

## Four Areas of Disciplinary and Substantive Knowledge which Underpin the Arrow Valley First School Science Curriculum



The assessment framework is structured according to the specific knowledge of scientific enquiry. It is followed by the substantive concepts related to the different scientific disciplines children will encounter as they become more experienced in scientific study. This framework is designed to inform how we plan for children to improve year by year and assess how well they are improving.

<b>Scientific enquiry and investigation</b>	Our curriculum enables pupils to get better at developing enquiry questions and conducting scientific investigations.
<i>During the primary years, children develop the skills required to apply their growing knowledge to practical investigations. They ask and refine questions, explore the substance of their questions through experimentation and investigation, becoming increasingly systematic and accurate as they do so. They record their findings, drawing on their observations to develop explanations. They learn to evaluate how they have gone about their investigation so that they can improve the quality of their work. As they progress, children study the work of selected scientists to understand the contribution to the growth of human knowledge and to the quality of human life which scientists have made, to build their knowledge of the scientific method of enquiry and to understand how scientists grapple with dilemmas as they look to find better answers to fundamental questions.</i>	
<b>Foundations of Biology</b>	Our curriculum enables pupils to get better at observing, describing, explaining and understanding the life processes of organisms.
<i>During the primary years, children begin to address three 'big questions' which are fundamental to their understanding of biology and life sciences: "What kinds of life are there?", "How do living things survive and grow?" and "What makes life go on?" Children observe and study the diversity of living things, building their knowledge of characteristics and classification of the animal and plant kingdoms. They learn that all living things adapt to their environments and that change, and diversity happens as a result of evolution. They observe and study the life processes in living things which are essential for survival and reproduction, and the factors which affect healthy life cycles.</i>	
<b>Foundations of Chemistry</b>	Our curriculum enables pupils to get better at observing, describing, explaining and understanding the properties of materials and how they can be changed.
<i>During the primary years, children begin to address two 'big questions' which are fundamental to their understanding of chemistry and the science of materials: "What are materials made from?" and "How can the form of materials change?" Children investigate different materials and their properties, and how materials are selected and created to suit their purpose. They develop understanding of the action of change of temperature on how materials change and change their state. They observe and study how reversible change differs from non-reversible change.</i>	
<b>Foundations of Physics</b>	Our curriculum enables pupils to get better at observing, describing, explaining and understanding forces, energy, the composition of the Earth and its planetary properties.
<i>During the primary years, children begin to address 'big questions' which are fundamental to their understanding of physics and the study of natural phenomena: "What makes objects move?", "What is the effect of energy?" and "How can forces be changed and controlled?" Children observe, describe and begin to explain manifestations of fundamental laws of physics relating to forces and energy: the motion of objects, the action of magnetic force, simple electrical circuits, how light travels and behaves and how sound is created and travels. Children investigate rocks and soils and learn about the structure of the Earth's surface.</i>	

**Scientific enquiry and investigation**  
Getting better at developing enquiry questions and conducting scientific investigations.

	Y1	Y2	Y3	Y4
Formulate questions	<p><i>Ask questions about living things, materials, movement and change they observe in their own environment and in their play.</i></p> <p><i>Ask people questions and use simple secondary sources to find possible answers to their questions.</i></p>	<p><i>Make links between different scientific questions they ask.</i></p> <p><i>Devise simple hypotheses and predictions.</i></p> <p><i>Select secondary sources which may help them develop answers to their questions.</i></p>		<p><i>Draw on prior knowledge and observations to devise a working hypothesis and probable outcomes.</i></p> <p><i>Use the results of their investigations to refine their scientific questions and make decisions about how to improve future investigations.</i></p> <p><i>Explain how they have used secondary sources to inform the questions they have developed.</i></p>
Observe	<p><i>Select what to observe, and what equipment they need to help them. notice.</i></p> <p><i>Look for, notice and describe similarities and differences.</i></p>	<p><i>Select what to observe, what equipment they need and plan how to ensure their observations are careful and systematic, and how they will record their findings.</i></p> <p><i>Describe what patterns and changes they notice and how these may be linked to their hypotheses. Sort, group and classify what they observe.</i></p>		
Carry out tests	<p><i>Formulate ways to test an idea.</i></p>	<p><i>Carry out a simple test, identifying what could stay the same and what could change.</i></p> <p><i>Take appropriate measurements of variables which change, checking for accuracy.</i></p>		<p><i>Identify constants and variables, and the control variable within a fair test.</i></p> <p><i>Explain and justify decisions made in setting up and carrying out a comparative and fair test.</i></p> <p><i>Use appropriate equipment to measure accurately in standard units.</i></p>

