



Science

Subject leader handbook

“High-quality science teaching builds pupils’ curiosity and critical thinking, helping them to develop a coherent understanding of the world around them.”

Professor Becky Francis
CEO, Education Endowment Foundation (EEF): *Improving primary science*

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The privilege of curriculum design

One of the greatest privileges that can be gifted to teachers and leaders in schools is the responsibility for curriculum design. The role of the ‘designer’ is to ensure that the curriculum offered meets statutory expectations and is informed by the most recent research and good practice.

SUBJECT LEADER GUIDES

Through our individual guides for subject leaders, we aim to ensure that the basic foundations of effective curriculum design remain firm. However, we also aim to ensure that leaders remain focused on, and energised by, the absolute joy that accompanies crafting a curriculum that remains holistic, interconnected, rich in primary-focused best practice and rooted in Nature, community, hope, relevance and inspiration for both leaders and learners. If designed well, a curriculum will shape children’s views of themselves, their relationships with others and their contribution to the world in which they live for the better.

As primary educators, we have the unique privilege of igniting transformational beginnings that, with thought, determination and a relentless focus on the child that sits at the heart of our design, will amount to a far greater whole than the sum of separate, individual-subject curriculum parts.

‘If we are to live sustainably into the future, we need to learn in a new way.’

Richard Dunne
Founder and director of
The Harmony Project

The purpose behind curriculum design

Whilst the temptation to seek an ‘off the shelf’ approach to curriculum planning may be strong, we believe that a focus on the purpose behind curriculum design should always remain stronger.

DEFINING PURPOSE

At a time when many challenges exist in primary education, a focus on the ‘Why?’ that underpins the decisions that we make about the content of our teaching, learning and subject leadership can often take us to a stronger place. Being able to define the purpose in our curriculum choices is a vital step in ensuring that we are clear as curriculum leaders, and as a teaching team, that we are on a shared pathway and are focused on outcomes for the child.

Whilst our intention is not to offer an ‘off the shelf’ or ‘one size fits all’ solution to curriculum planning, we hope that through our curriculum handbooks and exemplar planning, we can offer opportunities for subject leaders to make relevant links and to refine the design process, with a specific shared goal in mind. Every school will have its own individual ethos, vision and values, and will seek to align the content of individual subjects and its primary provision as a whole with these ultimate goals. These goals will be unique, but we believe there are some common threads

that can be identified within a Harmony curriculum.

The evidence and effect of our curriculum design should be reflected in the knowledge, skills, thoughts and behaviours of the children that sit at the heart of it. We hope that children who experience a Harmony curriculum will experience a deeper understanding of truly living in harmony with themselves and with the world around them, and that through a deeper connection with – and understanding of – Nature as our teacher, they can learn to live in more sustainable ways.

The golden threads of a Harmony curriculum

We believe there are three distinctive threads that, when woven together, create a unique approach to curriculum design and play a unique role in shaping a child's future.

These threads are evident in all our planning and the resources that we provide to support teachers and subject leaders.



01

Sustainability and Nature at the heart of education

Through a Harmony curriculum, children have opportunities to learn about Nature, to learn in Nature and to learn from Nature.

LEARNING ABOUT NATURE

The statutory requirements of the National Curriculum set out the content that must inform children's **learning about Nature** – but, of course, their learning will extend beyond this.

LEARNING IN NATURE

Opportunities for purposeful outdoor learning (**learning in Nature**) are included in our planning in recognition of what we know about children's learning and where they learn best. These opportunities frequently reveal the learner within every child, a learner who may not have emerged within a busy classroom environment.

Our learning is underpinned by the latest research around cognitive science, but equally the emerging field of environmental neuroscience, which seeks to explore why, and how, our brains are so profoundly affected by being in Nature. There is growing evidence that exposure to Nature also benefits cognitive function – all the processes involved in gaining knowledge and understanding, including perception, memory, reasoning, judgement, imagination and problem-solving.

LEARNING FROM NATURE

At The Harmony Project, we recognise Nature as our greatest teacher when it comes to nurturing a growing understanding of sustainability for young children. To this end, we include a focus on **learning from Nature** as a key element that underpins our planning.

A focus on Nature and a recognition that we are part of Nature generates resilience, hope, awe and wonder and ultimately has an impact on the mental health and wellbeing of both children and staff. Through a focus on the principle of geometry and patterns in Nature, children are supported in recognising and engaging with the beauty that surrounds them in the natural world.

Learning from Nature also helps us to recognise where we may be going wrong and provides children with an insight into potential solutions and increasingly empowered roles as proactive agents of change.

02

Interconnected curriculum coherence

Through enquiry-based learning, we plan a curriculum that sparks curiosity, deeper thinking and motivation, and a genuine desire to embark on a journey of discovery.

CELEBRATING CONNECTIONS

Our enquiry questions are designed to build disciplinary knowledge incrementally but also to provide genuine relevance to children's lives and their futures, to enable them to learn from Nature and to support their growing understanding of how to live in more sustainable ways.

They are designed to celebrate connections with other areas of learning and to contribute to an interconnected 'whole'.

03

A curriculum underpinned by principles of Harmony

We believe that a curriculum should serve to develop the whole child (academically, personally, socially and emotionally), placing significant emphasis on personal development and the nurturing of global citizens.

