Working Scientifically

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CSciTeach

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CPD MARK
LEAD FACILITATOR

CPD MARK
ONLINE FACILITATOR

Science
ACROSS THE CITY

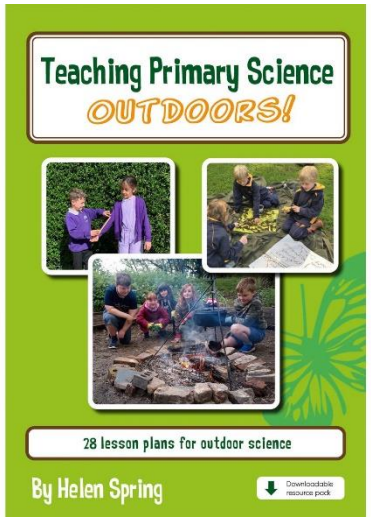
PSQM
Primary Science Quality Mark

HOWSHAM MILL
RENEWABLE HERITAGE TRUST

Explorify
Champion

fascinate

The Association for Science Education
Promoting Excellence in Science Teaching and Learning



POLAR EXPLORER
PROGRAMME

CLEAPSS
primary

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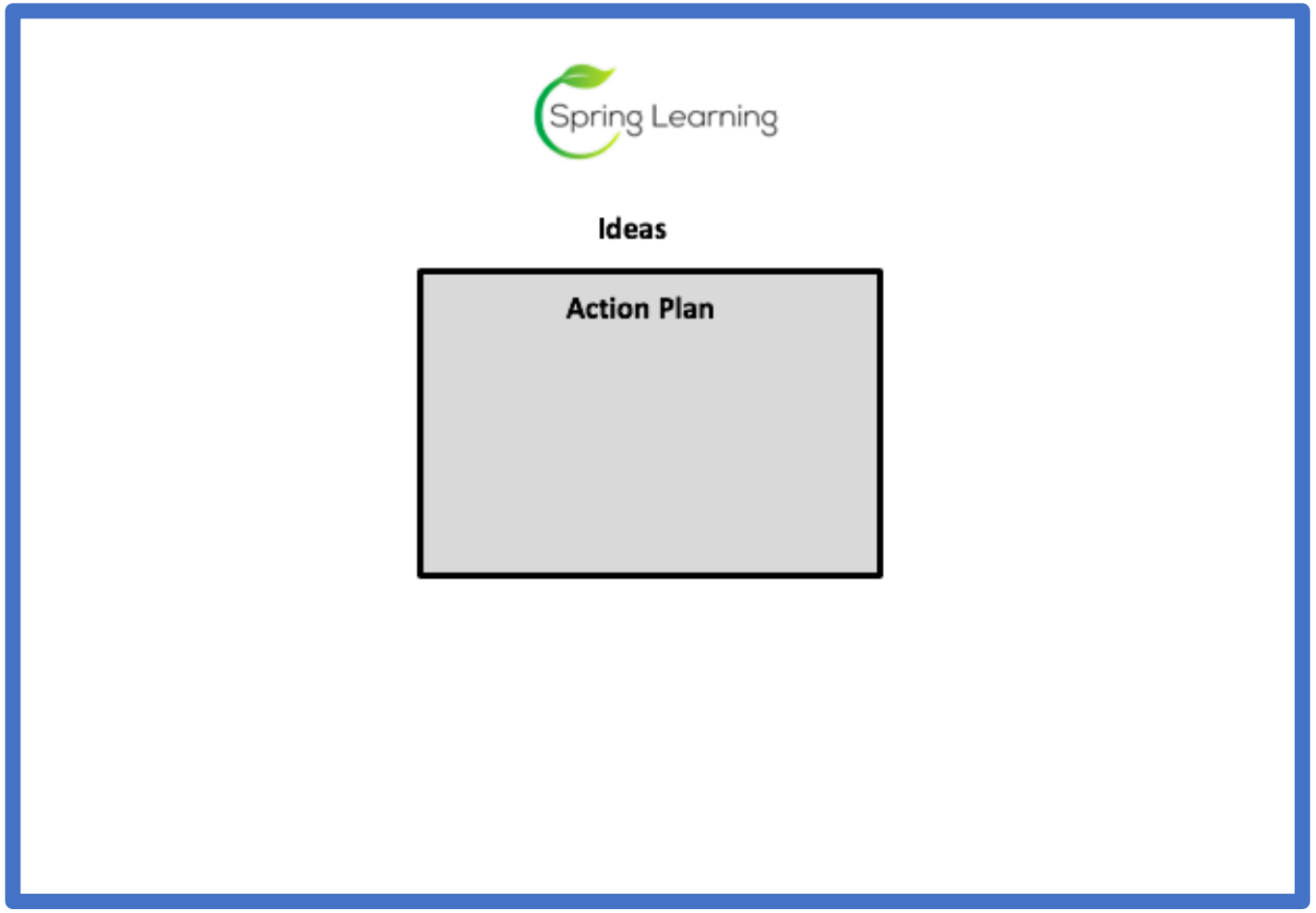
Action planning



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Learning outcomes

You will be able to:

- Explore how to raise the profile of the 5 types of Enquiry in our own classrooms
- Develop understanding of Progression in Working Scientifically and conceptual understanding
- Explore resources and strategies that can help to develop pupil independence and Working Scientifically Skills

Welcome…

What makes good science?

