Scientific Enquiry

Cheshire and Wirral Science Learning Partnership

Helen Spring

Primary Science and Outdoor Learning Consultant

www.SpringLearning.co.uk

helen@springlearning.co.uk

@SpringLearns





Intended learning outcomes

By the end of this session you will be able to:

- understand how to develop children's skills in collecting data and the progression in collecting data
- have an increased knowledge of progression in scientific enquiry





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Action Planning

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	Ideas							
	Action Plan							





Working Scientifically in my school...







Aims of the Primary Science Curriculum

Aims

The national curriculum for science aims 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.





Why do practical science?



Image : Robert Cooper

"The best science teachers, seen as part of this survey, set out to 'first maintain curiosity' in their pupils."

Maintaining curiosity :

A survey into science education in schools Ofsted Report November 2013 No. 130135





Working Scientifically in the Curriculum

There are non-statutory notes and guidance giving examples of how 'working scientifically' might be embedded, focusing on the key features of scientific enquiry.

Plants

Statutory requirements

Pupils should be taught to:

- observe and describe how seeds and bulbs grow into mature plants
- find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

Notes and guidance (non-statutory)

Pupils should use the local environment throughout the year to observe how different plants grow. Pupils should be introduced to the requirements of plants for germination, growth and survival, as well as to the processes of reproduction and growth in plants.

Note: Seeds and bulbs need water to grow but most do not need light; seeds and bulbs have a store of food inside them.

Pupils might work scientifically by: observing and recording, with some accuracy, the growth of a variety of plants as they change over time from a seed or bulb, or observing similar plants at different stages of growth; setting up a comparative test to show that plants need light and water to stay healthy.





5 Types of Enquiry

The nature, processes and methods of science

'Working scientifically' specifies the understanding of the nature, processes and methods of science for each year group. It should not be taught as a separate strand. The notes and guidance give examples of how 'working scientifically' might be embedded within the content of biology, chemistry and physics, focusing on the key features of scientific enquiry, so that pupils learn to use a variety of approaches to answer relevant scientific questions. These types of scientific enquiry should include: observing over time; pattern seeking; identifying, classifying and grouping; comparative and fair testing (controlled investigations); and researching using secondary sources. Pupils should seek answers to questions through collecting, analysing and presenting data. 'Working scientifically' will be developed further at key stages 3 and 4, once pupils have built up sufficient understanding of science to engage meaningfully in more sophisticated discussion of experimental design and control.





5 Types of Enquiry

- Observing over time
- Pattern seeking
- Identifying, classifying and grouping
- Comparative and fair testing
- Research using secondary sources







5 Types of Enquiry in EYFS

Children know about similarities and differences in relation to places, objects, materials and living things. They talk about the features of their own immediate environment and how environments might vary from one another. They make observations of animals and plants and explain why some things occur, and talk about changes.







'KS1 - pupils should be helped to develop their understanding of scientific ideas by using different types of scientific enquiry to answer their own questions, including observing changes over a period of time, noticing patterns, grouping and classifying things, carrying out simple comparative tests and finding things out using secondary sources of information.'

Science programme of study 2014





'LKS2 - Pupils should ask their own questions about what they observe and make some decisions about which types of scientific enquiry are likely to be the best ways of answering them, including observing changes over time, noticing patterns, grouping and classifying things, carrying out simple comparative and fair tests and finding things out using secondary sources of information.'

Science programme of study 2014





'UKS2 – Pupils should select the most appropriate ways to answer science questions using different types of scientific enquiry to answer their own questions, including observing changes over different periods of time, noticing patterns, grouping and classifying things, carrying out comparative and fair tests and finding things out using a wide range of secondary sources of information.'

Science programme of study 2014





Comparative and Fair Tests

- change something
- keep all other variables the same
- measure, observe, compare the effect

PLAN	DO	REVIEW
raise questionsfair-testpredict	 measure/observe record (usually as tables and graphs) 	 use tables and graphs describe results explain results

Involve children in making decisions





Progression in recording and presenting evidence: EYFS/KS1

How many marbles did each raft hold before it sunk?