SKILLS FOR LIFE AND CITIZENSHIP

Through each principle of Harmony, we offer:

- a summary of learning from Nature linked to this principle
- an overview of how understanding of the principle is developed progressively over time
- guidance on how this principle may become evident throughout primary practice in an effective Harmony school
- reflections on how this principle guides our 'way of being' and our positive contribution to an increasingly challenging world.

We believe that these principles nurture skills for life and citizenship and a transformative understanding of ourselves, our communities and our world.

'Research shows that the closer we get to Nature, the happier we are, the more worthwhile life seems, and the more we are willing to take action to help our wildlife and the environment. When we feel very close to Nature, we recognise ourselves as part of the natural world, and value our relationship with it. We notice Nature, seek it out and feel happy when we are in it.'

Professor Miles Richardson,
University of Derby
The Nature Connection Handbook



Nature's principles of Harmony – the 'ripples'

The intent of a Harmony curriculum is underpinned by Nature's principles of Harmony. These principles inform the content of our curriculum and our 'way of being' every day.

Through holistic curriculum design, underpinned by learning from Nature, we focus on developing awareness and understanding of these principles from four distinct perspectives.

Our visual representation of these 'ripples' within our curriculum planning reminds us of the importance of nurturing children's understanding of these principles through different lenses: intrapersonal ('me'), interpersonal ('my known community'), societal ('my wider community') and global ('my world').

Intrapersonal

What this principle means to me personally

Interpersonal

How this principle can be seen in my relationships with friends, family and familiar adults

Societal

How this principle can be seen within our wider communities

Global

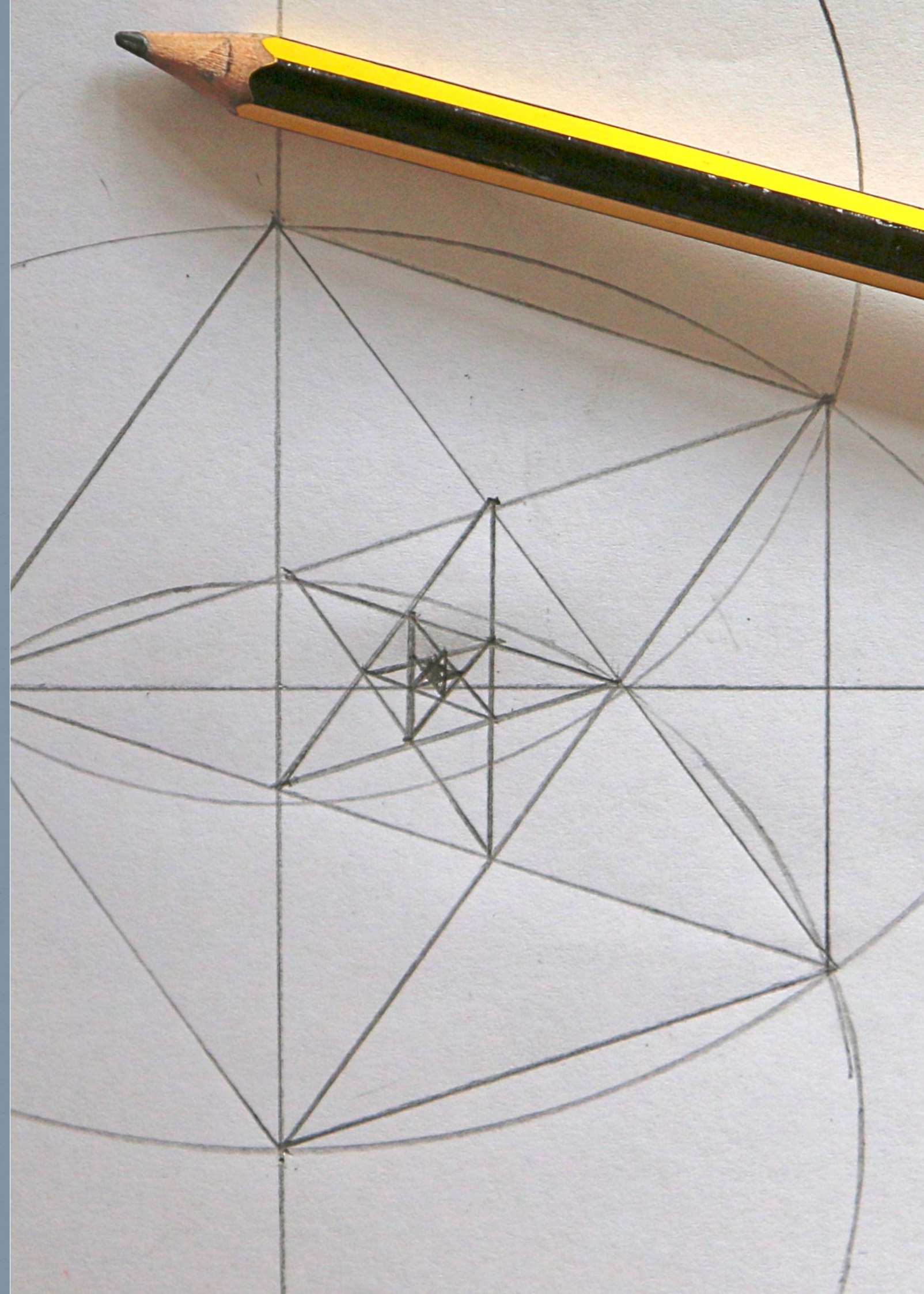
What this principle means and looks like in the wider world/natural environment

My world
My wider community
My known community
Me

Principles are introduced in a progressive way throughout a Harmony curriculum and an overview of learning relating to each principle can be found alongside our enquiry planning exemplification.