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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.

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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.

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5 Types of Enquiry

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5 Types of Enquiry in EYFS

Science in EYFS

ELG: The Natural World

Children at the expected level of development will:

- Explore the natural world around them, making observations and drawing pictures of animals and plants;
- 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;
- Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter.

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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

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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

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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

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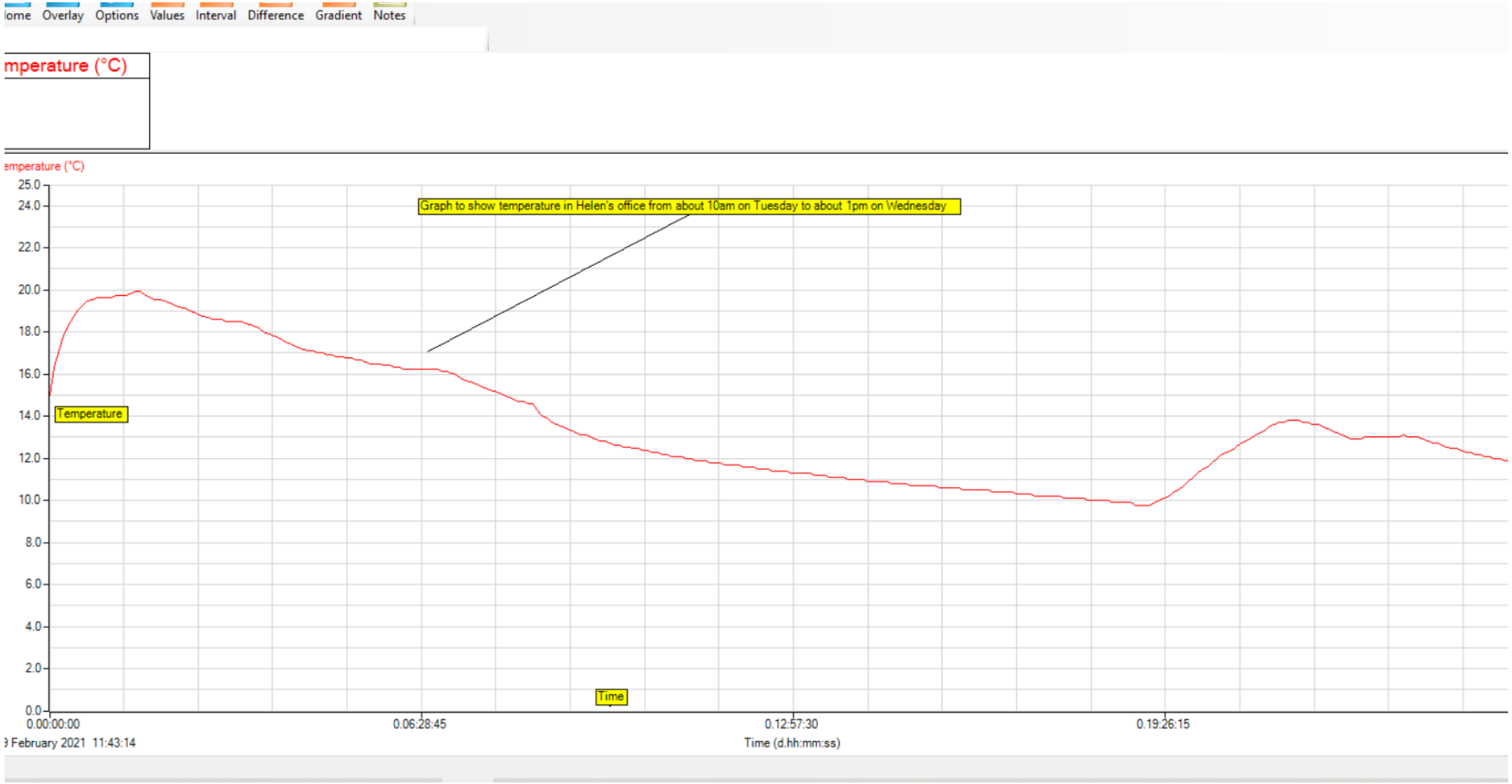
Observing over time



