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SCIENCE at Hayes: Subject Story

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The Hayes Curriculum Vision Statement

At Hayes, we strive for our children to push beyond any perceived idea of potential, to be all they can be, regardless of background. Our vision is for all of our children to leave us as good human beings- happy, kind and responsible. Our curriculum is integral in shaping the children to become independent and life-long learners. Our curriculum aims to equip our children with the ability to 'think' in order to make sense of an ever-changing world. The breadth our curriculum provides is underpinned by thinking. This thinking will allow our children to make sense of the world around them and before them in order that they can live fulfilling and happy lives, being all they can be.

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Intent: Science

Our intention at Hayes is is about developing children's ideas and ways of working that enable them to make sense of the world. Through building up a body of key foundational knowledge and concepts, children are encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. All children are encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes through investigation and in addition, using and applying process skills and thinking creatively.

The National Curriculum for Science aims to ensure that children:

- 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.

How does Science at Hayes School reflect our school's setting?

- We believe that a broad and balanced science education is the entitlement of all children, regardless of ethnic origin, gender, class, aptitude or disability:
- Hayes School is the neighbour of Paignton Zoo - we have close links with the zoo and the education staff who work there through our whole school Autumn 2021 Conservation Learning Experience and Y6's Palm Oil project, Summer 2021. These supportive environmental conditions foster strong relationships and community. These include positive sustained relationships that foster attachment and emotional connections; physical, emotional, and identity safety; and a sense of belonging and purpose.
- Productive science teaching and learning strategies that support motivation, competence, and self-directed learning beginning with Forest School in the EYFS. These curriculum, teaching, and assessment strategies feature well-scaffolded instruction and ongoing formative assessment that support conceptual understanding, take the children's ' prior knowledge and experiences into account, and provide the right amount of challenge and support on relevant and engaging learning tasks;

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Intent: Science

Our Science Curriculum at Hayes is designed to ensure:

- Sufficient curriculum time is allocated for pupils to embed what they have learned in long-term memory through extensive practice before moving on to new content.
- The component knowledge pupils need in order to read, write, represent and talk science is identified and sequenced.
- Curriculum plans consider how component knowledge introduced at one point in time influences future learning. This ensures that knowledge builds incrementally from pupils' prior knowledge and so pupils' misconceptions are less likely.
- The curriculum anticipates where pupils are likely to hold misconceptions. These are explicitly addressed, and pupils learn how the misconception is different to the scientific idea.
- Pupils know when and why models and rules can be used in science, which includes knowing what they can and cannot be used for.

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Implementation: Science

Implementation

The teaching of science will be implemented through the development of the following key headings as outlined below:

- **substantive and disciplinary**
- **conceptual and procedural**
- **discovery learning (enquiry-based teaching approaches and scientific enquiry in a real world context)**

*Substantive and disciplinary knowledge are the knowledge statements in the National Curriculum and disciplinary knowledge refers to the working scientifically statements.

*Conceptual elements of the science curriculum are the areas that the children need to understand and procedural elements of the science curriculum are the skills that the children need to be able to do, preferably in a cross-curricular context as defined below:

https://www.primary-science.co.uk/post/unpicking-the-vocabulary-of-ofsted-s-review

	Substantive National Curriculum knowledge statements	**Disciplinary** National Curriculum working scientifically statements
Conceptual Things pupils need to understand	Knowledge statements	Working scientifically statements that **cannot** be performed without conceptual knowledge
Procedural Things pupils need to be able to do	Knowledge statements that involve procedures that **cannot** be performed without conceptual knowledge	Working scientifically statements that involve procedures that are generic and **can** be performed without conceptual knowledge

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Implementation: Science

Implementation

What could this look like in a Science lesson?

https://www.primary-science.co.uk/post/unpicking-the-vocabulary-of-ofsted-s-review

	Substantive National Curriculum knowledge statements	**Disciplinary** National Curriculum working scientifically statements
Conceptual Things pupils need to understand	Knowledge statements from National Curriculum in England	• Asking scientific questions • Planning an enquiry • Observing closely • Drawing conclusions • Making predictions • Evaluating an enquiry
Procedural Things pupils need to be able to do	• Circuit diagrams • Light ray diagrams • Labelled diagrams • Venn diagrams • Carroll diagrams • Separating mixtures • Making circuit • Planting seeds • Food chains • Life-cycle diagrams • Changing the pitch of an instrument • Changing the size of a shadow • Changing the shape of an object	• Taking measurements • Gathering and recording results • Presenting results • Interpreting results

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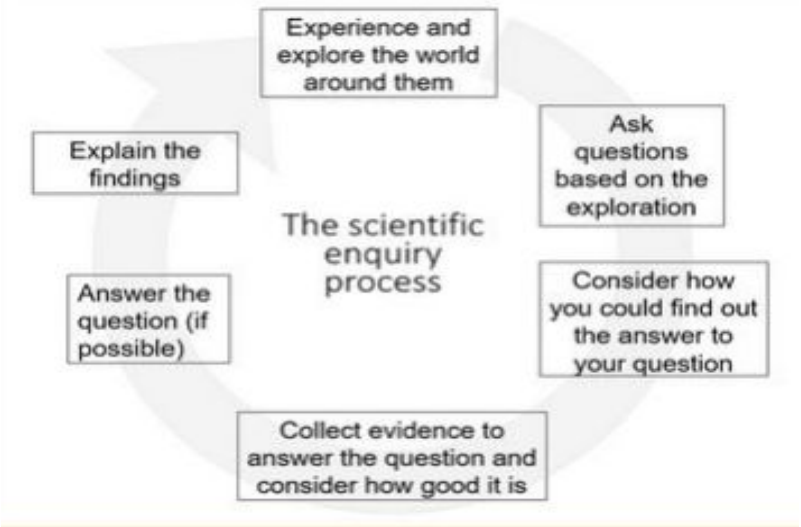
PRACTICAL WORK

Must have a clear purpose and the children need to know what this is…



https://www.primary-science.co.uk/post/what-does-it-say-about-practical-work-in-primary-science

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Implementation: Science

Discovery learning - children are given practical activities to introduce them to scientific equipment, objects and phenomena, such as air resistance, dissolving and melting, making a light bulb work, making shadows or observing living things in their habitats, BEFORE they are taught the substantive conceptual knowledge. The substantive conceptual knowledge needs to be taught explicitly and BEFORE the children undertake scientific enquiry.

Scientific enquiry - involves pupils using previously learnt substantive and disciplinary knowledge together to answer specific scientific questions using the scientific enquiry types as set out in the National Curriculum. Scientific enquiry can be scaffolded or independent.

Science is taught through our topics and the national curriculum objectives are linked to the topic. We plan using the **Hamilton Science lessons as our core teaching** for hands-on experiments, as well as utilising other STEM websites such as ASE, PLAN, PSTT, TAPS ASSESSMENT PROJECT to enhance scientific provision for all our children.
All year groups teach science twice a week with a focus being on one lesson for the investigation and the follow-up lesson for any relevant discussion or recording scientifically. Lessons are supported by science experiences offered via trips eg.visiting Paignton Zoo, local beaches and involving Torbay Coast and Countryside education.

Annual trips to our neighbouring secondary schools are arranged where appropriate and COVID allowing - our keen scientists are invited to experience the secondary school labs, we also join other schools for local science events e.g. Science Explorer Days at Torquay Boys Grammar School.

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Directed discovery learning

Using discovery learning as a way of finding out about scientific objects or phenomena.

For example, finding out about objects that dissolve in water. You cannot though assume children will understand what dissolving is just because they have made something dissolve. The discovery learning must be part of a sequence of teaching that includes the explicit teaching of the substantive knowledge.

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Directed discovery learning to teach disciplinary knowledge

For example, how to use a thermometer or how to group objects. To get the most out of scientific enquiries, children need to have the relevant skills. So learning how to use a thermometer whilst carrying out an enquiry will need yield the best results. Giving children time before the enquiry to learn how to use a thermometer will ensure they have the skills they need.

Images: PSTT (2019)

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Scientific enquiry: Our BIG questions!

The children should be using what they know (substantive and disciplinary) to answer questions. The children should experience all the different types of enquiry.

Images: PSTT (2019)

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Science teaching

"Evidence shows the importance of practice when learning science. Practice makes sure that learned knowledge is accessible and not forgotten."

It often feels as though there is insufficient time in school timetables for science. Wellcome's Understanding the 'state of the nation' report of UK primary science education in 2019 recommends two hours a week is required to cover the National Curriculum content in sufficient depth, but the average is just one hour 24 minutes a week.

1. We devote 2 hours of science per week in KS2 and 1 and a half hours of science per week in KS1.

2. Use cross curricular science opportunities for example outdoor learning.

3. Focus on the key learning that must be covered (see PLAN documents, KSV document). Where there are connections between topics or subjects, these are further opportunities for pupils to access their previously learned knowledge.

4. Vocabulary, addressing misconceptions, previous learning - especially possible gaps from lockdown, future learning - you don't need to teach them what they will learn the next time they come across this topic.

"Timetables must allocate appropriate teaching time to science, reflecting its status as a core subject in the national curriculum."

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Retrieval: Novice to expert learners

Nationally, there is lots of discussion about the differences between children who are novice learners and those who are experts (relative to their age group).
Children who become expert learners understand where the information and skills they have learnt fit within a bigger picture.
Example:

- Digestion - how the human body works and how we get nutrients into our body.
- What should they already know about it? (Remember PLAN progression document outlines this)
- What do they actually know about it?

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Retrieval: Novice to expert learners

Progression in knowledge

National Curriculum statements in red are from other linked topics.