Learning from Nature by exploring principles of Harmony can also enrich a school's wider provision. Whenever opportunities arise to include Harmony principles in further discussions in lessons, assemblies, staff correspondence, newsletters, parent emails or posters around the school, for example, the image below can be used to promote a whole community dialogue and to remind us that we are part of a truly complex, interconnected and greater whole.

It is a whole that thrives when inner Harmony, Harmony in our relationships with others and Harmony within our environment and the wider world around us are secured.



The role of the science subject leader within a Harmony curriculum

We recognise that there will be a wealth of advice and guidance to steer your role as a science subject leader.

Within this guide, we are focusing specifically on supporting the role of the science subject leader within a school that has taken the decision to place sustainability and Nature at the heart of learning.

In order to build an effective science curriculum, the science leader will need to ensure that the science thread:

- Contributes to the coherent whole and overall Harmony curriculum purpose
- Matches the school's vision, strategy and intended outcomes for children
- Enables teachers to teach well and to understand the subject area, addressing areas such as sustainability, learning from Nature and climate change confidently
- Is planned and sequenced logically alongside other subjects and the curriculum whole
- Is designed to secure progress in science alongside children's understanding of how science can contribute to a deeper understanding of Harmony
- Contains relevant, engaging and motivational content, inspired by learning about, in and from Nature
- Is designed with children and context in mind, reflecting children's prior experience and the communities in which they live

Planning the science thread of a Harmony curriculum

In addition to the aims and purpose of study outlined in the National Curriculum, it is important to identify the purpose and aims that enable us to ensure that the sequence of learning contributes to the whole and genuinely brings a Harmony curriculum to life.

We believe in the importance of considering and outlining what we value in terms of teaching and learning when looking at a subject through a Harmony lens. For example, in our science planning:

Where are wider aspects of scientific discovery embedded in our curriculum?

How is the procedural complemented by the opportunity for scientific awe and wonder?

How can our understanding of science contribute to our understanding of sustainability and learning from Nature?

Throughout our planning, we aim to ensure that fidelity to our overall Harmony curriculum ethos remains strong whilst maintaining fidelity to the purposes and aims of individual subject disciplines. We need to be able to describe our subject with clarity and confidence by responding to questions such as:

What is science?

What is a scientist?

What is special about the way a scientist thinks and works?

In addition, through a Harmony curriculum we want to explore the application and implications of science in the wider world, presently and in the future, and to consider how science can contribute to a deeper understanding of Harmony.

Evidence-informed Harmony practice

In the tables on the next pages, we have highlighted the key components of effective science teaching as outlined in Ofsted's *Research review series: science (April 2021)* and taken into account the most recent findings from school inspections in *Finding the optimum: the science subject report (February 2023)* to both inform the planning of the science thread of a Harmony curriculum, and to ensure that our planning is tailored to maintain a relentless focus on our overall aims.



01

Curriculum progression: What it means to get better at science

High-quality science education may have the following features

- The curriculum is planned to build increasingly sophisticated knowledge of science.
- Disciplinary knowledge (identified in the ‘working scientifically’ sections of the National Curriculum) comprises knowledge of concepts as well as procedures.
- When pupils develop their disciplinary knowledge, they learn about the diverse ways that science generates and grows knowledge through scientific enquiry.
- The curriculum outlines how disciplinary knowledge advances over time and teaches pupils about the similarities and differences between each science.
- Pupils are not expected to acquire disciplinary knowledge simply as a by-product of taking part in practical activities. Disciplinary knowledge is taught.
- Scientific processes such as observation, classification or identifying variables are always taught in relation to specific substantive knowledge. They are not seen as generalisable skills.

Key features of the science elements of a Harmony curriculum

In planning the science elements of a Harmony curriculum, we use the following to craft individual lesson plans and activities:

- The National Curriculum
- Our defined purpose and aims of science teaching within a Harmony curriculum
- Identification of key principles and concepts
- Our planned and holistically sequenced core knowledge and skills for each year group (including both substantive and disciplinary knowledge)
- Identification of the knowledge and skills specific to each learning enquiry
- Opportunities for interconnectivity and complementary sequencing
- Our Great Works and other curriculum outcomes
- Our assessment model, including our Harmony-focused questions
- Opportunities for review and adaptation

The Harmony model is designed to develop rich schema, ensuring that we teach in a way that recognises how children learn best and that the elements of an effective primary curriculum are interconnected and interdependent.

Informed by the latest research into cognitive science, we aim to create a curriculum that enables children to truly flourish as well as learn, remember and do.

PROGRESSION OF CORE KNOWLEDGE AND SKILLS ACROSS YEAR GROUPS

The table below shows how an enquiry is planned within a sequence of learning, taking into account children’s prior knowledge, revisiting and building on this and laying firm foundations for future enquiries.

Over the next two pages you will see how we then plan for the component knowledge within this enquiry and how each lesson plan is designed to fulfil our overall curriculum aims.