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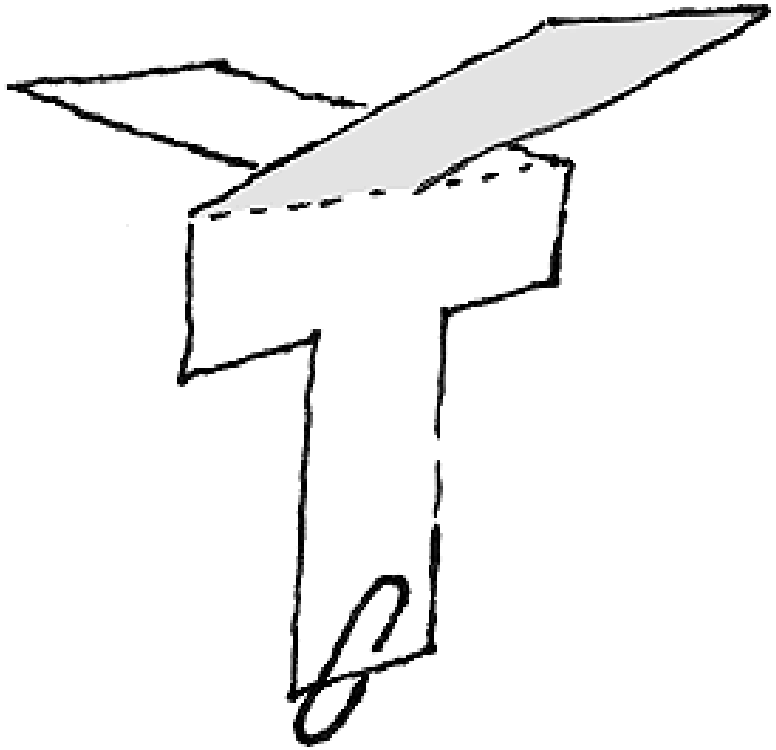
Comparative and Fair Tests



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Research using secondary sources

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Pattern seeking

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Identifying, classifying and grouping

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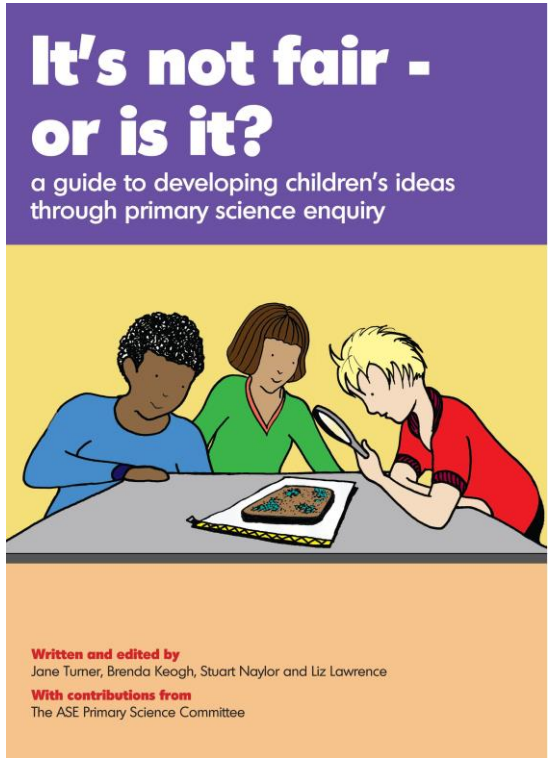
Resources to support the 5 types of enquiry