Plants

Birth to three	• Explore natural materials, indoors and outside.
Nursery	• Use all their senses in hands-on exploration of natural materials. • Explore collections of materials with similar and/or different properties. • Plant seeds and care for growing plants. • Understand the key features of the life cycle of a plant and an animal. • Begin to understand the need to respect and care for the natural environment and all living things.
Reception	• Draw information from a simple map. (Reception – Living things and their habitats) • Explore the natural world around them. (Reception – Living things and their habitats) • Describe what they see, hear and feel whilst outside. (Reception – Living things and their habitats) • Recognise some environments that are different to the one in which they live. (Reception – Living things and their habitats) • Understand the effect of changing seasons on the natural world around them. (Reception – Seasonal changes)
Year 1	• 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.
Year 2	• 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. • Identify and name a variety of plants and animals in their habitats, including microhabitats. (Y2 - Living things and their habitats)
Year 3	• Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers. • Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant. • Investigate the way in which water is transported within plants. • Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.
Year 4	• Recognise that living things can be grouped in a variety of ways. (Y4 - Living things and their habitats) • Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment. (Y4 - Living things and their habitats) • Recognise that environments can change and that this can sometimes pose dangers to living things. (Y4 - Living things and their habitats)
Year 5	• Describe the life process of reproduction in some plants and animals. (Y5 - Living things and their habitats)
Year 6	• Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals. (Y6 - Living things and their habitats) • Give reasons for classifying plants and animals based on specific characteristics. (Y6 - Living things and their habitats)

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Retrieval: NOVICE TO EXPERT LEARNERS

Progression in working scientifically skills

This document shows how the working scientifically statements from the science National Curriculum for England are linked and built on across the three phases in Key Stage 1 and 2. To highlight the links, the working scientifically skills statements are grouped under the following broader skills definitions.

- Asking questions and recognising that they can be answered in different ways
- Making observations and taking measurements
- Engaging in practical enquiry to answer questions
- Recording and presenting evidence
- Answering questions and concluding
- Evaluating and raising further questions and predictions
- Communicating their findings.

The working scientifically statements from the science National Curriculum for England are presented in bold. The bullet points that follow each statement are additional guidance that clarifies the expectations.

Working scientifically statements that feature in more than one of the broader skills definitions are shown in italics.

In the EYFS, the characteristics of effective learning from the Statutory Framework for the Early Years Foundation Stage are the foundations on which the working scientifically skills build in Key Stage 1. While children are playing and exploring, teachers should be modelling, encouraging and supporting them to do the following:

- show curiosity and ask questions
- make observations using their senses and simple equipment
- make direct comparisons
- use equipment to measure
- record their observations by drawing, taking photographs, using sorting rings or boxes and, in Reception, on simple tick sheets
- use their observations to help them to answer their questions
- talk about what they are doing and have found out
- identify, sort and group.

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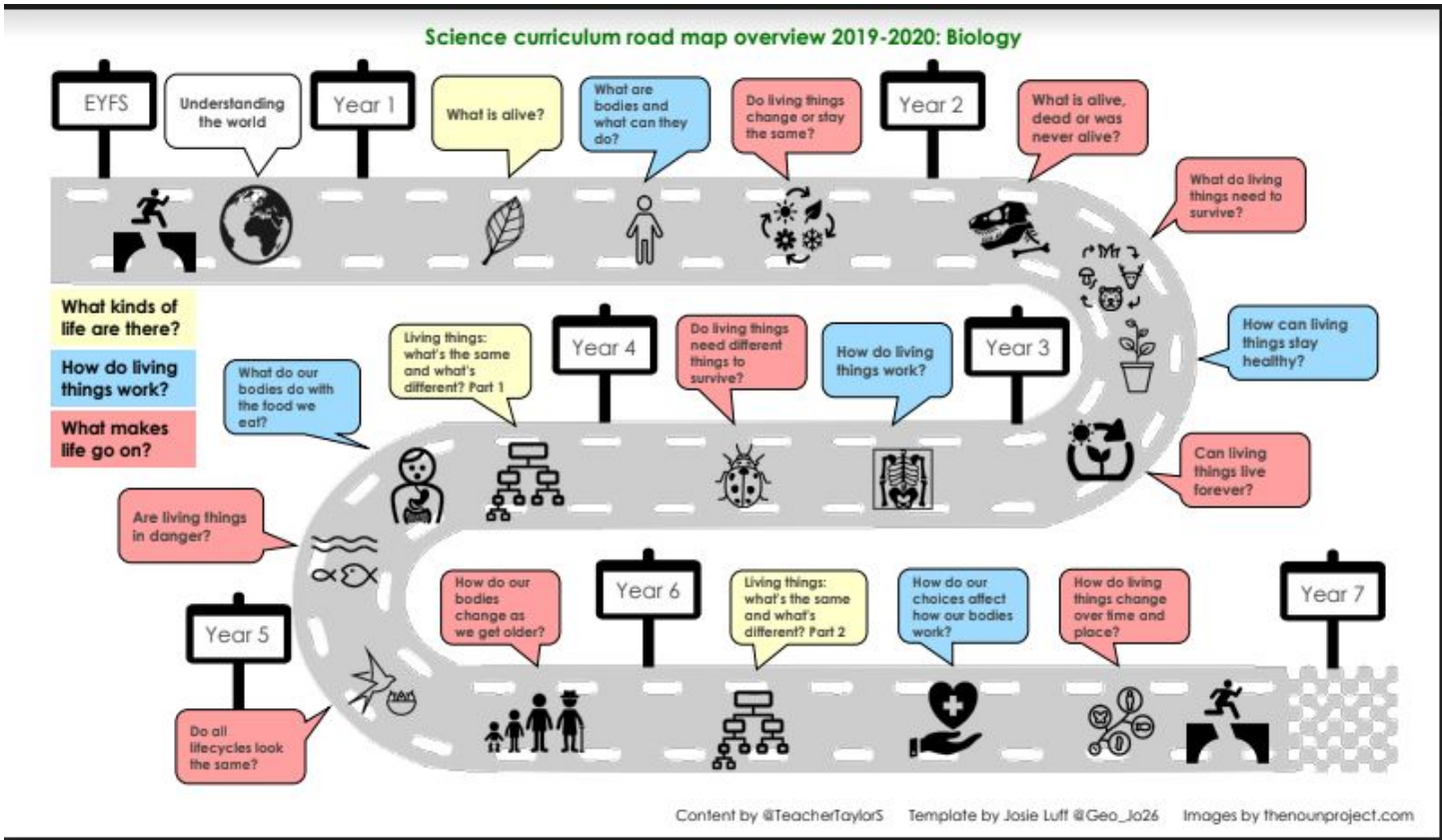
BIG QUESTIONS: BIOLOGY 2019 - 20



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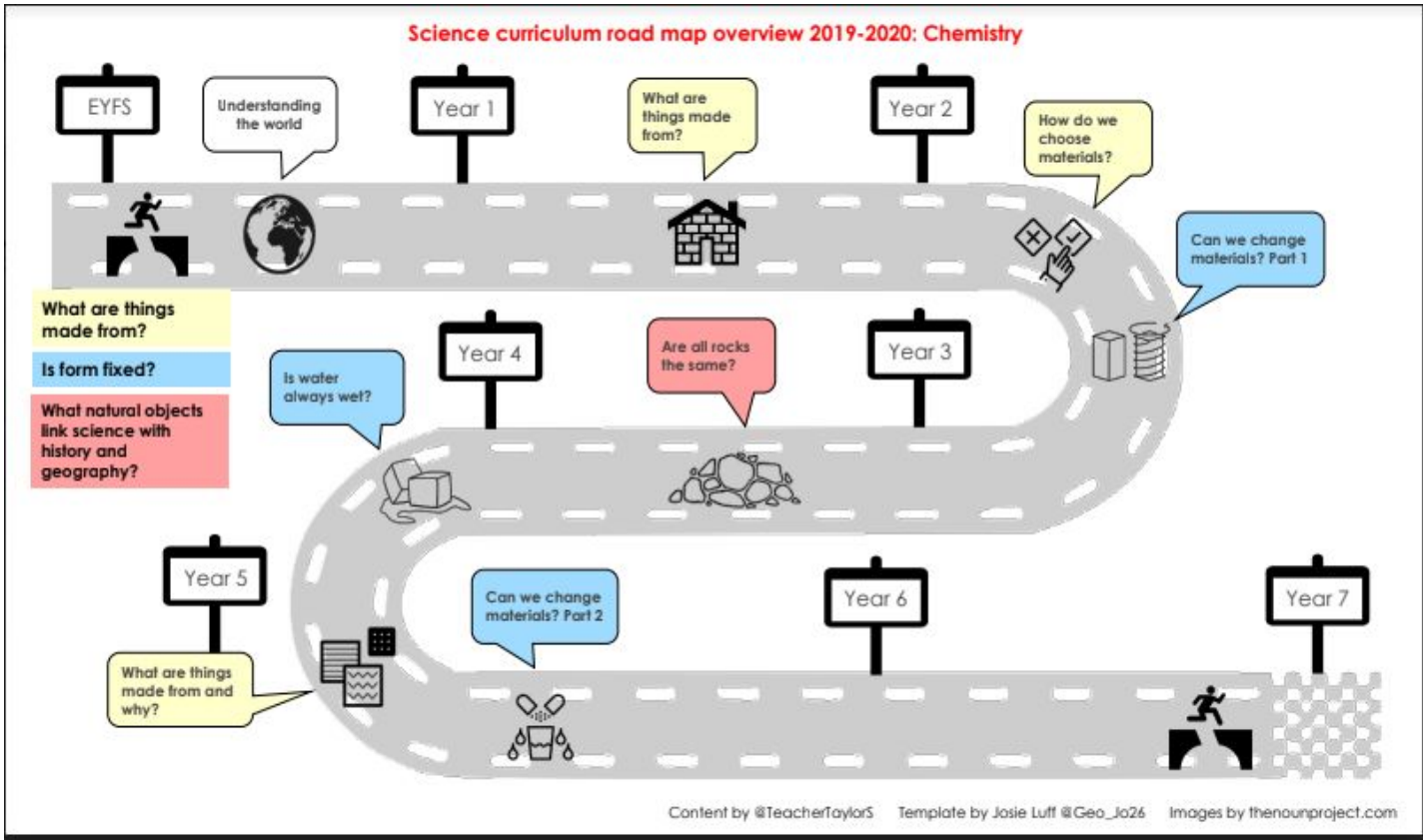
BIG QUESTIONS: CHEMISTRY 2019 - 20