Record and communicate findings	<p><i>Explain what they have noticed and how they went about their enquiry.</i></p> <p><i>Create simple representations of what they have done.</i></p> <p><i>Record changes they have observed.</i></p>	<p><i>Describe the test they have carried out - its purpose and method.</i></p> <p><i>Suggest an answer to their enquiry question based on what they have observed.</i></p> <p><i>Present information in the form of simple diagrams, tables and graphs.</i></p>	<p><i>Plan and write a scientific record of an investigation - its aim and hypothesis, variables and constants, equipment safety and method, diagrams, tables and graphs, an explanation of results and conclusion.</i></p> <p><i>Evaluate the success and accuracy of an investigation, identifying what elements needed to be repeated or altered to improve validity.</i></p>
Studying how scientists work	<p><i>Retell narratives of what specific scientists have done to find out more about their field of enquiry.</i></p>	<p><i>Describe the work of a specific scientist and how this work has helped to explain more about their field of enquiry.</i></p>	<p><i>Describe the work of a specific scientist or group of scientists, how this work linked to the work of other scientists in their field of enquiry and how this work has had an impact on people's lives.</i></p> <p><i>Identify how the work of a specific scientist demonstrates the scientific method of enquiry.</i></p>

## Foundations of Biology

Progression in observing, describing, explaining and understanding the life processes of organisms

	Y1	Y2	Y3	Y4
What kinds of life are there?	<p><i>Identify and describe the characteristics of familiar plants.</i></p> <p><i>Group animals in different ways according to their class, diet and main characteristics.</i></p>			<p><i>Use classification keys to group and identify living things according to their class and main characteristics.</i></p>
How do living things survive and grow?	<p><i>Identify the five senses in animals and describe them in relation to the sensory organs of the human body.</i></p>	<p><i>Compare and describe survival needs of animals and plants to grow and stay healthy.</i></p> <p><i>Describe the life cycles of animals and plants.</i></p> <p><i>Identify and explain how characteristics of their habitats support the survival of living things.</i></p>	<p><i>Describe the parts of a flowering plant, and explain how water is transported in plants.</i></p> <p><i>Compare and describe the diets of living things.</i></p> <p><i>Describe the need for a balanced diet and its effect on human health.</i></p> <p><i>Identify similarities and differences between skeletal structures in animals.</i></p>	<p><i>Identify and describe the functions of the basic parts of the human digestive system.</i></p> <p><i>Identify and describe the simple function of different teeth in humans.</i></p> <p><i>Identify and construct simple food chains.</i></p> <p><i>Identify and describe how changes to habitats can impact on living things.</i></p>
What makes life go on?			<p><i>Explain the life cycle of a flowering plant, including pollination, seed production and different forms of seed dispersal.</i></p>	

## Foundations of Chemistry

Progression in observing, describing, explaining and understanding the properties of materials and how they can be changed.

