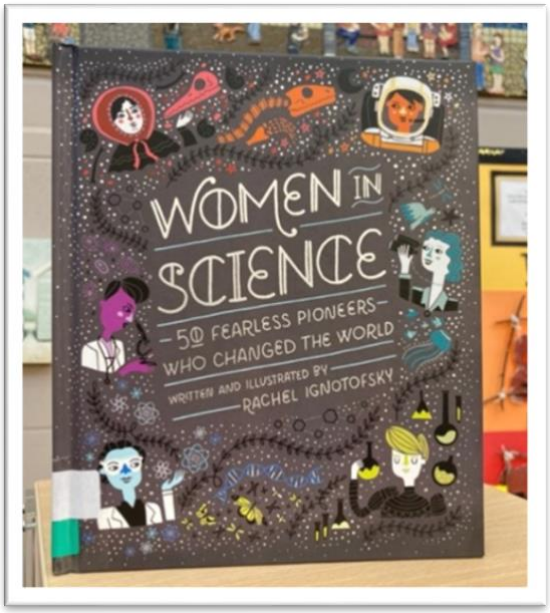
able learners are challenged using thinking hard tasks and through questioning. At the end of each lesson, children answer the questions using knowledge and vocabulary taught.

Science and English

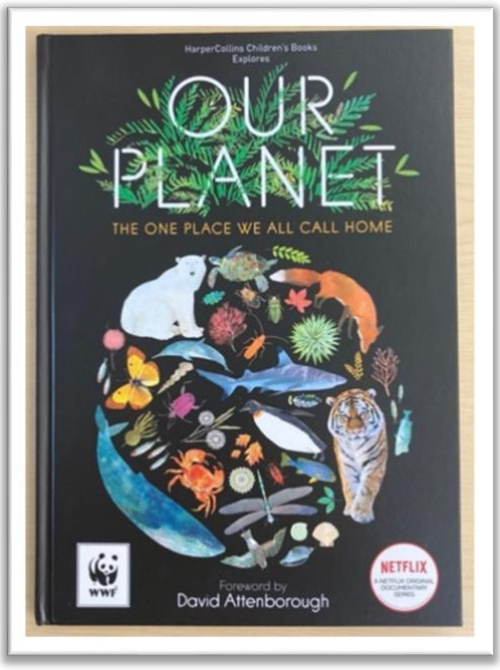
Reading

At Newcomen Primary School, we firmly believe that it is imperative for pupils to have access to high quality texts to support their learning and develop their skills in accessing information from a range of sources. Shared reading is implemented to help our pupils acquire knowledge and deepen their understanding of the subject. All opportunities for reading are exploited including shared reading the Knowledge Note, vocabulary and learning questions.

Vocabulary



Vocabulary forms a key part of every aspect of our curriculum. Subject specific Tier 2 and Tier 3 words are incorporated in each module and definitions are taught explicitly. Use of this subject specific vocabulary is linked to etymology where appropriate and their use is modelled by teachers to expand children's scientific vocabulary repertoire.



Oracy

When discussing their findings or presenting information, pupils are encouraged to speak using full sentences and incorporate the key subject vocabulary. This skill is consistently modelled by staff ensuring pupils are supported to develop their oracy skills in Science. As a Newcomen citizen, we want all of our pupils to be articulate and well-informed members of society.

Writing

Pupils are encouraged to write across all areas of the curriculum and teachers model how to write purposefully in each subject using key structures and vocabulary. Where appropriate, pupils are encouraged to apply their knowledge of the Writing Checklist in Science. Pupils are encouraged to use their Knowledge Organisers and Knowledge Notes to support their writing.

SEND/Inclusion

Newcomen Primary School is committed to ensuring that all pupils achieve their full potential. Barriers to learning are quickly identified and our school is committed to closing any gaps in achievement.

Each child is unique and within every school there will always be a number of children who, for a variety of reasons, are classified as having Special Educational Needs or Disabilities (SEND). Our school identifies children with a suspected Special Educational Need early so that interventions are swift and immediate.

All children receive quality-first teaching and activities are differentiated appropriately. Every teacher at Newcomen is a teacher of every child in our school, including those with SEND. When pupils are identified as needing additional support, proven intervention programmes, booster classes and 1-1 support are provided. Small, focused groups are also provided for children who may require additional support within lessons. The needs of children with English as an additional language will be met through targeted support in the classroom and additional 1-1 focused support.

More Able Learners

More able learners are identified as part of our assessment procedures. We provide for their needs through a framework of quality-first teaching which focuses on ensuring the children are challenged appropriately. In addition, we focus on developing their learning behaviours, including a greater depth of reflection, problem solving and enquiry, making connections, higher order thinking skills and independent learning.

Staff Development

All staff members keep up to date with Science subject knowledge and use a range of quality and consistent resources to deliver an ambitious and relevant curriculum. Training needs, based on local and national initiatives and priorities in the local area, are identified. All teachers and support staff attend all training. The Science Leader is part of a Primary Science Leaders Network which is run by Nicola Waller (Science Lead Practitioner) and a member of the Association for Science Education. As a result, she is up-to-date with the latest research. Continuing professional development is delivered by the Science Leader (National Professional Qualification in Senior Leadership/National Professional Qualification in Leading Teachers/member of Association for Science Education) and Science Team to ensure whole-school consistency.

Our staff have been trained in evidence informed reading pedagogy which emphasises the importance of teaching reading across all subjects and how to teach vocabulary – including etymology (the study of the origin of words) and morphology (the study of the forms of words). Teachers are encouraged to develop their subject knowledge by accessing resources and research and disseminating good practice in school and online.

