

WORKING SCIENTIFICALLY IN THE PRIMARY CLASSROOM:

Progression of Enquiry Skills from EYFS to KS3



CENTRE for INDUSTRY
EDUCATION COLLABORATION

Second edition published September 2021



Salters'
Institute



“

“The posters were very well received when I used them in a staff INSET to identify the expected progression in working scientifically! Each class now has a copy on their science display.”

”

1



“

“I adapted them slightly, to fit our curriculum planning, and they are laminated and can be found on the children’s tables. They are used as targets for learning and year 1 and 2 love them especially. I also used the statements to create Science ‘I can’ tracking sheets that are consistent with maths and literacy.”

”

2



“

“I have tried the poster with my class for one of the activities and it worked really well. It was easy for the Year 1 class to use. Next term I will build it in to my planning. I will be taking the first staff meeting of next term and I’m going to propose that we roll it out throughout the school.”

”

3

WORKING SCIENTIFICALLY IN THE PRIMARY CLASSROOM: PROGRESSION OF ENQUIRY SKILLS

INTRODUCTION

This booklet has been produced to help teachers understand how to 'work scientifically' within the primary science curriculum for England¹.

Each page contains a summary of information intended to enable teachers to:

- plan science lessons during which children can show progress in their learning
- ensure continuity and progression of essential enquiry skills
- differentiate activities and add challenge for more able children
- make accurate assessments, and facilitate high quality peer and self-assessments

The notes below provide guidance for teachers using and sharing the posters and progression grids in their own school and beyond. We do hope that these are useful to as many colleagues as possible in English primary schools, and would appreciate feedback on how they are used to ciec@york.ac.uk

ENCOURAGING CHILDREN TO WORK SCIENTIFICALLY

There are three aims in the English primary science curriculum, to ensure that all pupils:

- develop **scientific knowledge and conceptual understanding** through the specific disciplines of biology, chemistry and physics
- develop understanding of the **nature, processes and methods of science** through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future

This guidance provides support particularly for the second of these aims. In order for primary school children to operate as successful scientists, they should be taught a wide range of essential enquiry skills. These skills should build upon earlier opportunities they have had to play, explore, create, engage in active learning, and think critically in the Early Years Foundation Stage.

By carefully examining the statutory requirements for Working Scientifically at Key Stage One, Lower Key Stage Two and Upper Key Stage Two, it is possible to create a list of generic science enquiry skills common to all children across the primary age phase:

- Asking questions
- Planning and setting up different types of enquiries
- Performing tests
- Reporting, presenting and communicating data/findings
- Observing and measuring
- Identifying and classifying
- Gathering and recording data
- Using equipment

By further 'teasing apart' the statutory requirements and non-statutory notes and guidance for Working Scientifically, it is possible to see subtle differences in the way that each skill is described as children increase in age and ability. It is important that teachers understand the progression route for each skill to enable them to plan high quality science lessons.

¹ The National Curriculum in England Key Stages One and Two framework document September 2013, Department for Education

PROGRESSION OF SKILLS: GRIDS EXPLAINED

EARLY YEARS FOUNDATION STAGE TO KEY STAGE ONE

Progression of Enquiry Skills Early Years Foundation Stage to Key Stage One, is a succinct overview of science enquiry for our youngest scientists. Teachers can use this grid to see how emergent science skills act as precursors to the statutory requirements of Working Scientifically found in the English National Curriculum for Science for Key Stage One. The document has been separated into rows of distinct skills so that teachers can easily understand the expected standards as well as plan for differentiation and progression within each skill. The information in brackets shows where each statement comes from; whether it is an Early Learning Goal or a Characteristic of Effective Teaching and Learning found in the non-statutory guidance 'Development Matters'.

Teachers could also use this document to formulate Working Scientifically learning objectives and ensure that all areas of enquiry have been taught throughout the academic year. It could be used for both formative and summative assessment purposes whereby teachers highlight particular skills that have been achieved by either individuals or groups of children and then use this information to target areas of weakness as well as to indicate 'next steps' in learning. Note: Pupils are not expected to cover each aspect for every area of study.

KEY STAGE ONE TO KEY STAGE TWO

Progression of Enquiry Skills Key Stage One and Two is an organised summary of the statutory requirements and non-statutory notes and guidance for Working Scientifically from Years 1 to 6. It has the same purpose as the EYFS – KS1 grid and will enable teachers to understand and make quick reference to the expected national standards across the full primary age range.