	Y1	Y2	Y3	Y4
What are things made from?	<p><i>Identify objects which are made from natural products and those which are synthetic.</i></p> <p><i>Describe and group objects according to the materials from which they are made.</i></p> <p><i>Describe observable properties of natural and synthetic materials.</i></p>	<p><i>Describe and explain how the properties of natural and synthetic materials are suited to their use.</i></p>		
How can form change?		<p><i>Describe how the shape of some different solid materials can be changed.</i></p>		<p><i>Compare and classify materials according to whether they are solids, liquids or gases at room temperature.</i></p> <p><i>Describe how change in temperature causes materials to change state and the effect of the rate of change on materials.</i></p> <p><i>Describe and explain the changes of state of water as part of the water cycle.</i></p>

## Foundations of Physics

Progression in observing, describing, explaining and understanding forces and energy

	KS1	Y3	Y4
What makes objects move and stop moving?	<i>Observe and describe the movement of familiar objects and how the movement can change.</i>	<i>Describe and explain the action of a magnetic force.</i>  <i>Identify and classify materials according to their magnetic properties.</i>	
How does energy make things happen?		<i>Describe and classify natural and artificial different light sources.</i>  <i>Describe how light can reflect differently off different surfaces and how light can pass through different materials.</i>  <i>Describe and explain how a shadow is formed and how the size of shadows can change.</i>	<i>Identify and describe how different kinds of vibrations create a range of sounds.</i>  <i>Describe and explain how the human ear processes vibrations to hear sound.</i>  <i>Describe and explain factors that affect how we hear sound.</i>  <i>Construct and name the component parts of a simple electrical circuit wired in series.</i>
How can forces be changed and controlled?	<i>Describe how they can activate and control the actions of a simple mechanism.</i>		<i>Describe and explain the circumstances required for an electrical circuit to be complete and the function of a switch.</i>  <i>Identify and describe the properties of common electrical conductors and insulators.</i>
	Describe how weather changes according to the seasons.  Describe how the amount of daylight varies according to the seasons.	Describe and classify different types of rock.  Describe and explain the difference between sedimentary and igneous rocks.  Describe and explain the components of different types of soil.  Describe how fossils are formed.	

## How learning in the Early Years Foundation Stage provides the range of experiences and a secure knowledge base, on which the KS1 curriculum in Science builds.

Planning for the curriculum and children's learning in the Early Years Foundation Stage uses the elements of the EYFS statutory framework rather than the subject disciplines of the National Curriculum. This planning is supported by the use of the non-statutory Development Matters guidance.

The EYFS curriculum starts with the child's experience in their family and in their immediate environment. The content of the curriculum is often guided by teachers in response to children's interests and planning needs to take account of the balance between deliberate teaching and spontaneous learning driven by curiosity and purpose.

Children's experiences and learning which, once they are in KS1, can be thought of as typical of work in Science may in Early Years draw upon all the areas of learning - Communication and Language, Personal Social and Emotional Development, Physical Development, Literacy, Mathematics, Understanding the World and Expressive Arts and Design. There will be a strong connection between what children achieve in what is called Understanding the World and what they will develop in KS1 in Science, but developmental learning for children in EYFS is not linear, it proceeds in a web of multiple strands. For example, the development of the language associated with movement and position, and that of length, weight and capacity which will be a strong feature of children observing change in the natural world and the behaviour of objects in their play do not feature in the end of EYFS assessment statements for Understanding the World, but reflect aspects of Mathematics. Similarly, the foundational knowledge about hygiene, nutrition and healthy diets is outlined in Personal, Social and Emotional Development rather than what could be read as scientific elements of Understanding the World.

In our schools, the experiences children gain across the EYFS curriculum are rich in opportunities to investigate and explore their environment, to speculate and make choices to support their ideas, and to articulate their thinking within their play and within structured activities. The way in which the curriculum is designed and experienced by the children supports the development of the characteristics of effective learning in EYFS: playing and exploring, active learning and creating and thinking critically. These are foundational to what lies at the centre of the subject discipline of Science: close observation of the natural world, curiosity in their play and in their handling of objects and materials, asking questions, watching how things happen and change and wondering why this is so, and describing what they see, hear and feel.