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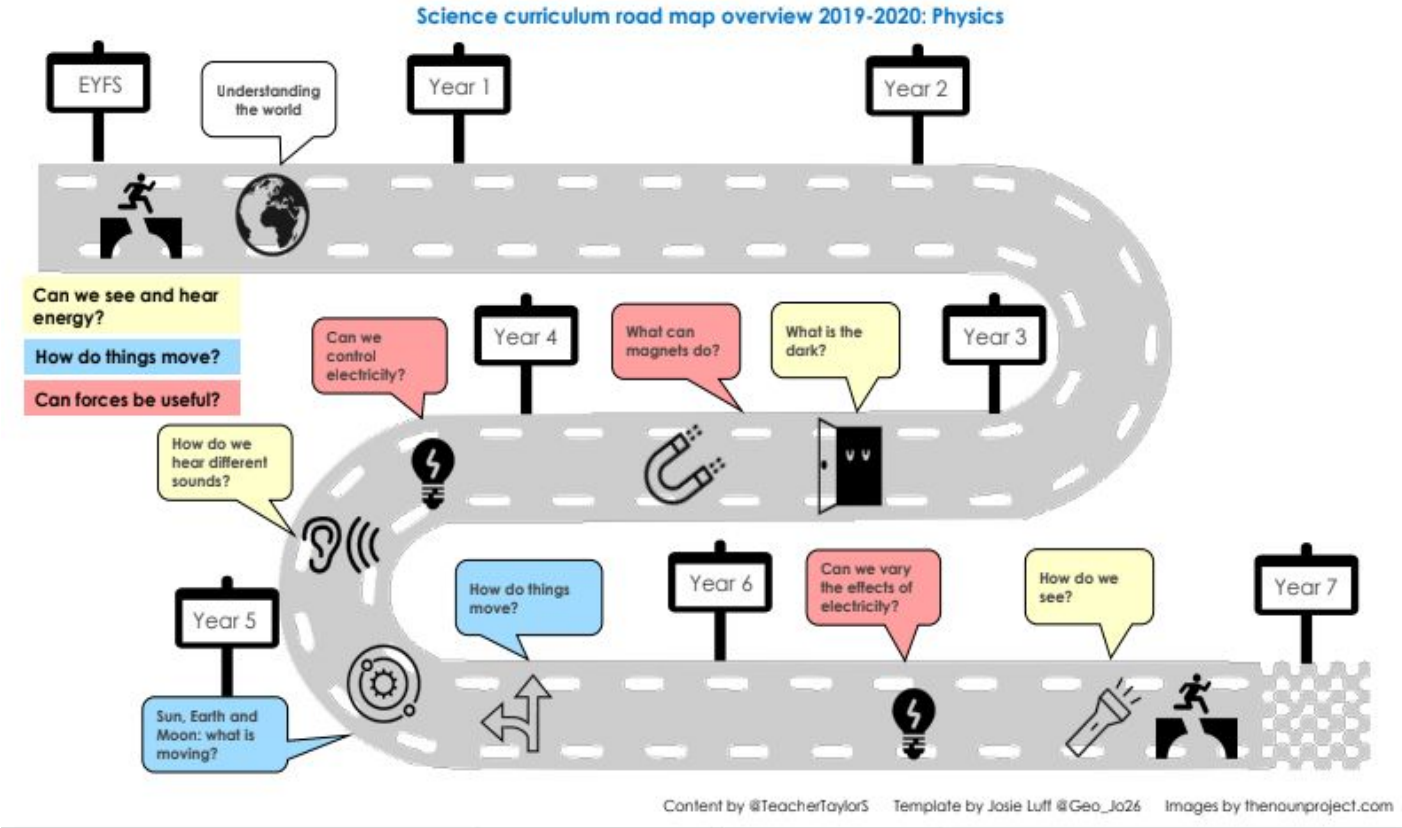
BIG QUESTIONS: PHYSICS 2019 - 20



Implementation: Science

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Science Knowledge Tracker: Whole School

SCIENCE: KNOWLEDGE TRACKER

N									
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS	SEASONS	MATERIALS	FORCES				
	DM- Plant, seeds and life cycles of plants	DM- Observations of animals and life cycles		DM- Characteristics of liquids & solids Exploration of natural materials.	DM -Explore forces.				
Year R									
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS	MATERIALS	SEASONS	LIGHT	FORCES		SOUND	ROCKS AND EVOLUTION
	DM-Explore Natural World	DM - Natural processes	DM -Senses and observations in the natural world	DM- Seasonal change to the natural world	DM- Shadows, light-natural world	DM- Floating, Magnetism-natural world.		DM - Vibration-natural world	
Year 1									
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS	MATERIALS	SEASONS/EARTH					
	NC: Plants Hamilton: What's growing in our gardens?	NC: Animals including humans. Hamilton: Healthy Animals	NC: Everyday Materials Hamilton: Let's Build Marvellous Materials	NC: Seasonal change Hamilton: Wonderful weather					

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Science Knowledge Tracker: Whole School

Year 2										
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS	MATERIALS							
	NC: Plants Hamilton: Ready, steady, grow! Habitats Garden and Allotments	NC: Animals, including humans Hamilton: Healthy Animals	NC: Use of Everyday Materials Hamilton: Materials Matter Squash, bend, twist, stretch							

Year 3									
	PLANTS, LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS INCLUDING HUMANS			LIGHT	FORCES			ROCKS/EVOLUTION
	NC: Plants Hamilton: Roots and Shoots Artful flowers, fruits and seeds	NC: Animals, including humans. Hamilton: Keeping Healthy			NC: Light Hamilton: Light and Shadows	NC: Forces and Magnets Hamilton: Amazing magnets			NC: Rocks Hamilton: Rocks and Fossils

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Science Knowledge Tracker: Whole School

Year 4									
	PLANTS, LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS INCLUDING HUMANS	MATERIALS				SOUND	ELECTRICITY	
	NC: Living things in their habitats Hamilton: Name that living thing! Help our habitats!	NC: Animals, including humans. Hamilton: Are these your teeth?	NC: States of matter Hamilton: States of matter Scientists				NC: Sound Hamilton: Listen Up!	NC: Electricity and circuits, conductors and insulators Hamilton: It's electric	
Year 5									
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS	MATERIALS	SEASONS/EARTH AND SPACE		FORCES			
	NC: Living things in their habitats Hamilton: The art of living	NC: Animals, including humans Hamilton: Life Explorers	Hamilton: Properties and changes of materials Hamilton: Music Festival Materials Changing Materials	NC: Earth and Space Hamilton: Space presenters		NC: Forces Hamilton: May the forces be with you			
Year 6									
	PLANTS/ LIVING THINGS IN THEIR ENVIRONMENT	ANIMALS, INCLUDING HUMANS		LIGHT				ELECTRICITY	ROCKS/ EVOLUTION
	NC: Living things in their habitats Hamilton: Classification connoisseurs	NC: Animals, including humans. Hamilton: The art of being human		NC: Light travel Hamilton: Crime Lab investigation				NC: Electricity Hamilton: Electric celebrations	NC: Evolution and inheritance Hamilton: The game of survival

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Science Knowledge Organiser: Y3 example

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Year 3 Science Knowledge Organiser: Animals including humans

Vocabulary dozen	
Nutrition	Food and nourishment necessary for growth
Carnivore	An animal that feeds on other animals
Herbivore	An animal that feeds on plants
Omnivore	An animal that feeds on other animals and plants
skeleton	An internal or external framework of bone, cartilage, or other rigid material supporting or containing the body of an animal or plant.
bones	Any of the pieces of hard whitish tissue making up the skeleton in humans and other vertebrates.
muscles	A band or bundle of fibrous tissue in a human or animal body that has the ability to contract, producing movement in or maintaining the position of parts of the body.
support	Bear all or part of the weight of; hold up.
protect	Keep safe from harm or injury.
movement	An act of moving.
spine	A series of vertebrae extending from the skull to the small of the back, enclosing the spinal cord and providing support for the thorax and abdomen; the backbone.
joints	A structure in the human or animal body at which two parts of the skeleton are fitted together.

Objectives

Sticky Knowledge:

•By the end of this unit of work, children will be able to:

- Identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat.
- Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Overview of Animals including Human

This unit focuses on the importance of nutrition. Children will be introduced to the main body parts associated with the skeleton and muscles, finding out how different parts of the body have special functions.

The children in Y3 will devote part of this study to our whole school Zoo Conservation project by focusing on some of the creatures that live in our local rivers/sea.

Children will work scientifically by: identifying and grouping animals with and without skeletons and observing and comparing their movement; exploring ideas about what would happen if humans did not have skeletons. Children will compare and contrast the diets of different animals and decide ways of grouping them according to what they eat. They will research different food groups and how they keep us healthy and design meals based on what they find out as an extension challenge

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Science: Knowledge, Skills and Vocabulary progression exemplars

Science progression of knowledge, skills and vocabulary

EYFS	CHARACTERISTICS OF EFFECTIVE LEARNING	ELGS
ENQUIRY SKILLS	Show curiosity about objects, events and people Questions why things happen Engage in open ended activity Take a risk, engage in new experiences and learn by trial and error Find ways to solve problems, find new ways to do things, test their ideas Develop ideas of grouping, sequences, cause and effect Comments and asks questions about aspects of their familiar world such as the place where they live or the natural world Use senses to explore the world around them Make links and notice patterns in their experiences Create simple representations of events, people and objects Build up vocabulary that reflects the breadth of their experiences.	Choose the resources they need for their chosen activities Handle equipment and tools effectively Answer how and why questions about their experiences Make observations Develop their own narratives and explanations by connecting ideas or events Explain why some things occur and talk about changes
KNOWLEDGE AND UNDERSANDING OF THE WORLD	Know about the similarities and differences in relation to places, objects, materials and living things They talk about the features of their own immediate environment and how environments might vary from one to another They make observations of animals and plants and explain why some things occur and talk about changes.	