Progression in recording and presenting evidence: Lower KS2

Stretch		Shape of :	sail	How far the boat travelled (cm)			
(cm) 8-		Triangle Rectangle Circle Star		28 60 35 31	Type of liquid	How high the liquid went in 3 minutes (cm)	
6-					oil	3	
4-					Retchup	2	
2-					water	7	
_	BATTON	medium	Very wis	xe	lemonade	7	
	hi	dth of elasti	ic band				





Progression in recording and presenting evidence: Upper KS2

Surface	Distance	slid (cm)			the band (cm)		*					
	1st try	2nd try	3rd try	Mean	10							
thin carpet	27	21	24				*		4			
corrugated card	15	19	17		5	×		height	Comparing peo	ople's heig	pht and hand	dspar
thick carpet	24	30	18		<u>.</u>			(cm) 170		× ×		×
matting	22	22	19			10 20	30 40 50 60	160		*	* *	×
Temperatur of water (°C	e Tin) for diss	ne taken sugar to solve (se	conds)	Temp (°c	erature) 20 18		One ice cube	150	trendline ×	* * * *	* *	
20	80				16		×	130	16 17 1 hi	18 19 andspan (cm	20 21	22
30	60				12. 10	×	*					
40	35				8							
50	30				2							
60	27				0	5 10	15 20 25	30 3	5 Time (minutes)			





Table or graph...

Children often choose the wrong type of graph to show their results, or they try to build a graph when it is not appropriate.

If children are taught the generic headings of their charts they will have no problem in identifying what graph to draw.

Use the table here to help children choose the right way to present their results.

What we change (Independent variable)	What we measure (Dependent variable)	Type of graph
words	words	No graph
numbers	words	No graph
words	numbers	Bar chart
numbers	numbers	Line graph





Research using secondary sources







Pattern seeking

Repeat



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.wikihow.com%2FMeas ure-Head-Circumference&psig=AOvVaw0Q4-NJAGbkl7hvga17pSRf&ust=1587707505829000&source=jmages&cd=vfe&ved=2ahU KE witkrTA7f3oAhUq3OAKHTtDB3gQr4kDegUIARD1AQ





Observing over time







Identifying, classifying and grouping













Simple Venn diagram not twisted wrapper **Twisted wrapper**





Further Venn diagrams







Carroll diagram

Carroll diagram	





Asking questions

Play 'Guess Who'



Eliminate as many Quality Streets with each question so that the Quality Street can be identified with the smallest number of questions.





Branching database

Does it have a twisted wrapper?







Resources to support the 5 types of enquiry

lt's not fair or is it?

a guide to developing children's ideas through primary science enquiry



Written and edited by Jane Turner, Brenda Kaogh, Stuart Naylor and Liz Lawrence With contributions from The ASE Primary Science Committee





making physics matter







Planning for the 5 types of enquiry

Year 2	Observing over time	Pattern seeking	Identifying, classifying and grouping	Comparative and fair testing	Research using secondary sources
Living things and their habitats					
Plants					
Animals including humans					
Uses of everyday materials					

























Planning for assessment







Working scientifically skills Year 1 & 2

Asking simple questions and recognising that they can be answered in different ways

- While exploring the world, the children develop their ability to ask questions (such as what something is, how things are similar and different, the ways things work, which alternative is better, how things change and how they happen). Where appropriate, they answer these questions.
- · The children answer questions developed with the teacher often through a scenario.
- The children are involved in planning how to use resources provided to answer the questions using different types of enquiry, helping them to recognise that there are different ways in which questions can be answered.

Observing closely, using simple equipment

- Children explore the world around them. They make careful observations to support identification, comparison and noticing change. They
 use appropriate senses, aided by equipment such as magnifying glasses or digital microscopes, to make their observations.
- They begin to take measurements, initially by comparisons, then using non-standard units.

Performing simple tests

The children use practical resources provided to gather evidence to answer questions generated by themselves or the teacher. They carry
out: tests to classify; comparative tests; pattern seeking enquiries; and make observations over time.

Identifying and classifying

- Children use their observations and testing to compare objects, materials and living things. They sort and group these things, identifying their own criteria for sorting.
- They use simple secondary sources (such as identification sheets) to name living things. They describe the characteristics they used to
 identify a living thing.

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Progression in working scientifically skills

NB - The National Curriculum statements in italics in these tables indicate that they feature more than once.