KEY STAGE TWO TO KEY STAGE THREE

Progression of Enquiry Skills Upper Key Stage Two to Key Stage Three has the same purpose as outlined above, with a focus on enabling teachers to see how the skills pupils learn at primary school can be extended beyond Year 6. Upper Key Stage Two teachers can use this information to create activities which challenge their most able children and make purposeful links to the additional mathematics required to carry out higher level science.

ENCOURAGING CHILDREN TO WORK SCIENTIFICALLY

A poster is provided for each of the following age ranges:

- Early Years Foundation Stage
- Key Stage One
- Lower Key Stage Two
- Upper Key Stage Two

The information from the grids has been converted into child-friendly 'I can' statements and presented in a format that may be used for both peer and self assessment.

Teachers may wish to replace the poster image with photographs of individual children in their class. Each child can use their own poster and personalise their learning by identifying the enquiry skills being taught in weekly science lessons. They could highlight, tick or date a skill when they feel they have achieved the expected standard of attainment. Teachers can use the posters as a quick and easy reference for age appropriate expectations when planning enquiry activities. The statements have been written in hierarchical order around the posters so that it is possible to refer to an earlier or later age group's poster to help with differentiation and challenge. This order is not intended to be explicit to children, and should therefore avoid 'labelling' or levelling themselves or each other.

PROGRESSION OF ENQUIRY SKILLS FROM EARLY YEARS FOUNDATION STAGE TO KEY STAGE ONE

EYFS (Statutory Framework 2021 & Development Matters 2020)	Key Stage 1 (NC 2014)
<ul style="list-style-type: none"> Explore the natural world around them (Understanding the World: reception) Notice and ask questions about differences (Personal, Social & Emotional Dev: birth-3) Understand simple questions about 'who', 'what' and 'where' (Communication & Language: 2 years) / understand 'why' questions (3-4 years) / ask questions to find out more (reception) Listen attentively and respond to what they hear with relevant questions (ELG: Listening, Attention & Understanding) 	<p>Explore the world around them and raise their own simple questions</p> <p>ask people questions and use simple secondary sources to find answers</p>
<ul style="list-style-type: none"> Make choices and explore different resources and materials (Playing & Exploring) Be confident to try new activities and show independence, resilience and perseverance in the face of challenge (ELG: Managing Self) 	<p>Experience different types of science enquiries, including practical activities</p>
<ul style="list-style-type: none"> Know more, so feel confident about coming up with their own ideas (Creating & Thinking Critically) Respond to new experiences that you bring to their attention (Playing & Exploring) Solve real problems (Creating and Thinking Critically) 	<p>Begin to recognise different ways in which they might answer scientific questions</p> <p>Carry out simple tests</p>
<ul style="list-style-type: none"> Sort materials (Creating & Thinking Critically) Explore collections of materials with similar and/or different properties (Understanding the World: 3-4 years) Know some similarities and differences between the natural world around them and contrasting environments, drawing on their experiences and what has been read in class (ELG: The Natural World) 	<p>Use simple features to compare objects, materials and living things and, with help, decide how to sort and group them</p>
<ul style="list-style-type: none"> Use all their senses in hands-on exploration of natural materials (Understanding the World: 3-4 years) Explore different materials and tools (Physical Dev: birth-3) Explore the natural world around them, making observations and drawing pictures of animals and plants (ELG: The Natural World) 	<p>Observe closely using simple equipment / with help, observe changes over time</p>
<ul style="list-style-type: none"> Realise that their actions have an effect on the world (Playing & Exploring) Notice patterns and arrange things in patterns (Mathematics: birth-3) / talk about and identifies the patterns around them (3-4 years) / continue, copy and create repeating patterns (reception) Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter (ELG: The Natural World) 	<p>With guidance, they should begin to notice patterns and relationships</p>
<ul style="list-style-type: none"> Make comparisons between objects relating to size, length, weight and capacity (Mathematics: 3-4 years) / compare length, weight and capacity (reception) Choose the right resources to carry out their own plan (Physical Dev 3-4 years) / develop their small motor skills so that they can use a range of tools competently, safely and confidently (reception) Use a range of small tools, including scissors, paint brushes and cutlery (ELG: Fine Motor Skills) Use drawing to represent ideas (Expressive Arts & Design: 3-4 years) / return to and build on their previous learning, refining ideas and developing their ability to represent them (reception) 	<p>Use simple measurements and equipment (e.g. hand lenses, egg timers) to gather data</p> <p>Record simple data</p>
<ul style="list-style-type: none"> Offer explanations for why things might happen, making use of recently introduced vocabulary from stories, non-fiction, rhymes and poems when appropriate; (ELG: Speaking) 	<p>Use their observations and ideas to suggest answers to questions talk about what they have found out and how they found it out</p>
<ul style="list-style-type: none"> Use a wider range of vocabulary (Communication & Language: 3-4 years) / learn new vocabulary & use new vocabulary through the day and in different contexts (reception) Talk about what they see, using a wide vocabulary (Understanding The World: 3-4 years) Offer their own ideas, using recently introduced vocabulary (ELG: Speaking) 	<p>With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language</p>