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Science: Knowledge, Skills and Vocabulary progression exemplars

Areas of Study	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
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	Understand that animals, including humans, have offspring which grow into adults 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	Identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat identify that humans and some other animals have skeletons and muscles for support, protection and movement	Describe the simple functions of the basic parts of the digestive system in humans. Identify the different types of teeth in humans and their simple functions. Construct and interpret a variety of food chains, identifying producers, predators and prey.	Describe the changes as humans develop to old age.	Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood. Recognise the impact of diet, exercise, drugs and lifestyle on the way bodies function. Describe the ways in which nutrients and water are transported within animals, including humans. - (see also Evolution and inheritance)
Vocabulary	Body, head, neck, arms, elbows, legs, knees, face, ears, eyes, eyebrows, eyelashes, nose, hair, mouth, teeth, tongue, feet, toes, fingers, nails, ankle, calf, thigh, hips, waist, trunk, chest, shoulders, back, hands, wrist, tail, wing, claw, fin, scales, feathers, fur, beak, senses, hearing, seeing, touching, smelling, tasting, smooth, bright, dim, loud, quiet, high, low	offspring, life cycles, grow, change, adults, basic needs, water, food, air survival, exercise, food types (fruit and veg, bread, rice, pasta, milk, dairy, foods high in fat and sugar, meat, fish, eggs, beans), hygiene	Nutrition, food types, carbohydrates, protein, vitamins and minerals, fat, sugar, fruits and veg, dietary fibre, water, balanced diet, skeleton, muscles, support, protection, movement, names of bones, vertebrate, invertebrate	Digestive system, nutrition, mouth, teeth, canine, incisor, molar, pre-molar, saliva, tongue, rip, tear, chew, grind, cut, oesophagus (gullet), stomach, small intestine, large intestine, rectum, anus, carnivore, herbivore, omnivore, producer, consumer, predator, prey, food chain		Circulatory system, heart, blood, blood vessels, pumps, oxygen, carbon dioxide, lungs, nutrients, water, diet, exercise, drugs, lifestyle, evolution, suited/suitable, adapted, adaptation, offspring, reproduction, variation, inherit, inheritance, fossils

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Knowledge and skills progression: Hamilton Science

Science | KS1 & KS2 | Lesson Plans & Resources | Hamilton Trust

Hamilton Science

Hamilton's science scheme uses hands-on investigative science activities to promote a deep understanding of scientific concepts and help children develop effective methods of scientific enquiry.

Here at Hayes Hamilton's science planning forms the basis of our science planning, although we enhance its provision by utilising wider science resources from ASE, PSTT, STEM, PLAN for example. Hamilton is arranged to take advantage of seasonal study opportunities and to ensure progression in scientific working skills, while covering the National Curriculum for England. Each year is comprised of 6 blocks of 6 sessions dedicated to one of the science areas and culminating in a meaningful outcome. Opportunities for children to meet the full range of scientific investigative approaches entail pattern seeking, exploring, problem solving, fair testing and analysing secondary sources.

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Impact of our Science provision

If you walked in on a Hayes Science lesson, you would see:

- ***Engaging investigations**
- ***Children asking open-ended questions**
- ***Children proving/disproving hypotheses**
- ***An understanding and respect of the natural world around them**
- ***A clear understanding of what a fair test is and the children will be able to explain an example of what this could look like**
- ***Collaborative and child-led learning**

<u>Our destination as Scientists at Hayes will be:</u>

This will include being a reflection of our school values where applicable:

- All children will demonstrate positive attitudes to all aspects of science
- Our children will be naturally curious, having developed a scientific approach to problems
- Hayes Scientists will be open-minded, persevere and take responsibility, whilst being independent and able to self-assess. Children will be aware of their own progression in skills and knowledge
- Scientific communication will take place in a variety of contexts promoting the skills of reading, writing, speaking and listening.
- Children will have developed confident communication and social skills through varied learning styles including partnerships and small mixed ability groups, in addition to whole class thinking, discussion and debates.
- Children will be confident enough to challenge their own thinking and that of others, whilst being respectful of the work of other scientists.
- As a whole school we will have provided children with an enjoyable experience of science, so that they will develop a deep and lasting interest and may be motivated to study science further.

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The Hayes Values

Our six values are embedded in all areas of school life and in our Science provision.

Responsibility
Success
Aspirations
Resilience
Discovery
Friendship

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Removing the barriers to the Science Curriculum for Hayes children

Science and SEND children 4 key support tools:

- Use of scaffolds to structure learning and to help with recording of ideas, results and conclusions.
- Using ELF:ELF as a method of peer support for reading and to help with mathematical ability - mixed ability pairings
- Use of vocabulary triangles, word banks and content specific vocabulary displayed on the Science working wall. Pre-teach key vocabulary, then ensure multiple and regular exposure to these words.
- Use of ISPs to ensure work is closely matched to need.

REDUCING RELIANCE ON MEMORY:

- Using a digital camera to capture each stage of an investigation or important findings can be used to build a visual record.
- Keep instructions short and use visual prompts e.g. lists, diagrams. Break tasks into manageable steps and check student knows what to do.

CHILDREN WHO FACE MATHEMATICAL DIFFICULTY:

- Provide templates to help drawing tables and graphs.
- Allow extra time to complete tasks 'with numbers'.
- Use concrete apparatus to help e.g. number lines.
- Check mathematical language is understood.

CHILDREN WHO STRUGGLE WITH ATTENTION:

- Create a working classroom environment that is calming and simple e.g. clear routines, organised workspace.
- Use preferential seating and proximity to engage all learners – have learners who struggle to concentrate at the front of the class.
- Plan movement breaks and classroom jobs e.g. handing out materials.

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Removing the barriers to the Science Curriculum for Hayes children

CHILDREN WHO STRUGGLE WITH CHANGE AND TRANSITION:

- Science doesn't always follow the same lesson format and structure, so prepare learners in advance by explaining how the lesson will run.
- Use visual timetables to segment the lesson into manageable chunks that are achievable for the learner.

VISUAL PROMPTS:

- Use visual prompts to support the pupil's learning, for example:
- pictorial task cards
- writing frames give the student the starting point to build on.
- word mats to keep relevant vocabulary close at hand.
- relevant classroom displays (working walls)

WORKING FOR PUPIL INDEPENDENCE:

- providing plenty of opportunity for pupil participation:
- scaffold questions to build confidence •
- give pupils time to process and talk
- make explicit links to previous learning
- ensure that pupils are familiar with the range of resources they need to use
- Provide hand-outs
- instructions on the board
- Provide templates with headings to help individuals work through an activity
- Keep groups of apparatus together to save time and minimise movement.
- Consider setting up apparatus before pupils arrive.
- Pupils with significant motor difficulties may benefit from adapted apparatus
- A digital camera is useful for recording investigations in progress and an individual's contribution to a paired/group activity

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National Context: EYFS Science OFSTED REVIEW 2021

Science begins in the Early Years

“Pupils begin their formal science education in the early years foundation stage (EYFS). This involves learning foundational knowledge primarily through the ‘understanding the world: the natural world area of learning. This provides a number of rich contexts for pupils to learn a wide range of vocabulary. These words form the beginnings of scientific concepts that will be built on in Year 1 and beyond. Because pupils develop their scientific and non-scientific vocabulary during this time, the EYFS should not just be considered as preparation for learning further science in Year 1.” (Ofsted, 2021)

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National Context: Science OFSTED REVIEW 2021

High-quality science education may have the following features:

- **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.**

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National Context: Science OFSTED REVIEW 2021

Other Ofsted recommendations:

- Teachers, teaching assistants and technicians should have access to high-quality subject-specific CPD to develop subject knowledge and pedagogical content knowledge. This is aligned to the curriculum.
- In primary schools, there is at least one teacher who specialises in teaching science and science leaders have dedicated leadership time.
- Pupils have access to sufficient practical resources to take part in demanding practical work, either independently or in appropriately sized groups that enable first-hand experiences.

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National Context: Science OFSTED RESEARCH SUMMARY 2023

ACKNOWLEDGEMENTS TO @mrmarchayes FOR THE SUMMARY OF OFSTED'S RECENT REPORT OVER THE FOLLOWING SLIDES:

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Develop Key Concepts Over Time

The curriculum should provide opportunities for pupils to build knowledge about both substantive and disciplinary content over time. This means that pupils will grow their schema about concepts such as 'habitats', 'forces' and 'variables'.

Curriculum Time

Leaders should ensure that science has enough curriculum time. This is important because content needs to be secured before pupils move on, and too much content within a lesson is likely to lead to cognitive overload.

Practical Work

Practical work is an important aspect of school science though more common in primary than secondary. It is most effective when it is used with a clear purpose and focuses pupils' thinking on the scientific content of the lesson. When pupils conduct practical work, it can increase their cognitive load.

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Practise and Consolidation

Opportunities for pupils to practise their learning and to consolidate their understanding need to be planned into the curriculum. Teachers should avoid teaching for coverage and should ensure pupils are secure with the intended content of the curriculum.

The Curriculum as a Path

Curriculum content should be sequenced so that pupils can build on prior knowledge, including content from other subjects such as mathematics and geography. Links between areas of the curriculum should be made explicit to children.

Disciplinary Knowledge

The components of scientific disciplinary knowledge should be considered in the same detail as those for substantive concepts. It is also important for this content to be sequenced so that pupils develop their understanding over time and so that disciplinary knowledge is taught with the same rigour as substantive concepts.