Year 1 & 2	Year 3 & 4	Year 5 & 6						
Asking questions and recognising that they can be answered in different ways								
Asking simple questions and recognising that they can be answered in different ways	Asking relevant questions and using different types of scientific enquiries to answer them	Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary						
 While exploring the world, the children develop their ability to ask questions (such as what something is, how things are similar and different, the ways things work, which alternative is better, how things change and how they happen). Where appropriate, they answer these questions. The children answer questions developed with the teacher often through a scenario. The children are involved in planning how to use resources provided to answer the questions using different types of enquiry, helping them to recognise that there are different ways in which questions can be answered. 	 The children consider their prior knowledge when asking questions. They independently use a range of question stems. Where appropriate, they answer these questions. The children answer questions posed by the teacher. Given a range of resources, the children decide for themselves how to gather evidence to answer the question. They recognise when secondary sources can be used to answer questions that cannot be answered through practical work. They identify the type of enquiry that they have chosen to answer their question. 	 Children independently ask scientific questions. This may be stimulated by a scientific experience or involve asking further questions based on their developed understanding following an enquiry. Given a wide range of resources the children decide for themselves how to gather evidence to answer a scientific question. They choose a type of enquiry to carry out and justify their choice. They recognise how secondary sources can be used to answer questions that cannot be answered through practical work. 						

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Assessing Working Scientifically

BATTH SPA UNIVERSITY	Overview of TAPS plans for Focused Assessment of Working Scientifically (Any focus can be chosen for open-ended enquiries, these are only suggestions)								
	Plan		Do		Rev	iew			
	Ask Qs and plan enquiry	Set up enquiry	Observe + Measure	Record	Interpret + Report	Evaluate			
KS1 (age 5-7) Develop close obs	Ask simple Qs and recognise that they can be answered in different ways*.	Perform simple tests.	Observe closely, using simple equipment.	Gather and record data to help in answering questions.	Identify and classify. Use appropriate scientific language to communicate ideas.	Use their observations and ideas to suggest answers to questions.			
Y1 TAPS plans	Materials: reflection tests	Materials: floating and sinking	Plants: structure	Seasons: seasonal change	Animals inc Humans: animal classification	Animals inc Humans: body parts			
Y2 TAPS plans	Materials: waterproof	Materials: rocket mice	Plants: compare growth	Living things: woodlice habitats	Living things: nature spotters	Animals inc Humans: handspans			
Lower KS2 (age 7-9) Develop systematic approach	Ask relevant questions and use different types" of scientific enquiries to answer them.	Set up simple practical enquiries, comparative and fair tests.	Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.	Gather, record, classify and present data in a variety of ways to help in answering questions. Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables.	Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions. Identify differences, similarities or changes related to simple scientific ideas and processes.	Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions. Use straightforward scientific evidence to answer questions or to support their findings.			
Y3 TAPS plans	Animals inc Humans: investigating skeletons	Forces: shoe grip Forces: strongest magnet	Plants: measuring plants	Light: making shadows Forces: cars down ramps	Rocks: rock reports	Plants: function of stem Forces: balloon rockets			
Y4 TAPS plans	Sound: investigating pitch	Materials: drying materials	Materials: measure temperature	Living things: local survey	Electricity: conductors Sound: string telephones	Animals inc Humans: teeth (eggs) in liquids			
Upper KS2 (age 9-11) Develop	Plan different types* of scientific enquiries to answer their own questions, including recognising and controlling variables	Use test results to make predictions to set up further comparative and fair tests.	Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate	Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.	Report and present findings from enquiries, inc conclusions and causal relationships, in oral and written forms such as displays and other presentations, using appropriate	Explain degree of trust in results. Identify and evaluate scientific evidence (their own and others') that has been used to support or refute ideas or			
ence	where necessary.				scientific language.	arguments.			
Y5 TAPS plans	Materials: dissolving Materials: nappy absorbency	Materials: insulation layers	Animals inc Human: growth survey Forces: spinners	Materials: sugar cubes Space: craters	Materials: champion tapes Living things: life cycle research	Forces: aquadynamics			
Y6 TAPS plans	Electricity: bulb brightness	Animals inc Humans: heart rate	Light: investigating shadows	Living things: outdoor keys	Living things: invertebrate research	Evolution: fossil habitats Evolution: egg strength			

*Types of enquiry including: observing changes over time, noticing patterns, grouping and classifying, comparative and fair tests, using secondary sources.

(English 2013 National Curriculum statements, additions from Interim Teacher Assessment framework 2016-7)





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Action Planning and Evaluations

Spring Learning								
	Ideas							
	Action Plan							





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