



Enquiry and Working Scientifically

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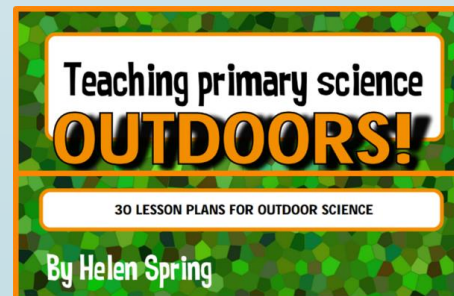
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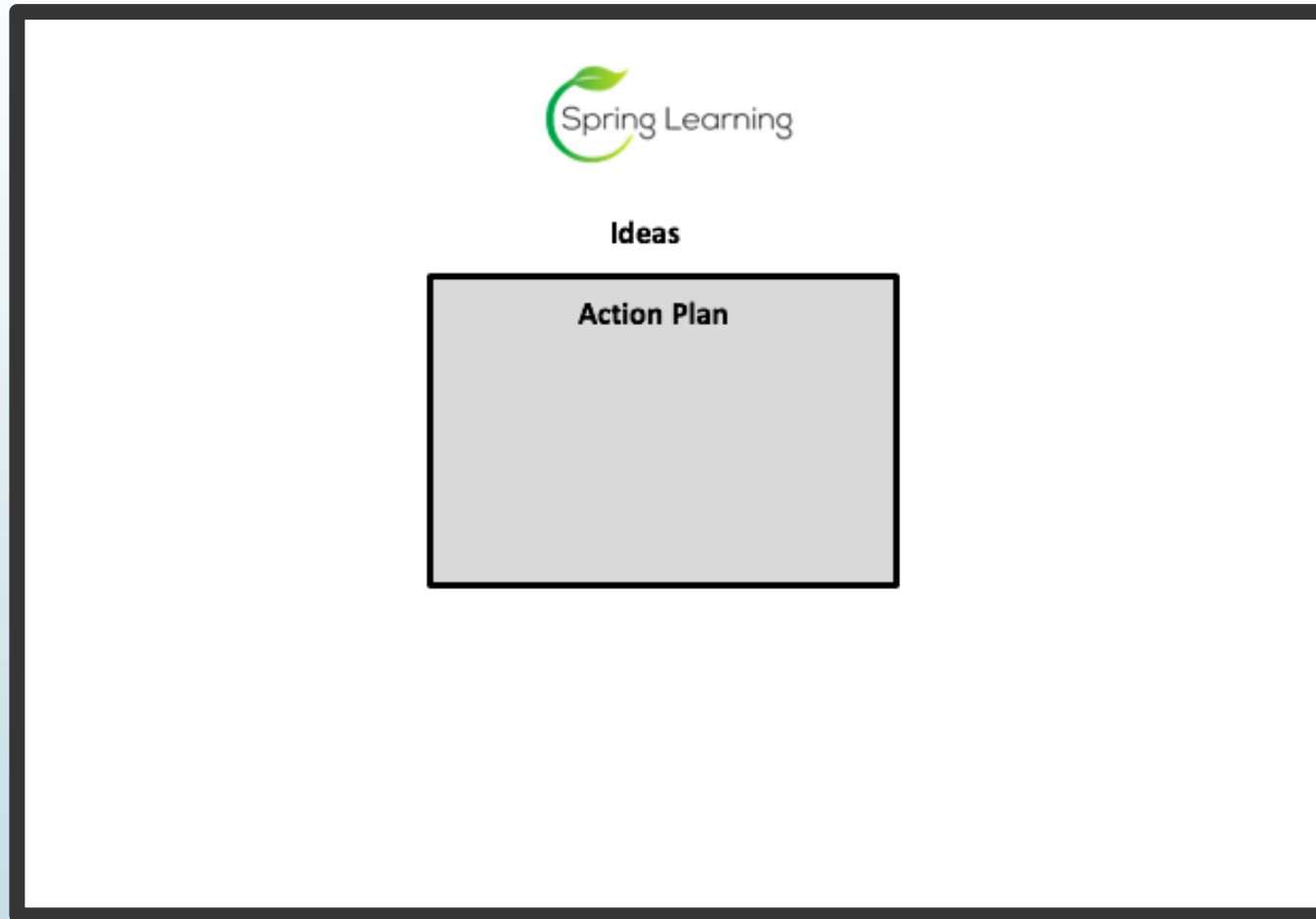
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Spring Learning