Green text indicates Early Learning Goal

PROGRESSION OF ENQUIRY SKILLS FROM KEY STAGE ONE TO KEY STAGE TWO

Lower Key Stage 2		Upper Key Stage 2	
Key Stage 1	Explore the world around them and raise their own simple questions	Lower Key Stage 2	Use their science experiences to explore ideas and raise different kinds of questions
	Experience different types of science enquiries, including practical activities		Talk about how scientific ideas have developed over time
	Begin to recognise different ways in which they might answer scientific questions		Select and plan the most appropriate type of scientific enquiry to use to answer scientific questions
	Carry out simple tests		Recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why
	Use simple features to compare objects, materials and living things and, with help, decide how to sort and group them (identifying and classifying)		Use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment
	Ask people questions and use simple secondary sources to find answers		Recognise which secondary sources will be most useful to re-search their ideas and begin to separate opinion from fact
	Observe closely using simple equipment with help, observe changes over time		Make their own decisions about what observations to make, what measurements to use and how long to make them for
	With guidance, they should begin to notice patterns and relationships		Look for different causal relationships in their data and identify evidence that refutes or supports their ideas
	Use simple measurements and equipment (e.g. hand lenses, egg timers) to gather data		Choose the most appropriate equipment to make measurements with increasing precision and explain how to use it accurately. Take repeat measurements where appropriate.
	Record simple data		Decide how to record data and results of increasing complexity from a choice of familiar approaches: scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
	Use their observations and ideas to suggest answers to questions		Identify scientific evidence that has been used to support or refute ideas or arguments
	Talk about what they have found out and how they found it out		Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas,
	With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language		Use oral and written forms such as displays and other presentations to report conclusions, causal relationships and explanations of degree of trust in results
			Use their results to make predictions and identify when further observations, comparative and fair tests might be needed

PROGRESSION OF ENQUIRY SKILLS FROM KEY STAGE TWO TO KEY STAGE THREE

Upper Key Stage 2	Key Stage 3
Use their science experiences to explore ideas and raise different kinds of questions	Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
Talk about how scientific ideas have developed over time	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
Select and plan the most appropriate type of scientific enquiry to use to answer scientific questions	Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
Recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why	
Use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment	
Recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact	Make predictions using scientific knowledge and understanding
Choose the most appropriate equipment to make measurements with increasing precision and explain how to use it accurately	Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
Take repeat measurements where appropriate	Evaluate the reliability of methods and suggest possible improvements Evaluate risks Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
	Apply sampling techniques Apply mathematical concepts and calculate results Use and derive simple equations and carry out appropriate calculations Undertake basic data analysis including simple statistical techniques
Make their own decisions about what observations to make, what measurements to use and how long to make them for	Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature Make and record observations and measurements using a range of methods for different investigations Present observations and data using appropriate methods, including tables and graphs
Decide how to record data and results of increasing complexity from a choice of familiar approaches: scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	
Look for different causal relationships in their data and identify evidence that refutes or supports their ideas	Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
Identify scientific evidence that has been used to support or refute ideas or arguments	Present reasoned explanations, including explaining data in relation to predictions and hypotheses Evaluate data, showing awareness of potential sources of random and systematic error
Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas	
Use oral and written forms such as displays and other presentations to report conclusions, causal relationships and explanations of degree of trust in results	
Use their results to make predictions and identify when further observations, comparative and fair tests might be needed	Identify further questions arising from their results