The Ogden Trust

making physics matter

Explorify

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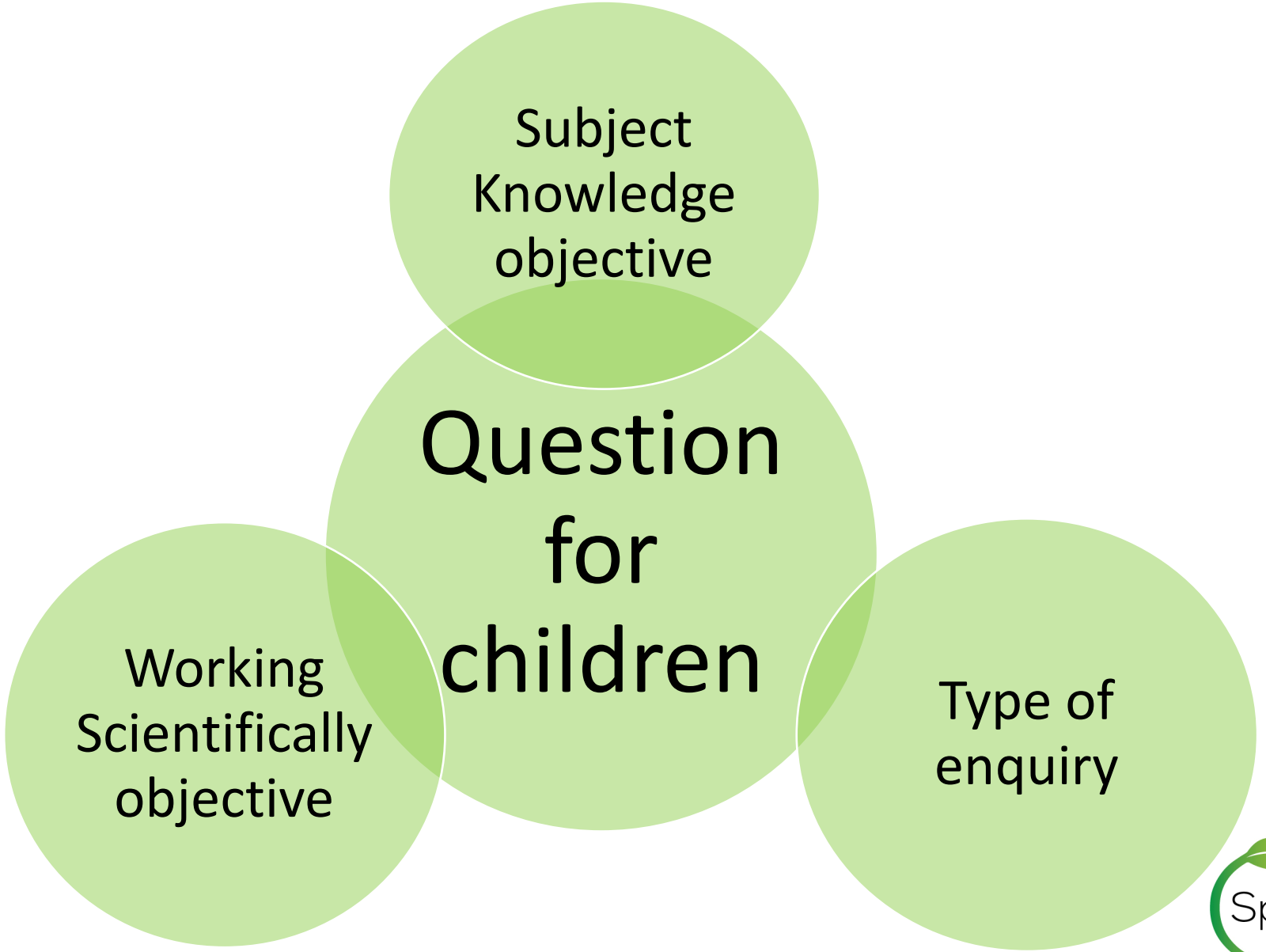
Planning for the 5 types of enquiry

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



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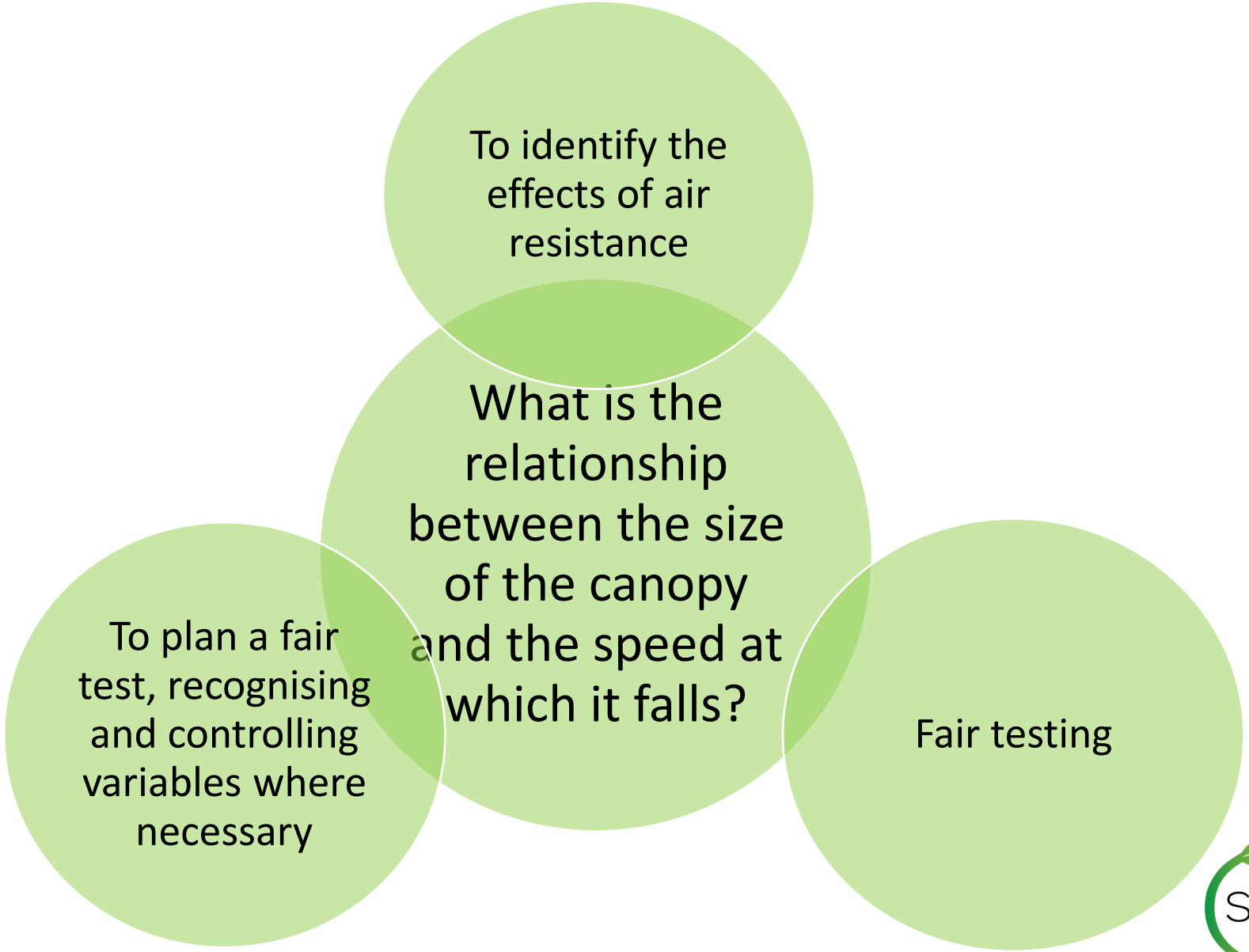
Planning for Working Scientifically