Action planning





Learning outcomes

You will be able to:

- Explore where Working Scientifically and Enquiry fit in with PSQM
- Develop understanding of the 5 types of enquiry
- Explore how to raise the profile of the 5 types of Enquiry in our own schools
- Develop understanding of Progression in Working Scientifically
- Explore resources and strategies that can help to develop pupil independence and Working Scientifically Skills



Working Scientifically in my school...



SCIENCE LEARNING

PSQM Science Learning Aim

Science learning is strengthened and developed through a shared understanding of:

- A. the purposes and process of science enquiry;
- B. the purposes of science assessment and current best practice;
- C. the importance of, and strategies for, developing all children's science capital.

These aims are expressed through the following PSQM Science Learning criteria, which define the evidence required to meet them and achieve PSQM, PSQM Gilt and PSQM Outreach.

For Primary Science Quality Mark:

Rd 20 PSQM Science Learning Criteria

Subject leadership develops teachers' practice:

- A. Children are taught to use different enquiry types to answer scientific questions about the world around them, through the use of scientific enquiry skills.
- B. A range of strategies and processes for formative, summative and statutory assessment are used, which reflect a shared understanding of the purposes of assessment in science and current best practice.
- C. Initiatives that encourage all children to think that science is relevant and important to their lives, now and in the future, are supported and promoted.

For Primary Science Quality Mark Gilt and Outreach:

Rd 20 PSQM GILT and OUTREACH Science Learning Criteria

Subject leadership develops and evaluates teachers' practice:

- A. Children develop independence in the full range of enquiry types, using scientific enquiry skills appropriately to answer scientific questions about the world around them.
- B. There is a school-wide commitment to continually improving assessment practice and processes for formative, summative and statutory assessment, through regular evaluation which ensures that they reflect the shared understanding of the purposes of assessment in science and current best practice.
- C. The whole-school community supports and promotes initiatives that encourage all children to think that science is relevant and important to their lives, now and in the future.

PSQM and Working Scientifically

A. Science enquiry

Required task

- Collect examples (planning, photographs and children's work) of how enquiry is planned and taught, linking the leadership activity that has supported this, and of the learning and attitudinal outcomes (both children and teachers). These will be needed to illustrate this criterion in your PSQM submission.

Recommended activities

- Allow children time to explore resources and ideas to see if they can come up with their own questions they would like to investigate. See <https://pstt.org.uk/resources/resources-available-through-tts/explore-engage-extend>
- Provide questions cards and equipment in the playground for children to access science activities outside – they don't all have to be about the environment, they could be observation, comparisons, measuring or estimating. See <https://pstt.org.uk/resources/resources-available-through-tts/playground-science>
- Set up a nature table or a mystery object table for children to ask questions and make observations about.
- Run a Science Day per term or a Science week with open ended topics like 'flight' or 'Balloons' or 'tea parties' or 'Eggperiments'. Provide the stimulus and let them come up with the ideas Use KWL grids to collect the children's questions
- For further question which arise during lessons create a question board to collect the questions to come back to at a later date
- Take part in the Great Science Share, an annual campaign to inspire young people to share their scientific questions with new audiences www.greatscienceshare.org
- Set up a science club, using Crest Investigators
- Read OfSTED: Intention and substance Further findings on primary school science from Ofsted's curriculum research – February 2019 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/777992/Intention_and_substance_findings_paper_on_primary_school_science_110219.pdf What evidence is there in your school of children's scientific understanding developing through enquiry. How can you ensure this?