Making Science Easier to Learn

The curriculum should be planned in a way which makes science easier to learn. This includes considering what knowledge is required at each stage and how misconceptions can be addressed and avoided.

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Reception and EYFS

The Reception curriculum should detail the content that pupils will learn. This should identify the component knowledge to achieve the high level outcomes of the EYFS. Once the content has been identified, learning is supported through purposeful activities and high-quality language-rich pupil-adult interactions.

Reception and Year 1 Transition

The curricula of these two stages should dovetail. Detailing the Reception curriculum will support pupils in achieving the knowledge they need to be successful with the Year 1 content.

KS2 - KS3 Transition

Secondary teachers should not assume that pupils lack knowledge from primary school. This can lead to unnecessary repetition and reduce the amount of teaching time for the content of the KS3 curriculum. The primary curriculum should ensure that knowledge is secure so that the concepts can be further built upon at KS3 and beyond.

Learning Activities

Activities which require pupils to think about the specific content of the lesson are the most effective ones to choose. Lesson time should be used to focus pupils' thinking on what they should learn and remember.

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Misconceptions

Curriculum planning should detail the misconceptions pupils are likely to have about scientific concepts so they can be appropriately addressed. The curriculum should also ensure that misconceptions are not created by considering how knowledge is introduced.

Retrieval Practice

This is an effective way of checking component knowledge but should go beyond just testing recall of isolated facts. Retrieval practice should be used to check children can apply their previously learnt knowledge. It is only effective, however, when learning is secure. Otherwise, it can reinforce misconceptions, especially if corrective feedback is not provided.

Teacher Explanations

Clear teacher explanations are more effective when they build on pupils' prior learning and link it to the new content being introduced. They are even more effective when they link the new content to other areas of the curriculum so that pupils can be enabled to appreciate these connections.

Models

Using models to demonstrate scientific concepts can be effective. However, they should be used with caution as they can sometimes create misconceptions.

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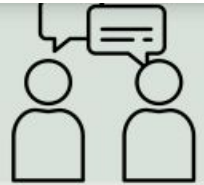
Vocabulary

Pupils should have ample opportunity to repeatedly practise the vocabulary related to the curriculum content. Where there is lots of vocabulary to acquire, it is useful for teachers to identify the key words which pupils will need within each lesson.



Curriculum Development

Curricula should be seen as provisional so that they can be continuously refined and improved in response to pupil learning. Evaluation of the curriculum intent, implementation and impact can be used to make appropriate improvements to school curricula.

Subject Leadership

Subject leaders play a vital role in improving education across school. Science leaders need time and support to ensure that they can focus on the quality of education. Access to CPD and wider networks can increase their expertise, which then leads to improvements across school.

Assessment

Teachers should check that content has been learned and remembered, including content from previous years. It is important to assess that pupils can apply their knowledge in a range of contexts. Summative assessessment should not be overused but should also inform curriculum development.

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Feedback should focus on what makes a strong response or on how pupils can improve by focusing on the specific scientific content. It is important that adequate time be provided to give feedback which addresses misconceptions.

Pupils with SEND

The curriculum should not be narrowed for pupils with SEND. Appropriate pacing and scaffolding can support pupils, as can providing additional support. It should not be assumed that pupils with SEND learn better with practical activities as this can often increase cognitive load and distract from the specific content of the curriculum.

CPD

Subject-specific CPD is an important part of improving education. It is important for teachers, especially non-specialists, to receive CPD for substantive concepts as well as for disciplinary knowledge.

What Pupils Remember

Pupils often fail to remember previously learned content. They are usually only likely to remember what has previously been taught. This means that prior learning should be revisited frequently to prevent content from being forgotten.

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SCIENCE RESEARCH SUMMARY FOR PRIMARY LEADERS AND TEACHERS

(Based on Ofsted's Report)

Children begin their formal science learning in **EYFS**. This time should be used to develop a broad **scientific vocabulary** and provide experiences of the phenomena children will learn about later in primary.

Teaching and learning in science is most effective when it is broken into **small**, manageable **chunks**. This avoids overloading **working memory**, and allows children to understand key components to support their conceptual development.

Working scientifically should be considered as **disciplinary knowledge** about how scientists work and learn. This knowledge contains the what, why, when, where and why of working scientifically skills.

Teachers should identify the best opportunities to teach **disciplinary knowledge** alongside the **substantive knowledge** of the curriculum. This may involve knowledge of how ideas have changed over time e.g. evolution.

Science is **hard** for pupils to learn because a lot of science contradicts the observations we make in every day life. This means that **misconceptions** are rife and can be enforceable. Only when pupils develop a strong understanding can some misconceptions be ready to address. ..

Pupils do not **transfer** their learning from one context to another that easily. Each time a scientific skill is being used, modelling, explanation and feedback are necessary to lead children to success .

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Although **practical work** is often enjoyable, this is not a justification in itself for it to be used. Rather, practical work should be used purposefully in line with curricular goals..

Teacher demonstration is also an equally valuable tool, and can actually be more effective due to the way it can increase working memory capacity for children.

Explanations make a critical difference to the quality of teaching, and are often reliant on excellent subject knowledge. Leaders should prioritise developing teachers' subject expertise to improve teaching and learning.

Retrieval practice in science is effective in preventing children from forgetting what they have learned. It is most useful when it is used so that children remember their learning in a way which reinforces their conceptual understanding.

The **sequencing** of the curriculum is **incredibly important**, and time needs to be appropriately attributed to each of the components existing in the curriculum. An ad-hoc approach to topics does not support learning in a way that careful planning and sequencing can achieve.

Enquiry-based learning - which is different to the scientific enquiries which the National Curriculum stipulates children learn - has variable outcomes in its effectiveness. Ofsted suggest that **teacher-directed instruction** can lead to **higher quality** learning

Language development is strongly associated with achievement in science. This means that every opportunity should be taken where children can not only develop in English, but also learn the language of science through stories, texts, songs, rhymes and poems. Repeated exposures to such texts can help children acquire new information with each reading or recital, thus building their knowledge base and understanding.

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Retrieval: Novice to expert learners

Can the children connect knowledge from previous themes/ years together?

Nursery children investigating cause and effect using Coke and Mentos….Y4 children apply their understanding to investigate how gases work during their study of ‘States of Matter.’

[redacted]

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

“How I imagine a Scientist to be…..”

Elodie, Y1

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

"I liked it when we made the Playdough here in class and watched it change from nothing to dough." Bodhi, Nursery

"Henry learnt so much about the planets, he was so excited for each planet! Henry took on his own learning. He brought in books about the planets from home to share with us." Henry, Nursery

"His mum told us how excited he was to tell the family about the Mintos and Coke experiment." Alfie, Nursery

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Reception: Dinosaurs and Fossils. “We melted the eggs. The hot water was like lava it was boiling in the kettle. There is nothing I dislike about science because it is such fun!!!” Harry C

Y1: “I really liked finding out about why ice melts. It gets hot and turns into liquid and I liked being a solid, a liquid and a gas outside.” Levison.

“ I didn’t really like learning about minibeasts because I’m scared of spiders and bees.” James

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y2: “It’s fun when we do investigations. I like working in a team and sharing ideas, like when we built bridges.” Josh, Y2

“I liked the healthy animal session because we did lots of fun things. I liked the human life cycle and the desert island. I also liked the investigation when we put weights on the bridges to see if they were rigid or not. I didn’t like making the bridges with paper because ours kept breaking down.” Ellis, Y2

Y3: “I’d like to go outside when we’re doing it.” Elias, Y3

“I think we can do even more experiments!” Maverick, Y3

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y4: “I like to share science with my friends.” Patryk, Y4

“I feel happy about science and I love learning about animals.” Sophie, Y4

Y5: “I already like science just the way it is and it doesn’t need to be improved.” Kayla Y5

“I think they (science lessons) don’t need improving as they have taught me a lot already!” George, Y5

“I’d like more time explaining what we do, a little bit more diagrams/pictures and some more riddles!” Oscar, Y5

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y6: Summarise their science experiences throughout their time at Hayes School: “We have learned about the Water Cycle, our eyes, electricity and we have made circuits in Y4. One of my favourites was the eyes: we did an experiment where we closed our eyes for 30 seconds and looked at our partner. When we opened them, our pupils had shrunk. We have also learned the different areas of our eyes including the cornea, which protects our eyes from dust, the retina which is at the back of your eye, your pupil which increases and decreases the light and the retina which receives the visual information. When you see an image it is upside down, but your brain flips it. When we made the circuit in Year 4, it was really fun because I could work with my friends. We always do lots of experiments in science. If we could add something to science it would be more equipment.” Logan Y6

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y6: Summarise their science experiences throughout their time at Hayes School:

"The science lessons I have experienced so far in my primary school life have been really interesting because when you are taught science, the teacher teaching the lesson will expand on the facts so it really sticks in your brain. So far, all of the lessons have been really fun and in some of them we get to draw; whereas in others we get to make a version of the learning activity ourselves which is very exciting…Some examples of lessons I can remember are: electricity, circuits, gravity, forces, human digestive system, eyes, heart, lungs, and light and shadows. Overall, I believe that from my experience, primary science lessons are incredibly fun…
Poppy, Y6

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y6: Summarise their science experiences throughout their time at Hayes School:

“During lockdown some of the science was fine because I could do the learning at home but some topics were harder because it was hard to do the electricity investigations at home as we don’t have the batteries and wires like we do in school. I enjoy finding out what happens and how things work so science is my favourite subject to learn about. I don’t feel like lockdown stopped me from learning science but it made it less fun.” Crocodiles, Y6

Implementation: Science

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HAYES PUPIL VOICE 2021 - 22

What is SCIENCE? The following are quotes and opinions on Science lessons at Hayes!