Examples of a range of activities, planned with reference to Development Matters, enable children typically, across a range of contexts,

- To explore the natural world around them, describing what they see, hear and feel whilst outside;
- To observe the effect of the weather and of changing seasons on the natural world around them;
- To plant seeds and care for growing plants, recognising the key features of the life cycle of a plant;
- To recognise key features of the life cycle of animals;
- To begin to understand the need to respect and care for the natural environment and all living things;
- To explore how things work and move, and talk about different forces they can feel;
- To observe and talk about the differences between materials and changes they notice.

All of these experiences and knowledge gained provide a secure foundation for what they will encounter in Science in KS1 and beyond.

## At the end of Year One

Scientific enquiry and investigation	Foundations of Biology	Foundations of Chemistry	Foundations of Physics
<p>Ask questions about living things, materials, movement and change they observe in their own environment and in their play.</p> <p>Ask people questions and use simple secondary sources to find possible answers to their questions.</p> <p>Select what to observe, and what equipment they need to help them. notice.</p> <p>Look for, notice and describe similarities and differences.</p> <p>Formulate ways to test an idea.</p> <p>Explain what they have noticed and how they went about their enquiry.</p> <p>Create simple representations of what they have done.</p> <p>Record changes they have observed.</p> <p>Retell narratives of what specific scientists have done to find out more about their field of enquiry.</p>	<p>Identify and describe the characteristics of familiar plants.</p> <p>Group animals in different ways according to their class, diet and main characteristics.</p> <p>Identify the five senses in animals and describe them in relation to the sensory organs of the human body.</p>	<p>Identify objects which are made from natural products and those which are synthetic.</p> <p>Describe and group objects according to the materials from which they are made.</p> <p>Describe observable properties of natural and synthetic materials.</p>	<p>Observe and describe the movement of familiar objects and how the movement can change.</p> <p>Describe how they can activate and control the actions of a simple mechanism.</p> <p>Describe how weather changes according to the seasons.</p> <p>Describe how the amount of daylight varies according to the seasons.</p>



## At the end of Year Two

Scientific enquiry and investigation	Foundations of Biology	Foundations of Chemistry	Foundations of Physics
<p>Make links between different scientific questions they ask.</p> <p>Devise simple hypotheses and predictions.</p> <p>Select secondary sources which may help them develop answers to their questions.</p> <p>Select what to observe, what equipment they need and plan how to ensure their observations are careful and systematic, and how they will record their findings.</p> <p>Describe what patterns and changes they notice and how these may be linked to their hypotheses. Sort, group and classify what they observe.</p> <p>Carry out a simple test, identifying what could stay the same and what could change.</p> <p>Take appropriate measurements of variables which change, checking for accuracy.</p> <p>Describe the test they have carried out - its purpose and method.</p> <p>Suggest an answer to their enquiry question based on what they have observed.</p> <p>Present information in the form of simple diagrams, tables and graphs.</p> <p>Describe the work of a specific scientist and how this work has helped to explain more about their field of enquiry.</p>	<p>Compare and describe survival needs of animals and plants to grow and stay healthy.</p> <p>Describe the life cycles of animals and plants.</p> <p>Identify and explain how characteristics of their habitats support the survival of living things.</p>	<p>Describe and explain how the properties of natural and synthetic materials are suited to their use.</p> <p>Describe how the shape of some different solid materials can be changed.</p>	<p>Observe and describe the movement of familiar objects and how the movement can change.</p> <p>Describe how they can activate and control the actions of a simple mechanism.</p> <p>Describe how weather changes according to the seasons.</p> <p>Describe how the amount of daylight varies according to the seasons.</p>