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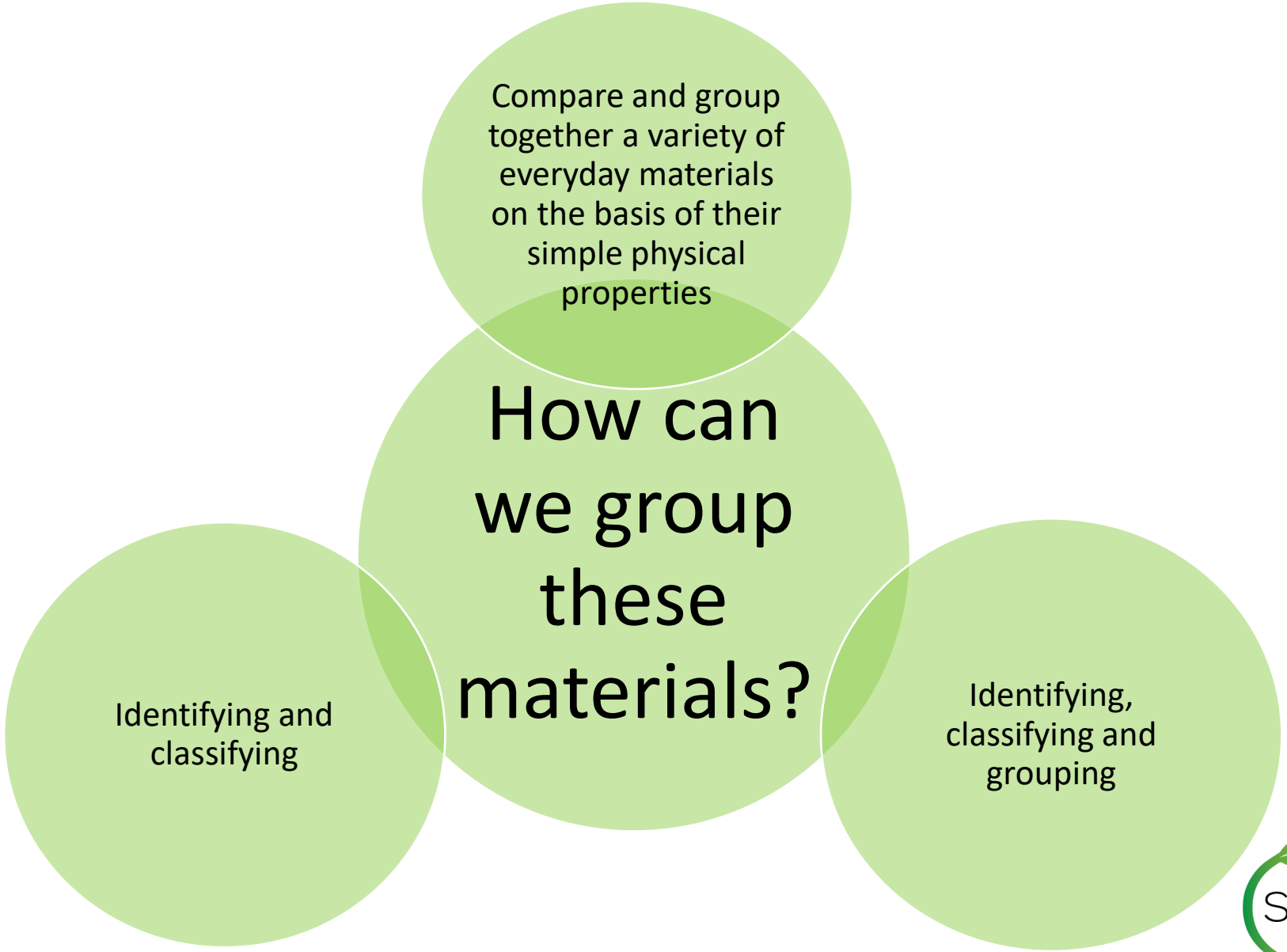
Planning for Working Scientifically