	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
ENQUIRY	Understanding the world	Which is my favourite wildflower and why?	What can I discover about different plants?	How can we identify native trees in autumn?	What do different indigenous cultures teach us?	How can we restore our UK habitats back to health?	Where do we find beauty in Nature?
SUMMARY OF LEARNING	Children will be guided to increase their knowledge and sense of the ecologically diverse world around them. They will explore the natural world, describe what they see, hear and feel whilst outside, recognise some environments that are different from the one in which they live and understand the effect of changing seasons.	Children will learn to identify different types of flowers, including local wildflowers, and trees, including deciduous and evergreen trees. They will learn the different parts of a plant including leaves, flowers, fruit, seeds, roots, bulb, trunk, branches and stem.	Children learn about the needs of a plant including water, light and temperature. They will begin to describe how seeds and bulbs grow into mature plants.	Children develop their knowledge of the needs of plants to include healthy soil and nutrients. They will recap the structure of a plant and learn the function or job each part of the plant has. Children investigate how water travels around the plant.	Children explore and use classification keys to help group, identify and name a variety of plants and animals. They will learn about potential dangers to living things when environments change. Children learn about the role of plants as producers within a food chain.	Children explore how plants reproduce, including seed dispersal and pollination, and learn about photosynthesis in simple terms.	Children will continue their understanding of classifying plants according to common observable characteristics and based on similarities and differences. They will also give reasons for classifying plants based on specific characteristics.
KEY VOCABULARY	flower tree seed bulb leaf plant fruit seasons blossom petal	deciduous evergreen wildflower roots branches stem trunk nectar pollen	germination pollen pollination soil	flowering plant nutrients bark twig trunk seed dispersal	food chain producer environment ecosystem	photosynthesis reproduction	classification characteristics adaptation evolution

PROGRESSION OF CORE KNOWLEDGE
WITHIN AN ENQUIRY

Within the introduction to each set of lesson plans, you will find examples of how to develop children’s core knowlege within the scope of the enquiry.

Week 1	Week 2	Week 3
Is a tree a plant? How do we know?	What makes healthy soil? How does a plant grow?	How is water absorbed and transported through a plant?
Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers	Recognise that soils are made from rocks and organic matter	Investigate the way in which water is transported within plants
Week 4	Week 5	Week 6
Why are a tree’s leaves so important?	How do flowers become fruits?	What can we learn from an apple tree? How do trees work together?
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	Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal	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

PROGRESSION OF SKILLS: WORKING
SCIENTIFICALLY WITHIN AN ENQUIRY

Where possible, the development of children’s skills in working scientifically is nurtured through outdoor learning opportunities.

Week 1	Week 2	Week 3
Is a tree a plant? How do we know?	What makes healthy soil? How does a plant grow?	How is water absorbed and transported through a plant?
Recording findings using simple scientific language, drawings and labelled diagrams	Recognising that soils are made from rocks and organic matter	Using results to draw simple conclusions and suggest improvements, new questions and predictions for setting up further tests
Scientific enquiry type: Grouping and classifying	Scientific enquiry type: Identifying and classifying	Scientific enquiry type: Comparing and fair testing
Week 4	Week 5	Week 6
Why are a tree’s leaves so important?	How do flowers become fruits?	What can we learn from an apple tree? How do trees work together?
Asking relevant questions and using different types of scientific enquiries to answer them	Identifying differences, similarities or changes related to simple scientific ideas and processes	Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
Scientific enquiry type: Research	Scientific enquiry type: Identifying and classifying	Scientific enquiry type: Pattern seeking

- Working scientifically vocabulary
- observe
 - record
 - present
 - predict
 - measure

PROGRESSION OF UNDERSTANDING OF HARMONY PRINCIPLES

The sequence of learning enquiries linked to a principle of Harmony facilitates progression in children’s ability to understand, think and talk sustainably in relation to that principle.

	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
ENQUIRY	Children are introduced to opportunities to explore and develop their initial knowledge and understanding about cycles (when leaves fall from trees, when day turns to night, what we notice around us in each season, and life cycles)	Which is my favourite wildflower and why?	Why should we reduce, reuse and recycle?	How can we identify native trees in autumn?	What are the cycles of our solar system?	What journey does a river take from source to sea?	Where do migratory animals travel to and from and why?
PROGRESSION: CONCEPT OF THE CYCLE		What is the life cycle of a wild flowering plant?	What do I throw away and where does it go?	What is the life cycle of a tree?	How does our solar system work in cycles?	How does water work in cycles?	How is migration cyclical?
THINKING SUSTAINABLY		Why should we let wildflowers grow?	How can thinking in cycles help us to live more sustainably?	How do trees sustain themselves?	What are the benefits of solar energy?	How do our actions impact the water cycle?	Why is migration a cycle in Nature but not for humans?
THINKING SUSTAINABLY VOCABULARY	life cycle season pattern rhythm routine	growth rest cycle seeds habitat	waste recycle reuse reduce consume	abundance decline restore regenerate self-sustain decay	cyclical sustainable pollution fuel	responsibility finite resources solution replicate	agency impact circular economy conserve



LESSON PLAN EXAMPLE

Each lesson within an enquiry contributes to progression within the learning sequence.

Lesson

01

Enquiry question:

How can we identify native trees in autumn?

Harmony principle:

The principle of the Cycle

NO Links

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

Working scientifically: Record findings using simple scientific language, drawings and labelled diagrams

Science enquiry type: Identifying, grouping and classifying

Key vocabulary

Examples of key language for this lesson is in bold to show how vocabulary is used within the context of building knowledge around plants as well as working scientifically.

Preparation

Children will need to see real plants and trees for this lesson. If this is not possible within school grounds, this could be done through arranging a visit to a local gardens or garden centre or going on a local walk.