Recommended PSQM resources (downloadable from the VLE)

PSQM Criterion Activities

- Criterion Activity: L Ai: Developing scientific enquiry types, working scientifically skills

PSQM Spotlights

- Spotlight: Exploring working scientifically

Recommended resources and reading

- It's Not Fair, or is it? ASE Guide to Primary Science Enquiry Turner et al www.millgatehouse.co.uk/shop. A handbook for subject leaders, expanding on five types of science enquiry and explaining how these might be integrated within the science curriculum.
- Wellcome Explorify. A massive range of short and longer activities to stimulate children's observations and questions. <https://explorify.wellcome.ac.uk/en/activities>
- Ogden Trust www.ogdentrust.com/resources-cpd/resources?type=&age=3-5-years,5-7-years,7-11-years&series= A wide range of downloadable resources to support teaching of 5 enquiry types, children's questions and working scientifically skills. Also see www.ogdentrust.com/resources-cpd/resources?series=working-scientifically
- PSTT: Definitions and examples of different types of scientific enquiry <https://pstt.org.uk/resources/curriculum-materials/enquiry-approaches>; Definitions, examples and symbols of different types of science skills <https://pstt.org.uk/resources/curriculum-materials/enquiry-skills>
- Strategies for Assessment of Inquiry Learning in Science Project (SAILS) <http://www.sails-teaching.com/> Teaching and assessing science through an inquiry approach. Harrison et al. King's College, London. Also, Assess Inquiry in Science, Technology and Mathematics Education (ASSISTME). <https://assistme.ku.dk/>
- High-quality picture cards and language prompts to facilitate rational discussion <https://pstt.org.uk/resources/curriculum-materials/i-can-explain>
- Enquiring Science for All, Resources to support enquiry – based learning in science <https://seerih-innovations.org/enquiringscience4all/>

What do you think the aims of the Primary Science Curriculum are?

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.

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.

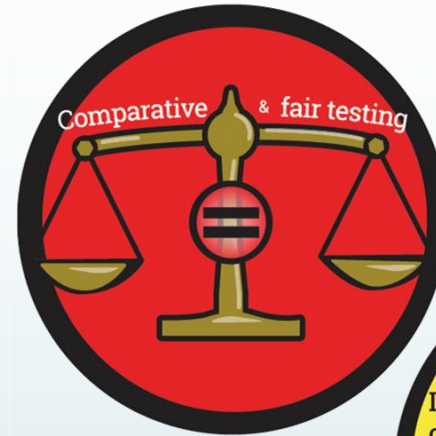
5 Types of Enquiry

- 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.



Progression in Working Scientifically

‘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

Progression in Working Scientifically

‘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

Progression in Working Scientifically

‘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



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwisconsinsskydivingcenter.com%2Fblog%2Fhow-parachutes-work%2F&psig=AOvVaw1M_7zFTwYD1zkRnxMV2PS&ust=1587707271202000&source=images&cd=vfe&ved=2ahUKEwio0MPQ7P3oAhWM_4UKHR1D11Qr4KDegUIARDQAg

Research using secondary sources



Pattern seeking

Repeat



<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.wikihow.com%2FMeasure-Head-Circumference&psig=AOvVaw0Q4-NJAGbkI7hvga17pSRf&ust=1587707505829000&source=images&cd=vfe&ved=2ahUKEwiKrTA7f3oAhUq3OAKHTtDB3gQr4kDegUIARD1AQ>

Observing over time



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.sciencephoto.com%2Fmedia%2F930960%2Fview%2Fsugar-dissolving&psig=AOvVaw0RLVeIVEr-pbxbsyoO1-og&ust=1587707649265000&source=images&cd=vfe&ved=2ahUKEwjN5OaE7v3oAhUI_hQKHWrBMYQr4kDegUIARCSAg

Identifying, classifying and grouping



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.vecteezy.com%2Fvector-art%2F682467-set-of-random-objects&psig=AOvVaw2m4mmZ99sdcP6w1fcw_wZ1&ust=1587707769153000&source=images&cd=vfe&ved=2ahUKEwjnPy97v3oAhUP2eAKHUnbCowQr4kDegUIARCeAg