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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) ***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 independ-ence***	Plan different types* of scientific enquiries to answer *their own questions,* 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, *using appropriate scientific language*.	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 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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Why go outside anyway?

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Evolution and inheritance

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Uses of Everyday Materials

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5 Characteristics of Effective Outdoor Learning

1. one that supports children in making the transitions from within the classroom to beyond it
2. one where there is both regular and frequent use of the outdoor setting.
3. fully prepares children for working in the outdoors by addressing the basic psychological and physiological needs of the children before leaving the classroom
4. the teachers manage the transition back to the classroom as consciously as they manage the move to the outdoor setting
5. a shift to weaker framing

HOATH, L. (2015).

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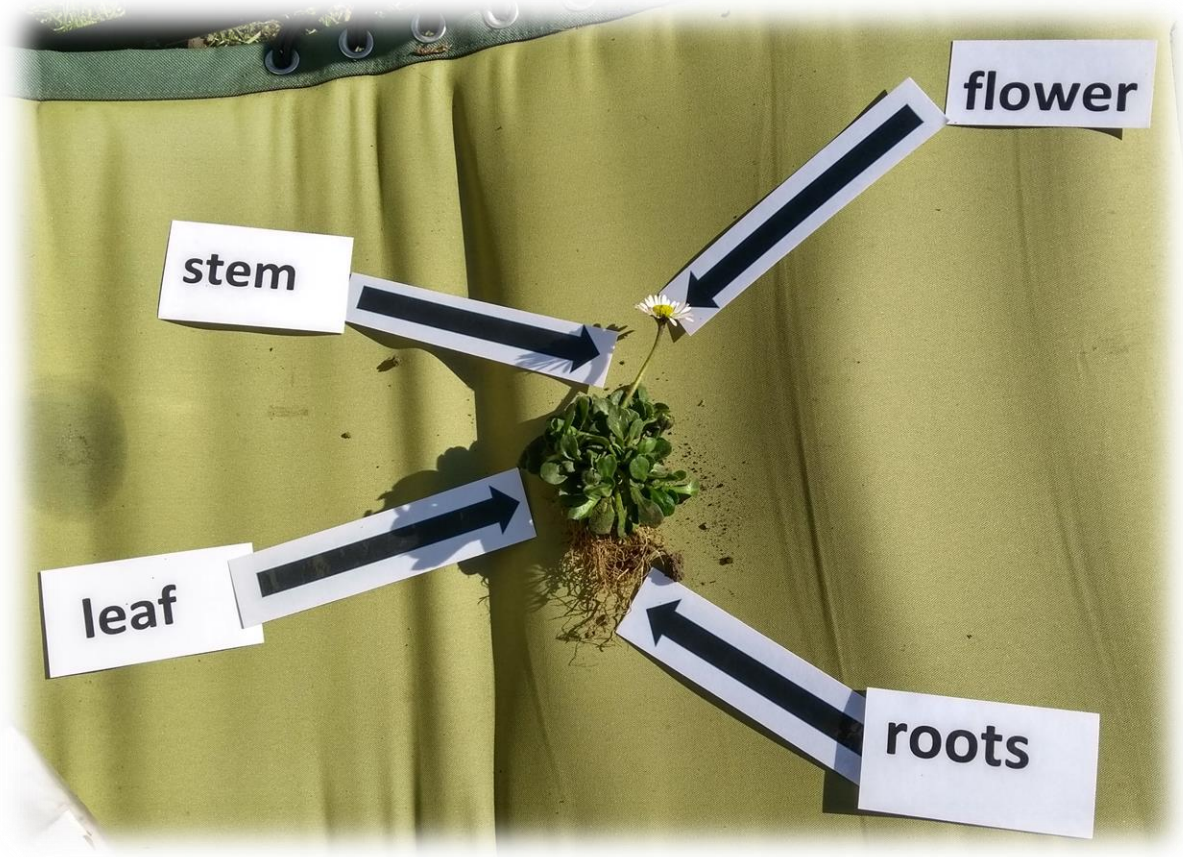
Definitely outdoors….



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Could be outdoors….