Y6: Summarise their science experiences throughout their time at Hayes School:

“I do enjoy science but I wish we could do more experiments instead of just one. I feel like when we were in lockdown I didn’t enjoy science as much because we couldn’t do investigations as we did not have the stuff at home. My favourite topic in science is the human body and I enjoyed taking part in the digestion one when we pushed food through tights!” Crocodiles, Y6

Implementation: Science

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ELF: Empowering Learners Through Feedback

'The most powerful single modification that enhances achievement is feedback.' (John Hattie)

Through effective assessment and feedback, we aim to raise attainment and accelerate progress for all pupils, helping them to 'be all they can be'.

At Hayes, we have developed 'ELF' : Empowering Learners Through Feedback.

ELF YOURSELF - Improve your own learning using a success criteria or similar.

ELF: ELF - Improve a peer's learning through peer feedback.

ELF HELP - Feedback from an adult to improve learning.

Implementation: Science

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ELF: Empowering Learners Through Feedback

'The most powerful single modification that enhances achievement is feedback.' (John Hattie)

Implementation: Science

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Retrieval: Maintaining a Healthy Body - Nursery and Y2

Impact: Science Nursery have been learning how to keep ourselves healthy investigating how to keep our hands free from germs and why it is important to brush our teeth! Y2 have introduced a purposeful ‘healthy’ Playtime PE to ensure our bodies keep fit!

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Retrieval: Y1 and Y2 investigating materials:

Y2 Lighthouses

Impact: Science Y1 read the story of 'The Three Little Pigs' in their science lesson. To extend their learning about materials, the children made the three houses from the story and evaluated the effectiveness of each. As the introduction to their learning experience on The Storm Whale, Y2 researched lighthouses and their uses, created plans and then chose materials to create a free standing structure.

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Retrieval: Plants - Reception to Y3

Impact: Science Reception enjoyed their visit to Forest School on 25.3.22. They looked for changes in the environment and drew pictures of their observations. Y3 have been investigating how bean plants grow and change over a period of time by keeping a Bean Diary and creating window greenhouses. Y3 have studied plants as part of their cross-curricular learning experience based on William Morris, Andy Goldsworthy and colour mixing.

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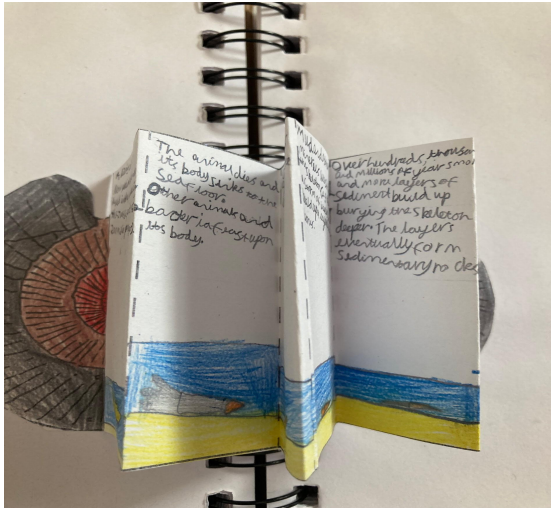
Retrieval: Dinosaurs to Fossils - Reception to Y3



Impact: Science Reception loved investigating dinosaur eggs and making different dinosaur skeletons and labelling body parts. Y3 build upon this knowledge during their study of rocks and soils investigating and classifying the different types of fossils! Y3 use their English skills to create mini fact books on fossils.

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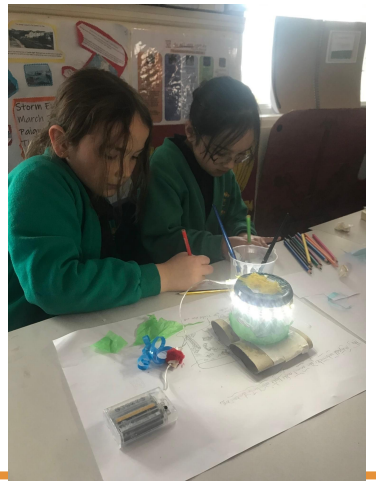
Retrieval - using and applying our understanding of electricity and materials: Y4 cross-curricular Science, Computing and DT project Spring 2022






Impact: Science The children had to work in pairs to design a night-light for a toddler. They constructed their designs using a variety of materials. The children also took part in a computer programming lesson learning how to control their light switches on and off.

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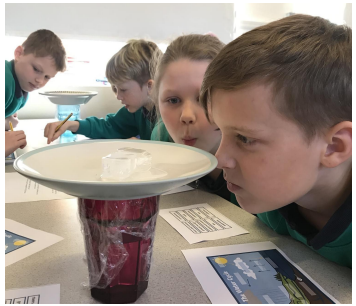
Retrieval: States of Matter - Reception to Y4:



<u>Impact: Science</u> Reception are enjoying playing with their new water station to see which way the water travels down the pipes! Y4 have observed how warm water evaporates inside a glass. The water vapour rises until reaching the top of the glass, where vapour cools and condenses back into water as a result of the ice cold plate. Y4 enjoyed creating their mini water cycle!

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Cross-curricular Science: Coding and sending messages to the International Space Station!

Y5 Coding - messages to the International Space Station!

Impact: Science Y5 have been coding messages to the International Space Station, which will be read by the astronauts!

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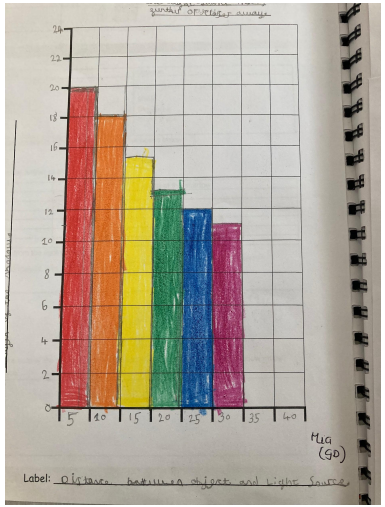
Retrieval: Light Y3 to Y6



Impact: Science Y3 investigate the spectrum and white light. Y3 used their maths skills to create bar charts to how far away an object is from the light source. Y6 further investigate how the distance that an object is from a light source affects its shadow size. Their next steps are to discuss whether their tests were fair and reliable and what they could do to improve their tests.

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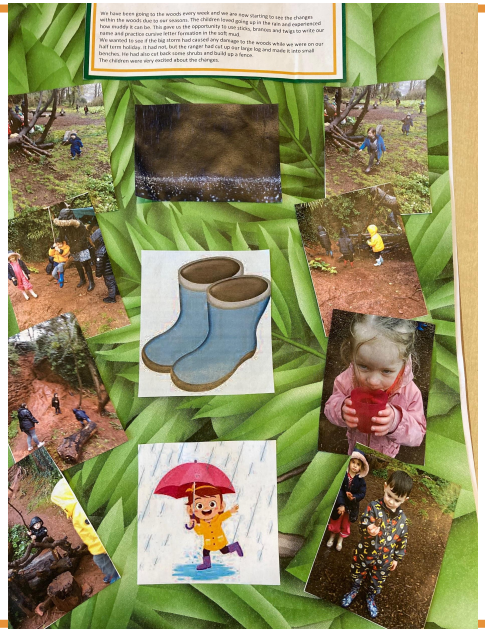
Investigation skills and knowledge: Nursery

"Nursery have been going to the woods every week
And we are now starting to see the changes within the
Woods due to our seasons. Nursery investigated whether the
'Big Storm,' had caused any damage to the woods, while they were
On holiday. It had not, but the ranger had cut up our large log and made it
Into smaller benches. He had also cut back some shrubs and built up a
Fence. The children were very excited about the changes! "



Impact: Science

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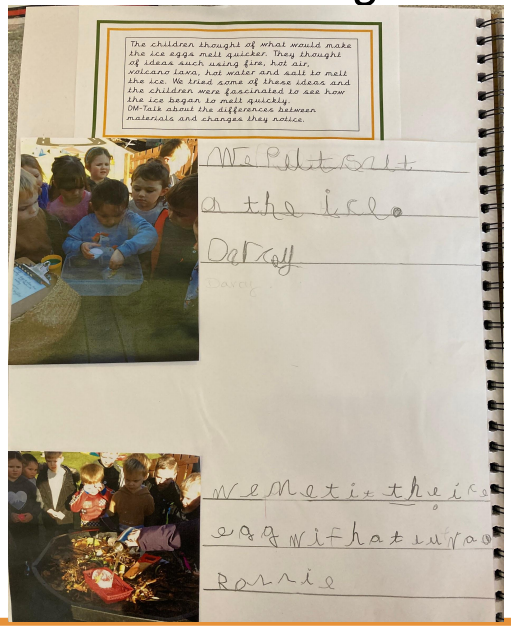
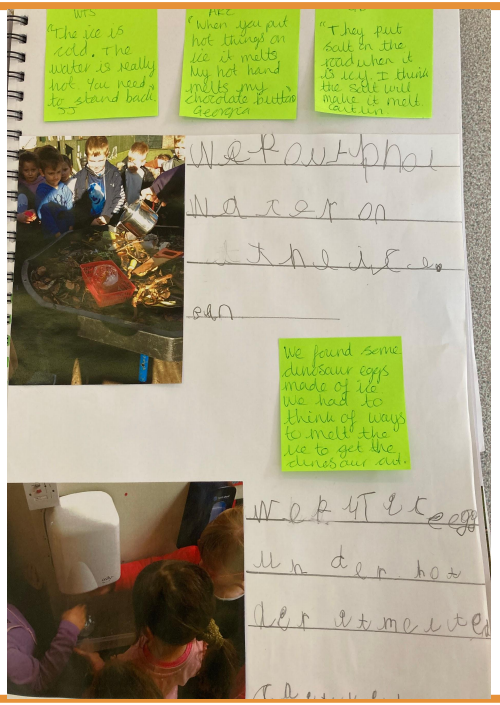
Investigation skills and knowledge: R





Impact: Science Reception investigated melting Dinosaur eggs. The children thought about what could make the ice melt quicker. The children thought about ideas such as using fire, hot air, volcano lava, hot water and salt to melt the ice. Some of their ideas were tried out and the children were fascinated to see how the ice began to melt quickly. DM - Talk about the differences between materials and the changes they notice.