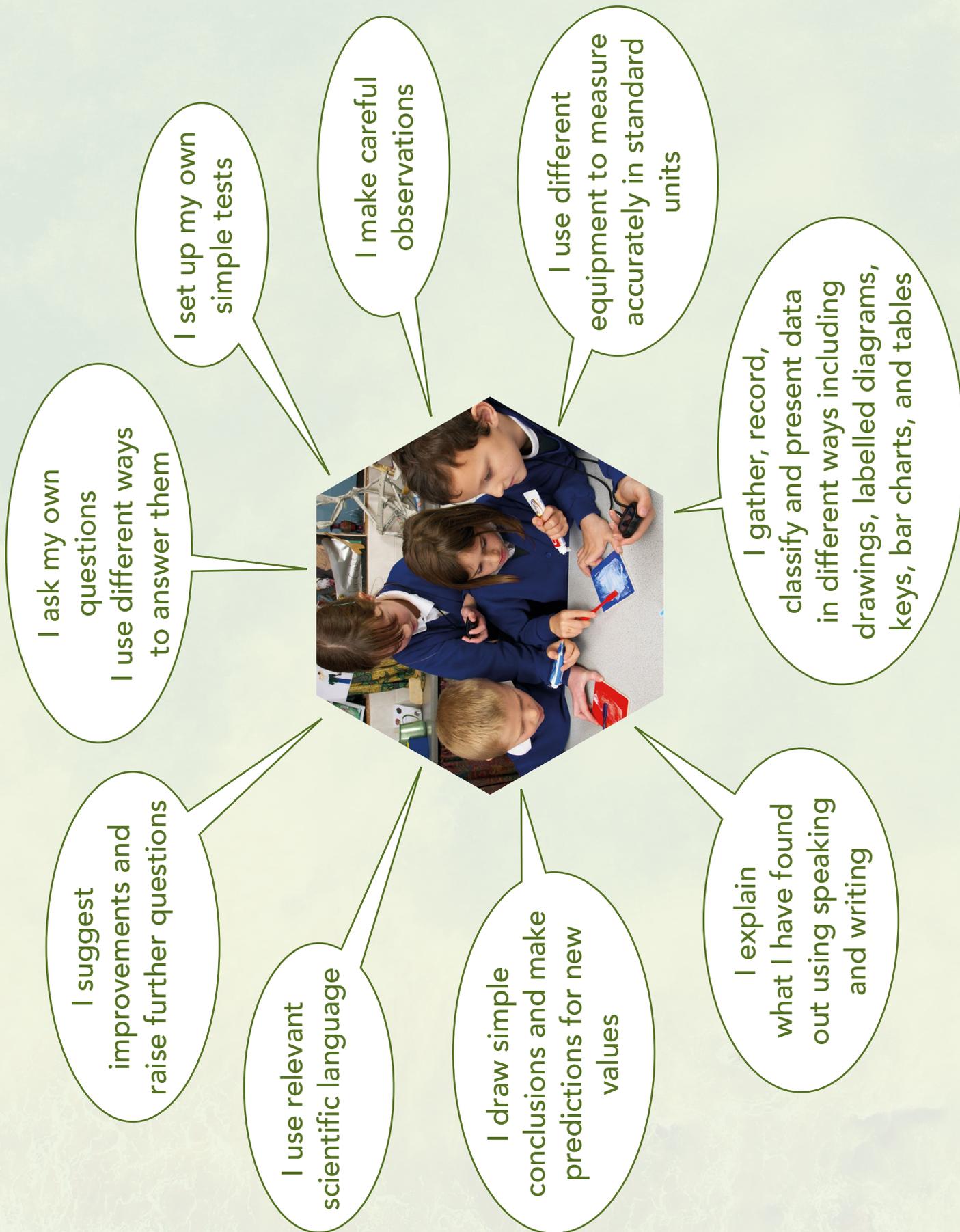
WORKING SCIENTIFICALLY POSTER FOR EARLY YEARS FOUNDATION STAGE



WORKING SCIENTIFICALLY POSTER FOR KEY STAGE ONE



WORKING SCIENTIFICALLY POSTER FOR LOWER KEY STAGE TWO



WORKING SCIENTIFICALLY POSTER FOR UPPER KEY STAGE TWO





CIEC offers support for the teaching of science across the primary age range and beyond. This support includes CPD programmes, bespoke in-school CPD, interactive websites for teachers to use with their pupils, and a wide range of downloadable resources which encourage collaborative, practical problem solving. For more information, please visit our website:

 www.ciec.org.uk

or contact:

 Centre for Industry Education Collaboration
CIEC Department of Chemistry
University of York
York
YO10 5DD

 Telephone: 01904 322523

 email: ciec@york.ac.uk

Revised 2021

The developing and printing of this resource has been made possible thanks to support from the Salters' Institute.

Author: Nicky Waller