## At the end of Year Three

Scientific enquiry and investigation	Foundations of Biology	Foundations of Chemistry	Foundations of Physics
<p>Make links between different scientific questions they ask.</p> <p>Devise simple hypotheses and predictions.</p> <p>Select secondary sources which may help them develop answers to their questions.</p> <p>Select what to observe, what equipment they need and plan how to ensure their observations are careful and systematic, and how they will record their findings.</p> <p>Describe what patterns and changes they notice and how these may be linked to their hypotheses. Sort, group and classify what they observe.</p> <p>Carry out a simple test, identifying what could stay the same and what could change.</p> <p>Take appropriate measurements of variables which change, checking for accuracy.</p> <p>Describe the test they have carried out - its purpose and method.</p> <p>Suggest an answer to their enquiry question based on what they have observed.</p> <p>Present information in the form of simple diagrams, tables and graphs.</p> <p>Describe the work of a specific scientist and how this work has helped to explain more about their field of enquiry.</p>	<p>Describe the parts of a flowering plant, and explain how water is transported in plants.</p> <p>Compare and describe the diets of living things.</p> <p>Describe the need for a balanced diet and its effect on human health.</p> <p>Identify similarities and differences between skeletal structures in animals.</p> <p>Explain the life cycle of a flowering plant, including pollination, seed production and different forms of seed dispersal.</p>		<p>Describe and explain the action of a magnetic force.</p> <p>Identify and classify materials according to their magnetic properties.</p> <p>Describe and classify natural and artificial different light sources.</p> <p>Describe how light can reflect differently off different surfaces and how light can pass through different materials.</p> <p>Describe and explain how a shadow is formed and how the size of shadows can change.</p> <p>Describe and classify different types of rock.</p> <p>Describe and explain the difference between sedimentary and igneous rocks.</p> <p>Describe and explain the components of different types of soil.</p> <p>Describe how fossils are formed.</p>

## At the end of Year Four

Scientific enquiry and investigation	Foundations of Biology	Foundations of Chemistry	Foundations of Physics
<p>Draw on prior knowledge and observations to devise a working hypothesis and probable outcomes.</p> <p>Use the results of their investigations to refine their scientific questions and make decisions about how to improve future investigations.</p> <p>Explain how they have used secondary sources to inform the questions they have developed.</p> <p>Select what to observe, what equipment they need and plan how to ensure their observations are careful and systematic, and how they will record their findings.</p> <p>Describe what patterns and changes they notice and how these may be linked to their hypotheses. Sort, group and classify what they observe.</p> <p>Identify constants and variables, and the control variable within a fair test.</p> <p>Explain and justify decisions made in setting up and carrying out a comparative and fair test.</p> <p>Use appropriate equipment to measure accurately in standard units.</p> <p>Plan and write a scientific record of an investigation - its aim and hypothesis, variables and constants, equipment safety and method, diagrams, tables and graphs, an explanation of results and conclusion.</p> <p>Evaluate the success and accuracy of an investigation, identifying what elements needed to be repeated or altered to improve validity.</p> <p>Describe the work of a specific scientist or group of scientists, how this work linked to the work of other scientists in their field of enquiry and how this work has had an impact on people's lives.</p> <p>Identify how the work of a specific scientist demonstrates the scientific method of enquiry.</p>	<p>Use classification keys to group and identify living things according to their class and main characteristics.</p> <p>Identify and describe the functions of the basic parts of the human digestive system.</p> <p>Identify and describe the simple function of different teeth in humans.</p> <p>Identify and construct simple food chains.</p> <p>Identify and describe how changes to habitats can impact on living things.</p>	<p>Compare and classify materials according to whether they are solids, liquids or gases at room temperature.</p> <p>Describe how change in temperature causes materials to change state and the effect of the rate of change on materials.</p> <p>Describe and explain the changes of state of water as part of the water cycle.</p>	<p>Identify and describe how different kinds of vibrations create a range of sounds.</p> <p>Describe and explain how the human ear processes vibrations to hear sound.</p> <p>Describe and explain factors that affect how we hear sound.</p> <p>Construct and name the component parts of a simple electrical circuit wired in series.</p> <p>Describe and explain the circumstances required for an electrical circuit to be complete and the function of a switch.</p> <p>Identify and describe the properties of common electrical conductors and insulators.</p>