Resources to support the 5 types of enquiry



making physics matter



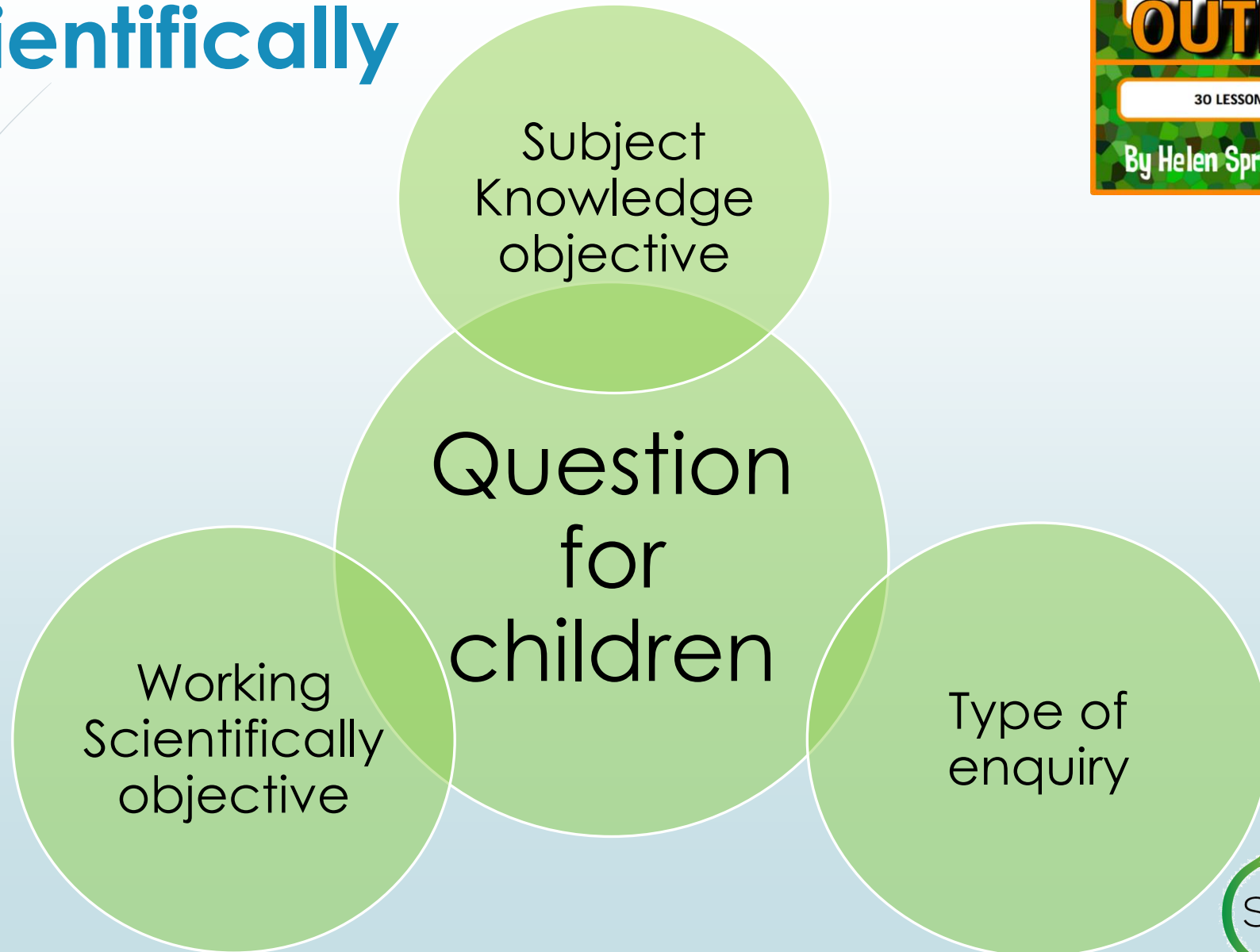
Explorify



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 Working Scientifically



Planning for Working Scientifically

To identify the effects of air resistance

What is the relationship between the size of the canopy and the speed at which it falls?

To plan a fair test, recognising and controlling variables where necessary

Fair testing

Planning for Working Scientifically

Compare and group together a variety of everyday materials on the basis of their simple physical properties

How can we group these materials?

Identifying and classifying

Identifying, classifying and grouping

Progression in Working Scientifically



PLAN

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.