Planning to teach science outdoors

Animals, including humans – Year 1

Pupils should be taught to:

- identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals
- identify and name a variety of common animals that are carnivores, herbivores and omnivores
- describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals including pets)
- identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense

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Planning for Outdoor Learning

- Take a copy of the curriculum
- Highlight the obvious opportunities for outdoor learning in your year group (eg – identifying trees)
- In a different colour, highlight the less obvious opportunities for outdoor learning
- Choose one objective and plan how you will teach it outdoors. What barriers need to be overcome in your context?

PLAN
Planning for assessment

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How do you assess **Working Scientifically** in your school?

How do you assess **Conceptual Understanding** in your school?

- Formative assessment
- Summative assessment
- Tests
- Resources

- Practical tasks
- Children's work
- Tracking

What is working well? **What isn't working well?** **What questions do you have?**

Good practice in Assessment of Primary Science

- Assessing Working Scientifically (PSTT TAPS)
- Assessing conceptual understanding (PLAN Assessment)
- An effective tracking system

Year 5																		
Living things and their habitats																		
Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird																		
Describe the life process of reproduction in some plants and animals																		
Animals, including humans																		
Describe the changes as humans develop to old age																		
Properties and changes of materials																		
Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets																		
Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution																		
Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating																		
Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic																		
Demonstrate that dissolving, mixing and changes of state are reversible changes																		
Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda																		

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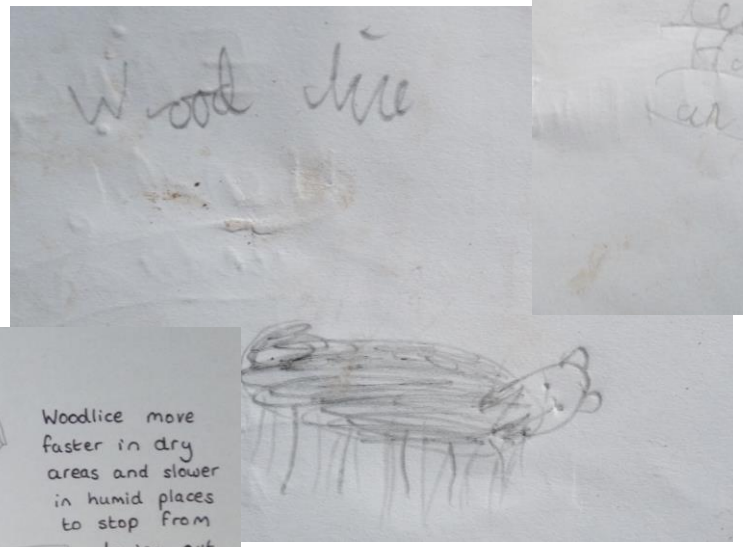
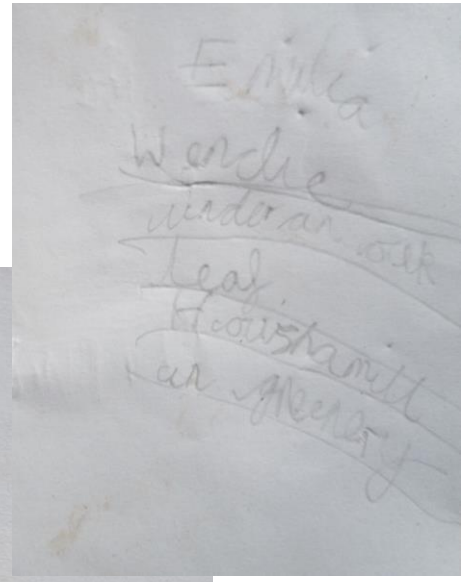
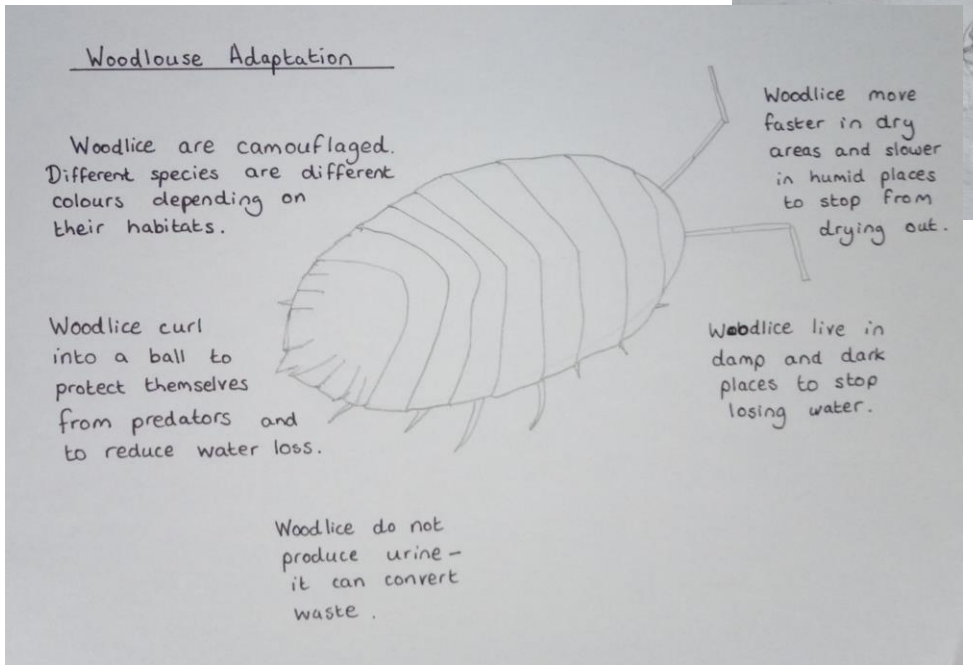
Assessment of conceptual understanding