Prepare word cards with names of parts of tree and flowering plant and a description of their functions

Adapt the learning

Provide labels for the children to cut out, if appropriate. Challenge children to add their own description of each part of the tree to their diagrams.

Link the learning

MATHS: Provide children with the height of one of the trees that they can see and ask them to estimate the heights of the others using this information.

STEM SENTENCE: I estimate that this tree is _____ m because it is taller / shorter than _____.

What do we already know?

Begin the lesson by recapping the children's prior learning about Nature.

Using a real flowering plant or a picture of one, ask the children to name as many of its parts as they can, drawing on what they already know.

Look at a tree or a picture of a tree alongside

What are we learning today?

Move the children's learning about Nature on by asking them: *Do you know what each part of a plant or tree does?*

Provide the children with word cards showing the names of parts of a plant or tree and word cards featuring descriptions of the functions of each part e.g.
Stem/Trunk – Provides support for the plant or tree and helps transport water and nutrients from the roots.
Leaf – Uses sunlight to create sugars that give the tree energy. Absorbs carbon dioxide from the atmosphere, which helps keep the planet healthy.

How are we learning today?

The element of learning in Nature takes place in a green area with established trees or in a woodland.

Using their sheet with the names of the parts of trees and the matching descriptions, the children work in pairs to identify each part of a tree, ticking them off on their sheet as they go. Ask them: *Do all the leaves look the same? Do all the trunks look the same? Can you see any tree roots?*

TIME TO EXPLAIN: The children draw a tree and label it, using the names of the parts of a tree on their sheet for support, if necessary. Ask them: *What is the job of each part of the tree? How do you think the tree might look different at different times of year?*

STEM SENTENCE: When I compare the _____ of the plant with the _____ of the tree, I notice _____.

e.g. When I compare the stem of the plant with the trunk of the tree, I notice that the trunk has bark, which is brown and rough, but the stem is green and smooth.

What have we learned today?

Encourage the children to reflect on their learning about Nature, and assess their understanding, by asking: *Is a tree a plant? How do we know? What part of the tree anchors it in the ground? How does the trunk help the tree to grow? What is the job of the leaves?*

Draw out the learning from Nature by discussing as a class the importance of each part of the tree for the tree's survival. Ask the children: *Could the tree survive without its trunk? Without its roots? Why/why not? How is this similar to our own bodies? How is this similar to our class? Our school? Our community?*

a flowering plant or an image of one. Ask the children: *Is a tree a plant? Why do you think this?* Begin to draw out similarities and differences between trees and other flowering plants in terms of their appearance and the names of their parts e.g. their size; their lifespan; the use of the words 'stem' or 'trunk' and 'branches' etc.

Working in pairs, the children match each word card featuring the name of the part of a tree with the correct word card featuring a description of its function. Give children time to share their thinking with the class and clear up any misconceptions.

Ensuring each word card is paired with the correct description, the children glue these onto a sheet of paper in two columns. They will need this sheet for their outdoor activity.

Give children time to share their tree drawings with others before moving the children's learning about Nature on by asking the children: What do you think trees and plants need to stay healthy?

In pairs, the children work through the BBC Bitesize *What do plants need?* resources.

TEACHER TIP: If following the Harmony Curriculum, children will be able to revisit the content of the Year 3 Science National Curriculum relating to 'Plants' during the summer term. Children will be able to work scientifically at an ideal time to investigate the conditions required to grow flowering plants within the learning enquiry 'Where does our food come from?'

Ask the children: *Where do you think a plant gets its nutrients from?* Briefly discuss how a plant's nutrients come from the soil, to link to the learning in the next lesson in this unit.

Revisiting prior learning
Each lesson plan includes examples of opportunities to recap children's prior learning.

Learning about Nature
The statutory requirements of the National Curriculum set out what children need to learn about Nature, although, of course, their wider learning about Nature will extend beyond this. Our plans show how these requirements can be delivered in the context of this lesson.

Learning in Nature
In addition to learning about Nature, a Harmony approach also provides children with rich opportunities to learn in Nature. These opportunities are highlighted in our planning and can be adapted as necessary.

Learning from Nature
The third key element of a Harmony approach to learning is learning from Nature. Each lesson contributes to children's understanding of a principle of Harmony and how this can help them to live in more sustainable ways.

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02

Organising knowledge within the subject curriculum

High-quality science education may have the following features

- In the early years, pupils are introduced to a wide-ranging vocabulary that categorises and describes the natural world. These words are not too technical but provide the ‘seeds’ for developing scientific concepts that will be built on in later years.
- Attainment targets, specification points and the EYFS educational programmes are broken down into their component knowledge.
- Substantive knowledge is sequenced so that pupils build their knowledge of important concepts such as photosynthesis, magnetism and substance throughout their time at school.
- Knowledge is sequenced to make the deep structure of the scientific disciplines explicit. This allows teachers and pupils to see how knowledge is connected.
- Disciplinary knowledge is sequenced to take account of:
 - its hierarchical structure
 - the best substantive contexts in which to teach it.
- Once disciplinary knowledge is introduced, it is used and developed in a range of different substantive contexts.
- Planning for progression takes account of what is taught in other subjects. For example, the science curriculum should be coherent with what is taught in mathematics. Where there are differences, these are made explicit to pupils and teachers.

Key features of the science elements of a Harmony curriculum

UNDERSTANDING THE WORLD

Within our guidance for early years provision, and particularly ‘Understanding the World’, we incorporate examples of wide-ranging vocabulary and component knowledge that can be used to categorise and describe the natural world.