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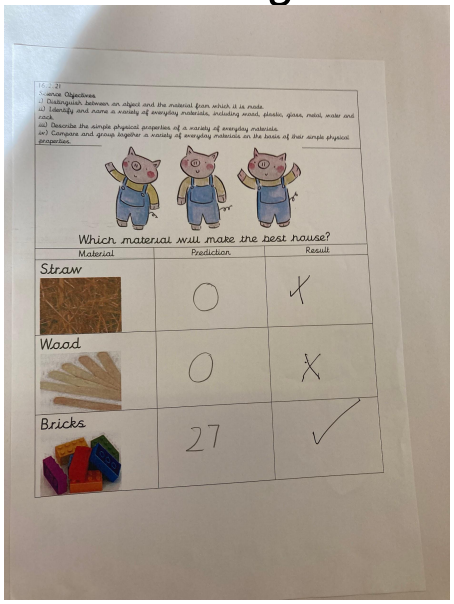
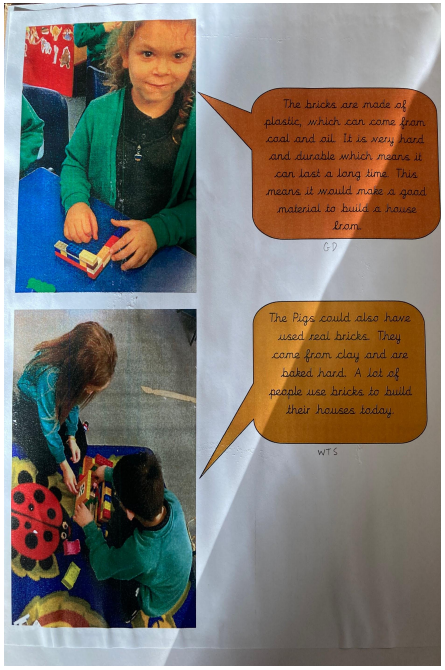
Investigation skills and knowledge: Y1





Impact: Science Y1 investigated everyday materials through the story of 'The Three Little Pigs and their building choices. Y1 listened to the story of The Three Little Pigs and in small groups recreate using straw, sticks and bricks. The children had to make predictions. Photographs were taken of their investigations!

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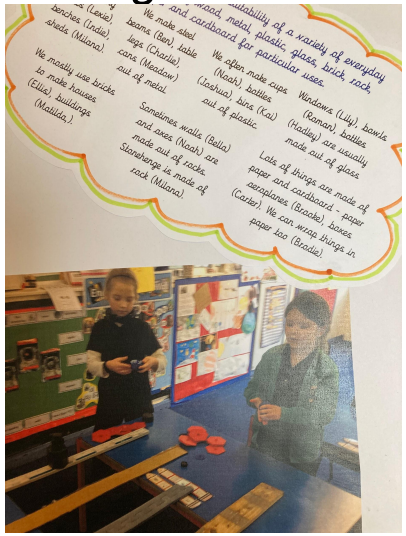
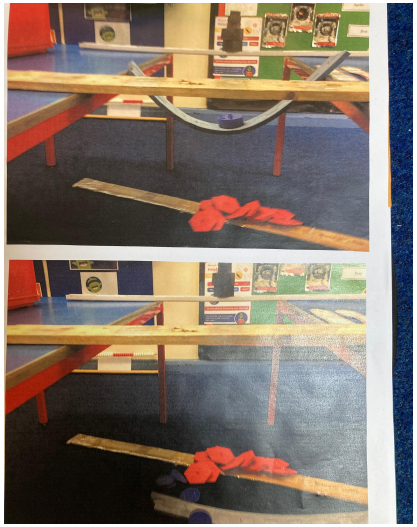
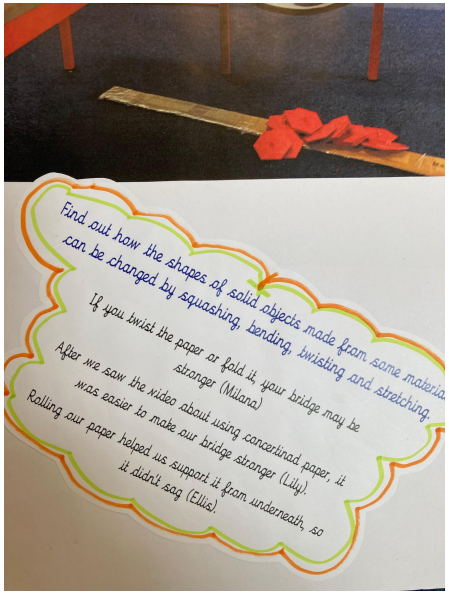
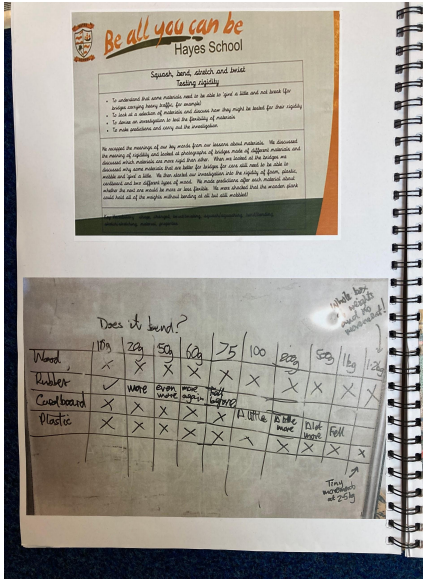
Investigation skills and knowledge: Y2









Impact: Science Y2 recapped the meanings of key scientific words from their lessons about materials. Y2 looked at bridges in a real life context and discussed why some materials that are better for bridges for cars still need to be able to wobble and give a little. Y2 predicted and investigated how rigid foam, plastic, cardboard and two different types of wood are. Y2 were shocked that the wooden planks could hold all the weight without bending but still wobbled!

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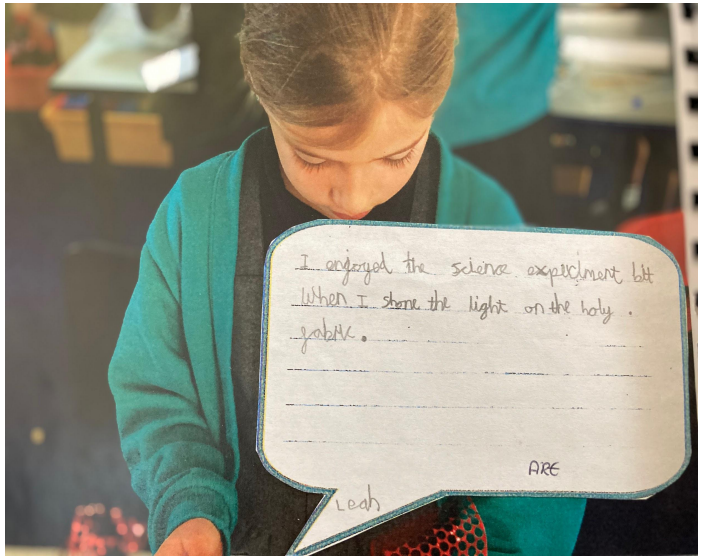
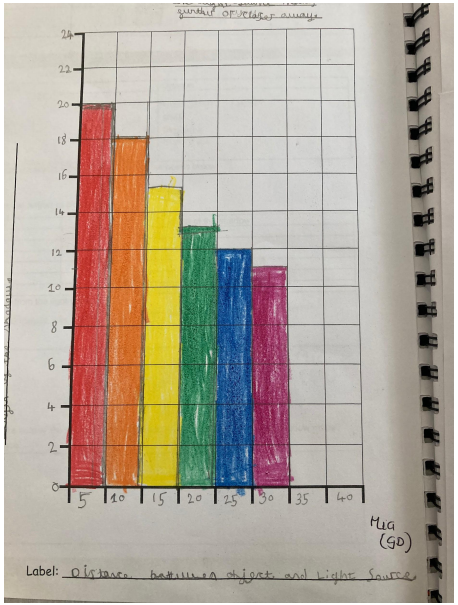
Investigation skills and knowledge: Y3





<u>Impact: Science</u> Y3 investigated which materials made the most effective shadows by shining a light source on a variety of surfaces and on different materials. Y3 discussed that the variable being changed was the materials and how to ensure this was a fair test by using the same type of light source in the same darkened environment. The children also investigated how shadows changed in size dependent upon the distance between an object and a light source. Using their maths skills, the children created a bar chart of their results.