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		
<p>Asking simple questions and recognising that they can be answered in different ways</p> <ul style="list-style-type: none"> 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. 	<p>Asking relevant questions and using different types of scientific enquiries to answer them</p> <ul style="list-style-type: none"> 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. 	<p><i>Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary</i></p> <ul style="list-style-type: none"> 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.

Assessing Working Scientifically



Overview of TAPS plans for Focused Assessment of Working Scientifically

(Any focus can be chosen for open-ended enquiries, these are only suggestions)

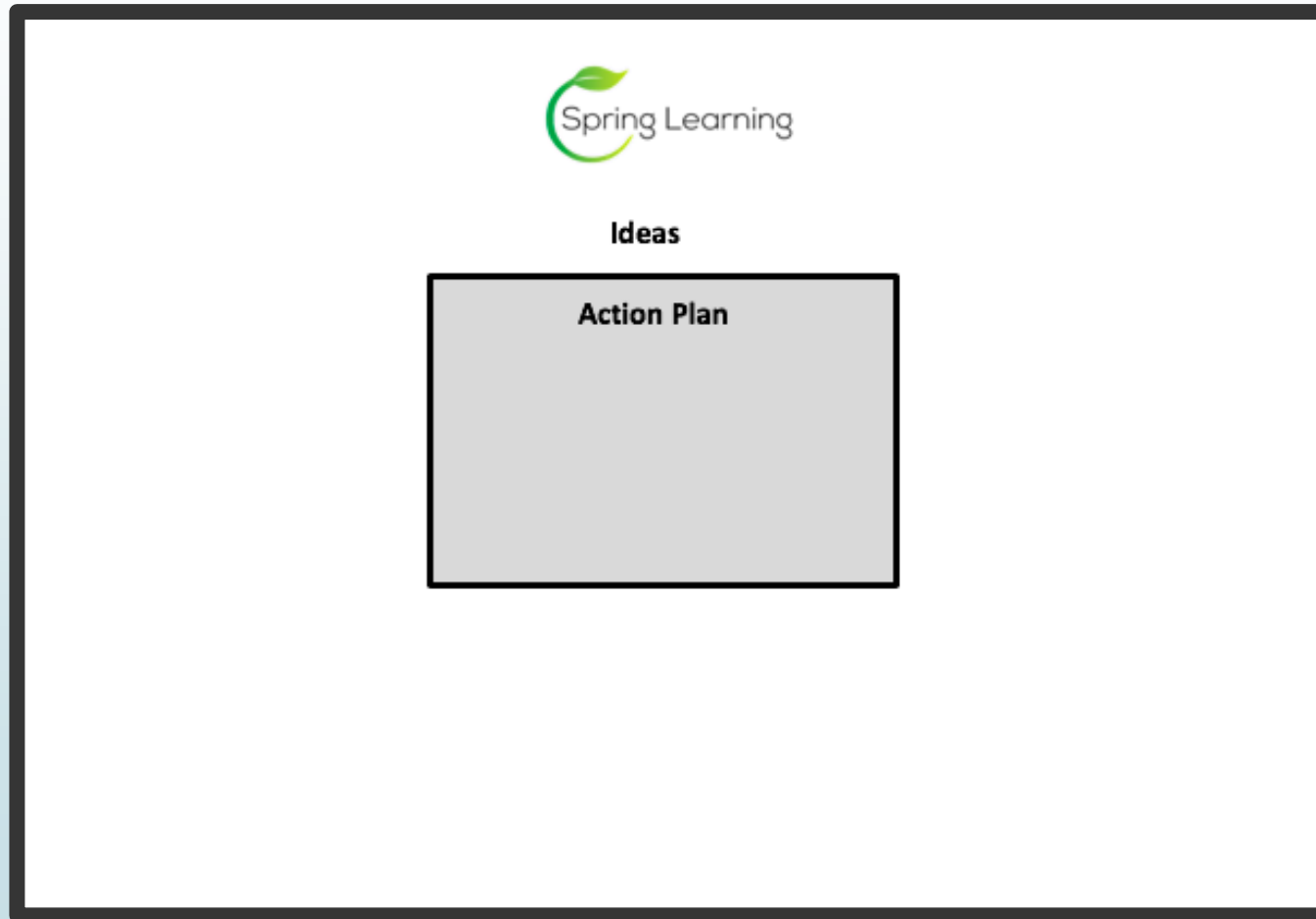


	Plan		Do		Review	
	Ask Qs and plan enquiry	Set up enquiry	Observe + Measure	Record	Interpret + Report	Evaluate
KS1 (age 5-7) <i>Develop close obs</i>	Ask simple Qs and recognise that they can be answered in different ways*.	Perform simple tests.	Observe closely, using simple equipment.	Gather and record data to help in answering questions.	