Our planning acknowledges the need to ensure that the Year 1 and Reception curriculums ‘dovetail’. It provides leaders with examples of the key vocabulary and concepts that they may want children to learn, and the scientific phenomena that they may want children to encounter and learn about.

We recognise the importance of children having sufficient vocabulary to talk about the phenomena that they are learning about in order to avoid misconceptions but, more than anything, to enable them to readily engage with the awe and wonder of the natural world.

JOINED-UP LEARNING

A Harmony curriculum celebrates relevant substantive contexts and interconnectedness. It recognises the expectations within individual subject disciplines and strives to maintain individual subject rigour alongside a commitment to ensuring that children are able to make connections in their learning, to gradually build their understanding of key concepts, to consolidate their learning through different lenses and to see their learning as part of a joined-up whole.

The science thread of a Harmony curriculum is planned to take account of what pupils learn in other subjects, particularly in mathematics, and complementary sequencing and flexible connectivity are utilised effectively to maximise opportunities for interconnection. We believe that it is important for a curriculum leader to ask ‘How well does my subject help to prepare children for success in other subjects?’ and also ‘How well does my subject contribute to and enhance our overall curriculum aims?’.

03

Other curricular considerations

High-quality science education may have the following features

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.

Key features of the science elements of a Harmony curriculum

CURRICULUM EVOLUTION & ADAPTATION

Our individual lesson plans provide examples of practice that will support the retrieval of prior learning and give opportunities for practice and consolidation of developing scientific knowledge. They also show how assessment can be used to identify misconceptions and further support children’s understanding of Harmony principles.

Through the regular inclusion of opportunities for assessment and review, we facilitate deliberate curriculum evolution and adaptation.

ADDRESSING MISCONCEPTIONS

Where possible, we identify areas where common misconceptions linked with sustainability can occur, and provide further guidance for teachers in addressing this. This may include models that provide a useful way for pupils to practise what they have learned about a scientific concept and for the class teacher to check that their understanding is correct.

TIME TO EXPLAIN

Through the ‘Time to Explain’ sections of our individual lesson plans, we provide further guidance around the component knowledge needed for pupils to be able to read, write, represent and talk science.

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04

Curriculum materials

High-quality science education may have the following features

- Online resources match what the curriculum is intending pupils to learn and are not a source of errors/misconceptions.
- If science kits are used, they help achieve the curriculum intent and the activities themselves do not become the curricular goal.
- High-quality textbooks are used as an important resource for learning and teaching science.

Key features of the science elements of a Harmony curriculum

SOURCES & SIGNPOSTING

Where possible within our individual lesson plans, we signpost teachers to high-quality, relevant resources that support teachers in their own subject knowledge around sustainability and climate change, alongside recommended secondary sources that support scientific enquiry and the sustainability agenda.

‘To disrupt the current pace of environmental destruction and climate change, we cannot continue to do the same things that we’ve been doing; we cannot continue to be the same people; and we cannot continue to be the same teachers.’

Jickling & Blenkinsop, 2020



05

Practical work

High-quality science education may have the following features

- The curriculum is sequenced so that pupils have the necessary disciplinary and substantive knowledge to carry out practical work successfully and learn from it.
- The purpose of practical work is clear in relation to curriculum content so that practical activities can be set up and managed to develop pupils’ disciplinary and/or substantive knowledge.
- Practical activities form part of a wider instructional sequence that gives pupils time to connect theory to observation.
- Pupils are not expected to learn disciplinary knowledge only through taking part in practical work – disciplinary knowledge should be taught using the most effective methods.
- Pupils encounter the full range of objects and phenomena they are studying through both laboratory and fieldwork. These encounters should take pupils beyond their everyday experiences to develop a sense of wonder and curiosity about the material world.

Key features of the science elements of a Harmony curriculum

PURPOSE & PRACTICALITY

Throughout our planning, we aim to ensure that all pupils have frequent opportunities to take part in high-quality practical work that has a clear purpose in relation to the science thread of a Harmony curriculum.

We provide guidance for teachers to use demonstrations of practical science and place a significant emphasis on the power of outdoor learning and learning about Nature, in Nature and from Nature within our individual lesson plans. This reflects our understanding of how young children learn best and our determination to nurture a sense of curiosity, awe and wonder about the natural world.

Well-structured, carefully planned enquiry questions are used to focus a particular activity on a particular aspect of the curriculum.

PRIOR KNOWLEDGE & ASSESSMENT

Through our sequencing and individual lesson plans, we also ensure that pupils have the necessary prior knowledge to carry out practical tasks effectively and to be able to talk about and describe their learning scientifically, with assessment opportunities tailored to practical tasks, where possible.

06

Pedagogy: Teaching the curriculum

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.

Key features of the science elements of a Harmony curriculum

SUSTAINABILITY & NATURE

Through our Harmony approach, we are always looking to place sustainability and Nature at the heart of learning, as is evident in all our planning. This enables subject leaders to ensure that learning activities align with this intent, alongside the aims and purposes of individual subject disciplines.

EARLY YEARS IDEAS

Our bank of early years ideas, linked with the development of key concepts to be explored in Year 1, supports teachers in understanding how principles of Harmony and a focus on sustainability can be delivered effectively within the context of adult-led or child-directed early years provision.