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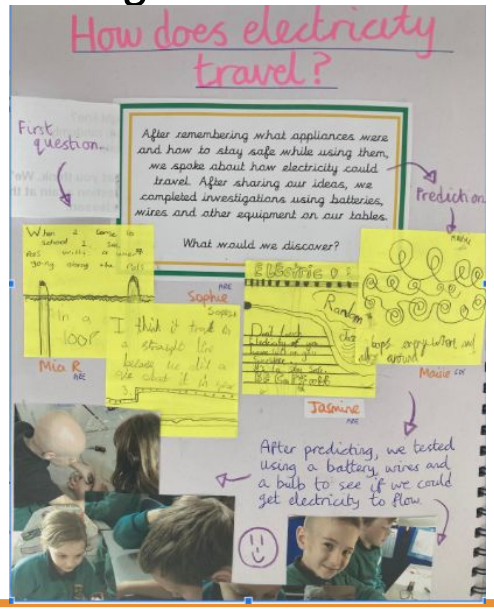
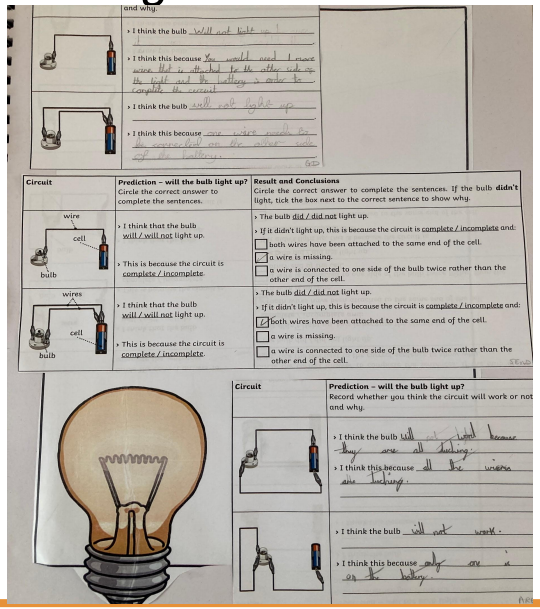
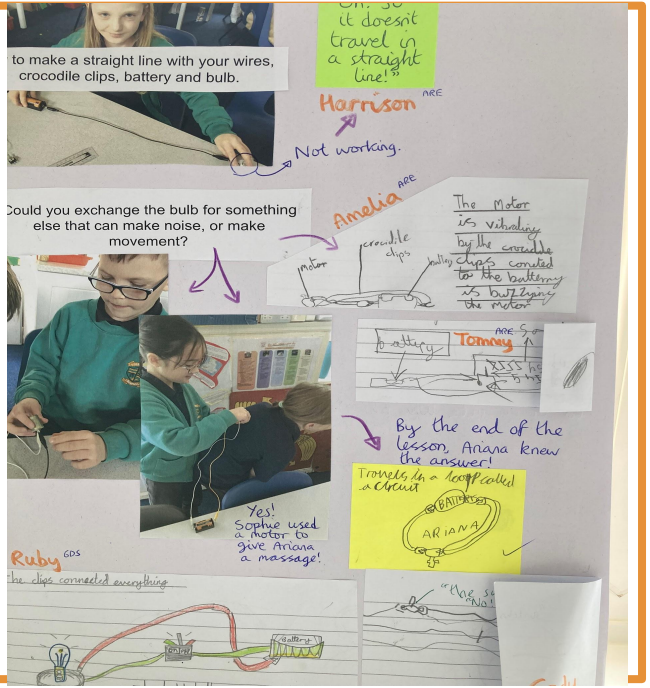
Investigation skills and knowledge: Y4







Impact: Science After revising what appliances are and how to stay safe while using them, Y4 discussed how electricity could travel. Y4 completed different investigations (after sharing their initial thoughts) using batteries, wires and other equipment at their table. The children used their observational skills and scientific diagrams to draw their conclusions.

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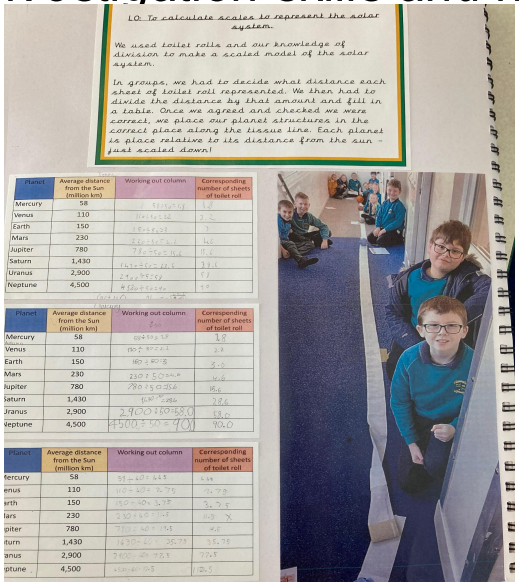
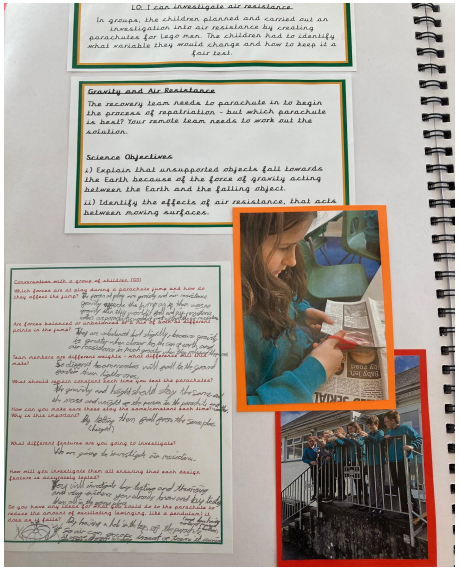
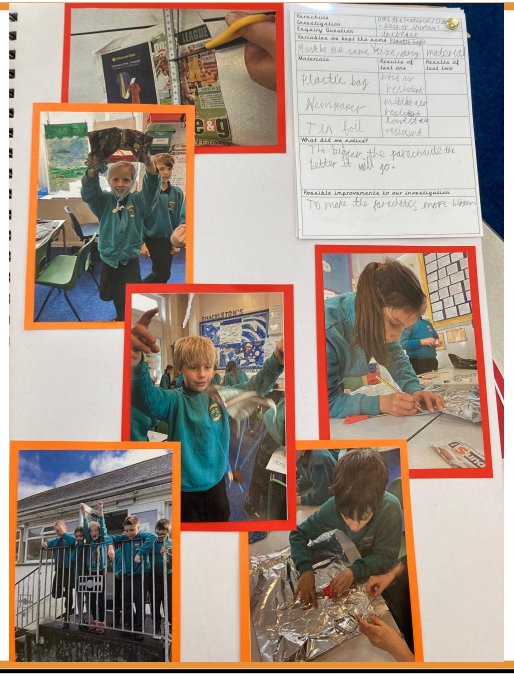
Investigation skills and knowledge: Y5







Impact: Science Y5 used their maths skills to calculate scales to represent the solar system. They used toilet rolls and their knowledge of division to make a scaled model of the solar system. Y5 also planned and carried out an investigation into air resistance by creating parachutes for Lego characters. The children had to identify what variable they would change and how to keep it a fair test.

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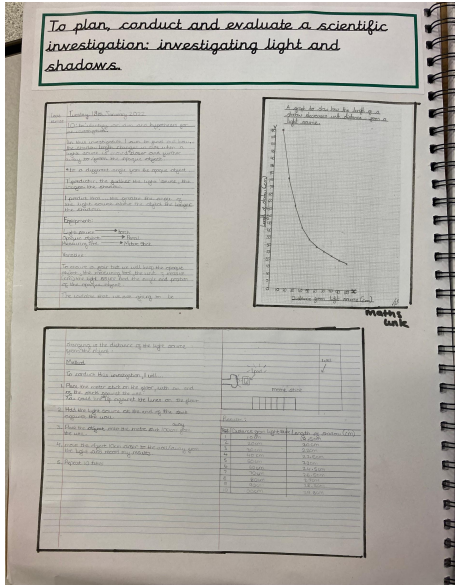
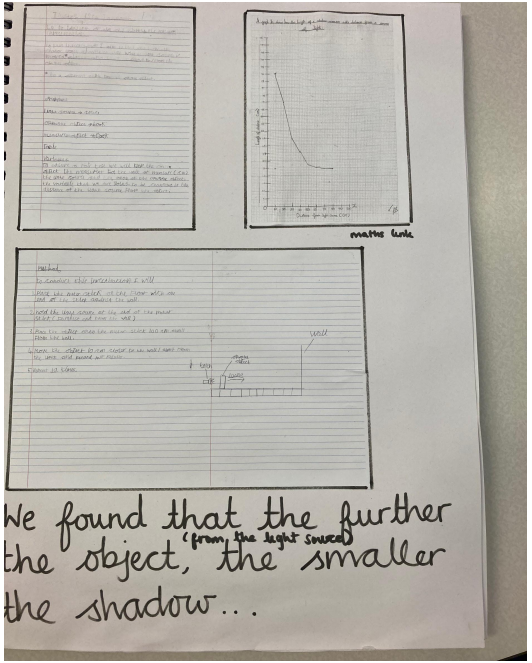
Investigation skills and knowledge: Y6





Impact: Science Y6 planned, conducted and evaluated a scientific investigation - investigating light and shadows. Y6 used their mathematical knowledge to present their data using accurate line graphs and tables.

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Frequently Asked Questions

What subject leaders need to know: (From the Key)

- Has the school made the objectives of their curriculum clear for your subject?
- Does the school's curriculum for your subject align with national policy and statutory requirements?
- How do you know your curriculum is working? Can you demonstrate how you know?
- Why is the curriculum right for the children in your school at this time?
- What are the strengths of your current subject curriculum?
- What are the areas of the curriculum that might need development?
- How effectively are curriculum policies and plans translated into practice?
- Is the same importance given to all foundation subjects?
- How is the curriculum delivered across each year group and across key stages, ensuring progress in skills, knowledge and understanding from different starting points?
- How is progress and attainment measured?
- How are pupils given opportunities to apply basic skills in your subject?
- Where is the evidence of pupils' SMSC development?

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Science CPD 2021 - present

Date	CPD
November 2021 - November 2022	NPQLTD teaching and learning modules, seminars and assessments.
September 2021 - present	Teach First ECT framework resources SWIFT ECF weekly newsletters
September 2021 - present	Science assessment, teaching and learning CPD modules and reading PSTT Bath Spa University
Tuesday 14th June 2022	Whole staff Science INSET - AFL and introduction of the KSV document for September 2022
January 2023	The National College Adapting provision for pupils with SEND

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Science CPD 2021 - present

Date	CPD
17.1.23	KS2: Feedback on book monitoring, Floor Book teaching and learning CPD module PSTT Bath Spa University