Identify and classify. <i>Use appropriate scientific language to communicate ideas.</i>	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) <i>Develop systematic approach</i>	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) <i>Develop independence</i>	Plan different types* of scientific enquiries to answer <i>their own questions</i> , including recognising and controlling variables where necessary.	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, <i>using appropriate scientific language.</i>	Explain degree of trust in results. Identify <i>and evaluate</i> scientific evidence (<i>their own and others'</i>) that has been used to support or refute ideas or 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

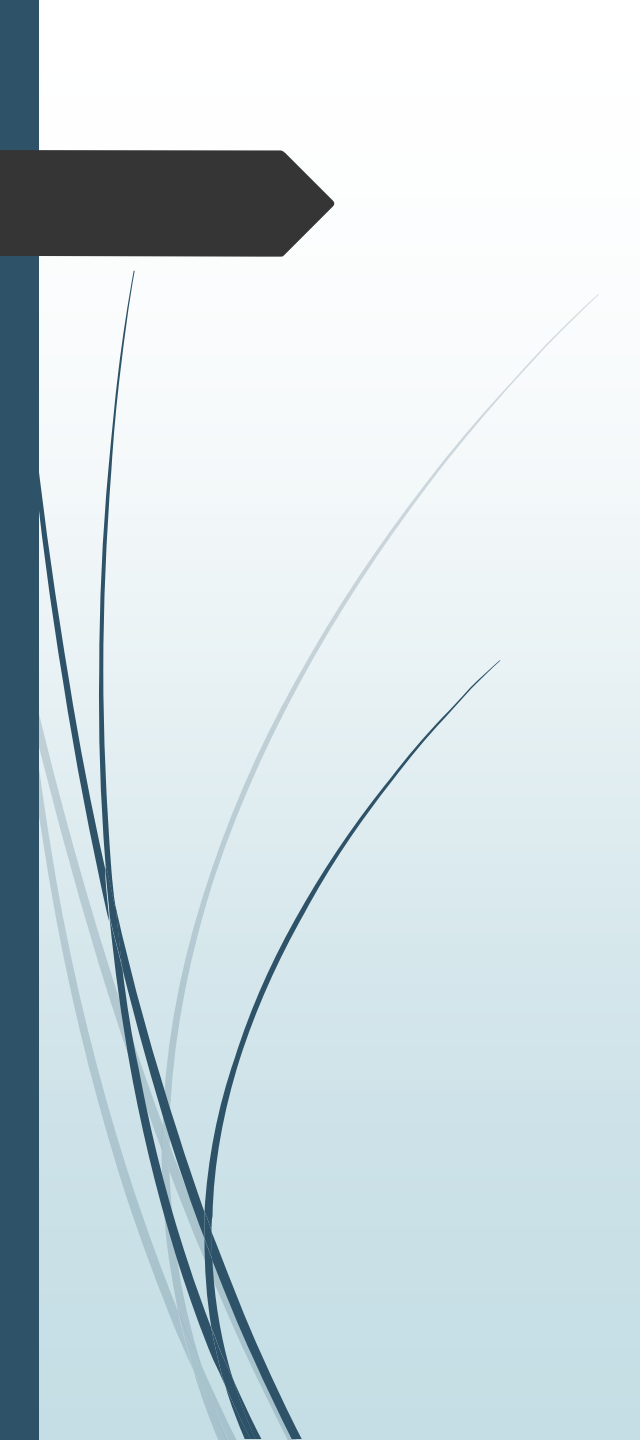
**Types of enquiry including: observing changes over time, noticing patterns, grouping and classifying, comparative and fair tests, using secondary sources.*

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

Action planning and evaluations



<https://www.surveylegend.com/s/27wx>



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