BUILDING VOCABULARY

We recognise the importance of children progressively building vocabulary to talk about the phenomena they are learning about in order to avoid misconceptions but also to enable them to engage with the awe and wonder of the natural world. In all our planning, we provide links to Tier 2 and Tier 3 science vocabulary alongside a growing bank of words that enable children to express their knowledge of Harmony principles and extend their ability to ‘think sustainably’.

COGNITIVE SCIENCE

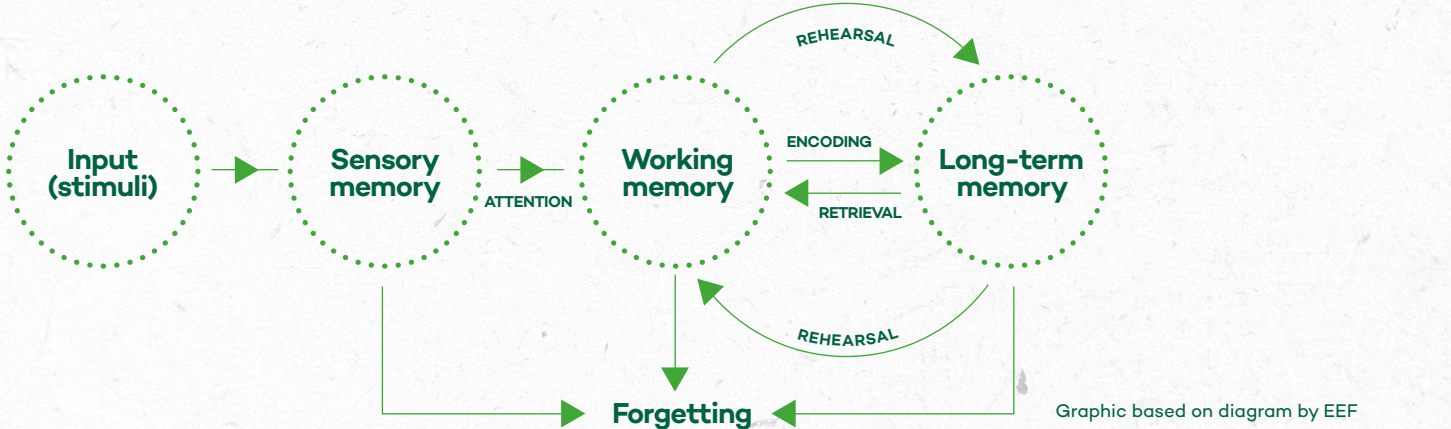
Learning enquiries and lesson plans are designed to build on teachers’ growing understanding of cognitive science. We recognise the importance of developing our understanding of memory and how to balance cognitive load, how to apply this effectively within individual subject areas and how to maximise opportunities for improved outcomes for all children.

CONCEPT MAPPING

Within our individual and long term planning, we demonstrate how new learning can be connected to prior learning. This includes showing children how knowledge from different areas of the curriculum connects. By mapping key concepts across our curriculum, we provide an accessible guide to support retrieval practice in the classroom.

CPD

We recognise the importance of CPD in understanding the efficacy of specific approaches relating to science and use professional bodies to support our understanding that appropriate teaching and learning approaches need to be selected for specific content.



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Assessment

High-quality science education may have the following features

- Teachers and pupils are clear on the purpose of assessment. There is clarity about what is being assessed.
- Assessment is not overly burdensome on teachers’ time in relation to marking, recording or feedback.
- Feedback is focused on the science content and not on generic features. Teachers have sufficient subject knowledge to be able to do this.
- Pupils regularly retrieve knowledge from memory to help them remember and organise their knowledge. This is coupled with feedback. Teachers think carefully about what pupils are being asked to retrieve and whether this prioritises the most important content.
- Systems are in place to support teachers to make accurate decisions when assessing pupils’ work. This includes supporting primary teachers with statutory teacher assessment of science at key stages 1 and 2.

Key features of the science elements of a Harmony curriculum

SECURE KNOWLEDGE

Before new content is introduced, we aim to ensure that children have a secure knowledge of what has already been taught. This includes checking whether pupils have specific misconceptions and that retrieval is focused on the essential elements of prior learning.

TARGETED UNDERSTANDING

Key assessment questions are included in our planning that exemplify assessment through the lens of Harmony. These assessments are targeted to identify children’s understanding of the essential knowledge and skills that we have outlined in our curriculum. This includes checking that they can use their substantive and disciplinary knowledge to select, plan and carry out different types of relevant scientific enquiry, alongside their developing awareness of Harmony principles and their ability to think sustainably.

ANALYSING OUTCOMES

In the design of our assessments, we acknowledge the importance of analysing ‘outcomes’ through a broad range of lenses including talking with children. This helps us to analyse whether the intent behind a Harmony curriculum is working and how well children are doing ‘within and because of’ our curriculum.

ASSESSMENTS

Assessments may take place close to the point of instruction, after a significant period of time has elapsed from the original instruction or in a variety of contexts that are different in form, scaffolding or structure to the initial instruction.

ADAPTIVE TEACHING

Within our individual lesson plans, we highlight opportunities for adaptive teaching. This reflects our commitment to ensuring that the curriculum is designed to be accessible to all learners initially but also provides a tool that can be used in response to assessment and in addressing misconceptions.