As a National Support School, Newcomen Primary School supports the Self-Improving School System and actively works with, and supports, other schools with staff development work and whole school improvement.

Resources and Accommodation

The subject of Science is extremely well-resourced at Newcomen Primary School. The Science Team regularly audit and replenish equipment. Furthermore, staff have a written document outlining the resources we have and where in school they are located. Having clearly labelled, accessible resources supports staff in the delivery of inspiring and practical Science lessons across the school.

In addition to classroom resources, Newcomen Primary School has extensive grounds which enable countless opportunities for learning outside the classroom; our Science curriculum is enriched by our thriving bug hotel which the Early Years and Key Stage One children love to visit, a vibrant wildlife garden attracting a range of native birds and insects and a delightful fruit orchard. Year 4 take great pride in developing and maintaining our sensory garden. This provides a secluded spot to observe living creatures in their natural habitat, enjoy the scents of a variety of herbs and become immersed in Mother Nature. Our hibernacula are suitably placed and attract hedgehogs and hoglets aplenty!

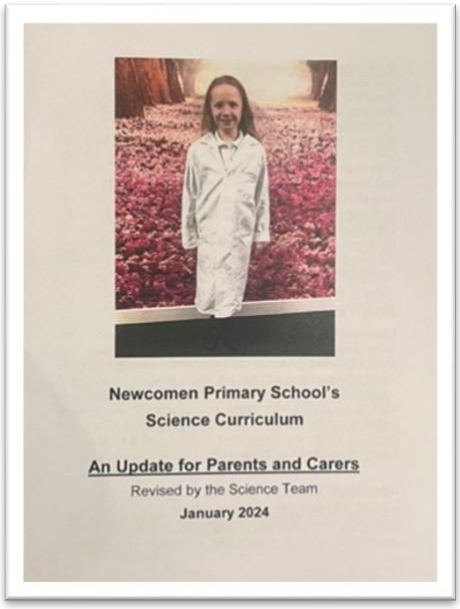
An age-appropriate selection of high-quality texts are available in our popular school library situated in Learning Area 3. This selection is updated regularly and is carefully selected to inspire our learners and compliment their learning. In addition our school library, we use digital texts from 'Curriculum Visions' to ensure a wide range of inspirational resources can be accessed at home. This enables our children to enthusiastically share what they have been studying with their parents and carers.

Monitoring and Evaluation

The Head Teacher, members of the SMT and the Science Team monitor Science. Shared collaborative book studies are undertaken and the Science Team monitor teaching and learning by observing lessons across the whole school. These ensure whole-school consistency. Furthermore, the Science Team speak to children about what helps them to learn during Science lessons, which aspects of Science that they particularly enjoy and we can work together to improve Science at Newcomen.

Home School Partnership

Newcomen Primary School is a family school with a strong sense of identify and tradition. Our school is embedded deeply within the community and parents and carers are very supportive; their opinions are welcomed and acted upon reflecting an honest and genuine home school partnership. At the beginning of each academic year, all parents and carers receive a laminated Year Group Curriculum Overview detailing information about the curriculum. This explains the curriculum in detail. The 'Science Curriculum Map' is also available on our website for our parents and carers to refer to. Annually, parents and carers are provided with booklet produced by the Science Team which provides up-to-date information about Newcomen's approach to teaching, learning and assessment in Science.



Science at school and at home is regularly celebrated on the @NewcomenPS Twitter feed. It is with such joy that snapshots of learning are shared with our families and celebrated for our children. On a termly basis, scientific vocabulary is the theme of our Head Teacher's Celebration Assembly and children relish the opportunity to confidently demonstrate their knowledge in front of their peers. World Science Day is celebrated on an annual basis and focuses on inspirational scientists from a range of cultures, races and backgrounds.

Impact

Assessments are undertaken in line with our school assessment policy. Teachers use effective assessment for learning to ensure planning is based on prior attainment and that pupils know what needs to be done to achieve the next steps.

Cumulative Quizzing

Throughout each module, pupils continually revisit previous content in order to articulate what has been retained in their long-term memory and misconceptions are addressed immediately. A low-stakes cumulative quiz is undertaken by pupils at the beginning of each Science lesson which empowers them to celebrate what they have remembered and understand what needs to be reinforced. At the end of each module, pupils undertake a final quiz (recorded into Science books in Year One, an oral multiple-choice quiz in Year Two and into Science books in Key Stage Two) to check their understanding and knowledge aiming for at least 80% retention by most pupils. Children love to celebrate their successes! In addition to assessing knowledge, scientific enquiry skills are also assessed.

Pupil Book Study

Senior leaders and subject leaders regularly undertake book studies to monitor the effectiveness of teaching and learning. This includes sessions with small groups of pupils using questioning to check and ensure information and knowledge is acquired and understood with increasing confidence. Feedback is given to teaching staff to inform future planning.

Ongoing Teacher Assessment

Teachers assess pupils throughout each session to monitor pupils and inform planning for subsequent sessions. Pupils, who are identified as needing support, will work with an adult post-teaching or during the following Science session as appropriate. Pupils working at above expected standard will also be identified and challenged appropriately to extend their learning.

Consultations and Open Afternoon

Consultations with parents and carers take place each term and an annual written report is given in the last term of the school year. Open afternoons occur on a termly basis where parents and carers are invited into school to celebrate and enjoy children's work in books and the learning environment. Parents and carers are warmly welcomed into school and actively encouraged to contact school should the need ever arise. Teachers also contact parents/carers to discuss the progress of a child and to celebrate achievement.