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Systems at subject and school level

High-quality science education may have the following features

- Teachers, teaching assistants and technicians 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.
- Science teachers engage with subject associations, and take responsibility, with support from the school, for developing their own subject knowledge throughout their career.
- Early-stage teachers, in particular, have timetables that allow them to develop expertise in one science and that do not give them too many key stages to teach.
- Timetables allocate appropriate teaching time to science, reflecting its status as a core subject in the National Curriculum. There are particular concerns that pupils in some primary schools are not receiving sufficient curriculum time to learn science.
- 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.

Key features of the science elements of a Harmony curriculum

CONNECTIONS & TEACHING TIME

Throughout our planning, you will see the importance in our messaging of making relevant connections across curriculum subjects and reducing curriculum overload to allow sufficient time to teach science as a core subject.

TARGETED UNDERSTANDING

We recognise the importance of CPD and the support needed for subject leaders as well as class teachers. Within our planning, you will find further guidance for teachers to ensure that their teaching around sustainability and climate change, in particular, is informed by the latest studies and research.

ANALYSING OUTCOMES

Our planning supports subject leaders in prioritising curriculum time for teaching the key scientific knowledge and skills that support our overall purpose and aims.

We ensure that the focus is on making sure that pupils learn and remember what has been taught, so that they develop increasingly sophisticated and connected scientific knowledge that supports them in their understanding of sustainability.

Building science capital through a Harmony curriculum

‘High-quality science teaching builds pupils’ curiosity and critical thinking, helping them to develop a coherent understanding of the world around them. Primary science teaching plays a crucial role in shaping pupils’ attitudes toward the subject, nurturing participation that can support future pathways into science, technology, engineering and mathematics (STEM) fields.

Much like the other core subject areas of the National Curriculum, in science, there is a stubborn gap in attainment between socio-economically disadvantaged pupils and their classmates. This gap is also reflected in pupils’ participation in science, with those from disadvantaged backgrounds far less likely to progress to further study in science subjects when it is no longer compulsory. It is crucial that early science teaching empowers all pupils, regardless of their background, to engage fully with science learning, equipping them with the knowledge and skills they need to access opportunities later in life.’

Professor Becky Francis, CEO, Education Endowment Foundation (EEF)
Improving primary science

RECENT FINDINGS

Finding the optimum: the science subject report (February 2023) highlights the following good practice in terms of building science capital:

- In some schools, pupils learned about the work of specific scientists. In the best cases, this was closely linked to the content that they were learning at that time. For example, in one school, pupils learned about the work of Mae Jemison when studying space. Leaders were generally keen that pupils learned about a range of scientists. This enabled pupils to develop an accurate and genuine understanding of science, for example knowing that scientific research is not just carried out by men in white coats working in laboratories.
 - Some leaders identified that pupils perform less well in science because of their limited background knowledge. These pupils can often think that science is not for them. Leaders typically tried to address this by helping pupils to see the relevance of what they were learning, for example by highlighting science in the news, organising educational trips to museums and revealing real-world applications of scientific knowledge.
- Importantly, these approaches did not change the scientific concepts that pupils learned, but focused on specific approaches to teaching those concepts when they came up in the curriculum.

RESOURCES & REPRESENTATION

Where possible within our lesson plans, we include links to further resources that support the building of science capital for all children, whatever their current experience or starting points.

Children’s growing understanding of sustainability and Nature can be so deeply underpinned by their experience of high-quality science provision and the world that this can open up to them.

With experience and inspiration, this knowledge can be nurtured and developed further as they grow and begin to think about the contribution that they would like to make to the world in their future professional roles.

We also believe that through our planning and the examples of key scientists and science in action, children should be able to see themselves represented in the curriculum. The Harmony curriculum should act as a vehicle for sensitively introducing children to both similar and contrasting lives, communities, places and objects, simultaneously holding up a mirror and opening a window in our curriculum design and the choice of resources that support this.

Links, research and further reading

NATURE-BASED LEARNING RESEARCH

[The Dasgupta Review](#)

Nature and me

[The nature cure: how time outdoors transforms our memory, imagination and logic](#)

According to the **biophilia hypothesis**, popularised by the American sociobiologist EO Wilson, humans function better in natural environments because our brains and bodies evolved in, and with, Nature.

FURTHER READING

A key initiative of the [DfE's Sustainability and climate change strategy for education](#) is 'sustainability leadership and climate action plans'. The strategy states: 'By 2025, all education settings will have nominated a sustainability lead and put in place a climate action plan'.

CLIMATE ACTION PLANS

Creating a climate action plan will allow you to take a structured and strategic route toward ensuring your setting or trust is acting

toward, and educating about, sustainability. You may choose to have a climate action plan that sits within an individual setting, or across a trust, or both.

A climate action plan should typically cover the following four areas, to align with:

- decarbonisation, for example calculating and taking actions to reduce carbon emissions, such as becoming more energy efficient

- adaptation and resilience, such as taking actions to reduce the risk of flooding and overheating

- biodiversity, for example engaging with the National Education Nature Park and enrolling in the Climate Action Award

- **climate education and green careers, such as ensuring the education you provide gives knowledge-rich and comprehensive teaching about climate change, and that your teaching staff and lecturers feel supported to offer this**

Through participation in the National Education Nature Park and enrolling in the Climate Action Award, children and young people will develop a meaningful connection to Nature and an understanding of our role to act on the biodiversity and climate crises.

Engaging in the programme will develop key skills around communication, decision making and creative thinking, as well as scientific skills in biology, natural history and Nature identification and recording, and digital skills including data analysis and data visualisation.