PLAN
Planning for assessment







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Comparative Examples – ASE PLAN

Testing materials to use for a coat

- identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses

The children were posed the question 'Which materials are suitable for making a coat?' The children were given the range of materials to handle and asked to predict whether they would be suitable for a coat or not. They recorded this on a prepared table. They were then given some additional resources and asked to test each material.

Material tested	Prediction	What happened to the water?	Is it waterproof?
fabric	✗	very wet underneath	✗
paper	✗	very wet underneath	✗
paper towel	✓	very wet	✓
plastic	✓	very wet	✓
felt	✗	very wet	✗
cling film	✓	stayed on top	✓
sponge	✗	stayed on top	✓
foil	✗	stayed on top	✗

There is no consistency in the way that Mollie interprets her results. A material could be wet underneath and be classed as either waterproof or not waterproof. The water may have sat on top but again it may have been classed either way.

Her decision appears to be based on her original prediction rather than the results of the testing.

Testing materials to use for a coat

- identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses

The children were posed the question 'Which materials are suitable for making a coat?' The children were given the range of materials to handle and asked to predict whether they would be suitable for a coat or not. They recorded this on a prepared table. They were then given some additional resources and asked to test each material.

Material tested	Prediction	What happened to the water?	Is it waterproof?
fabric	✗	very wet underneath	✗
paper	✗	very wet underneath	✗
paper towel	✓	it was sucked in	✓
plastic	✓	on top	✓
felt	✓	very wet underneath	✗
cling film	✓	stayed on top	✓
sponge	✓	it was sucked in	✓
foil	✓	sat on top	✓

Max's group chose to place the material over a beaker and put drops of water on using a pipette. Max observed that either 'the water stayed on top, it was wet underneath or the water was sucked in.

Where the water 'was sucked in' by the sponge and the paper towel he interpreted this as indicating that the material was waterproof.

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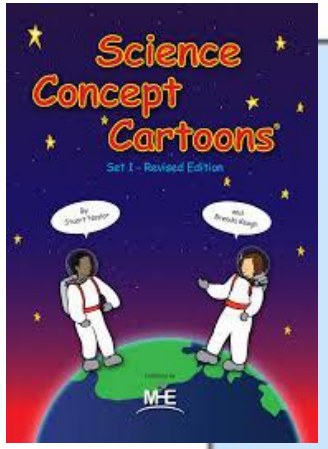


2.10 Rabbits and foxes

There are always more rabbits than foxes

There are more rabbits because they don't need as much to eat

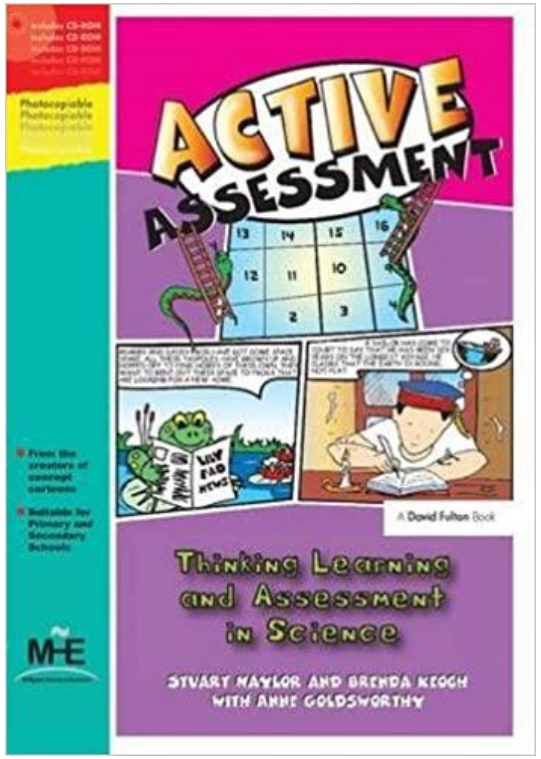
There are more rabbits because they produce more babies

There are more because foxes are at the top of the food chain and have more energy

?

Resources to support assessment of conceptual understanding

Explorify



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PLAN

Planning for assessment

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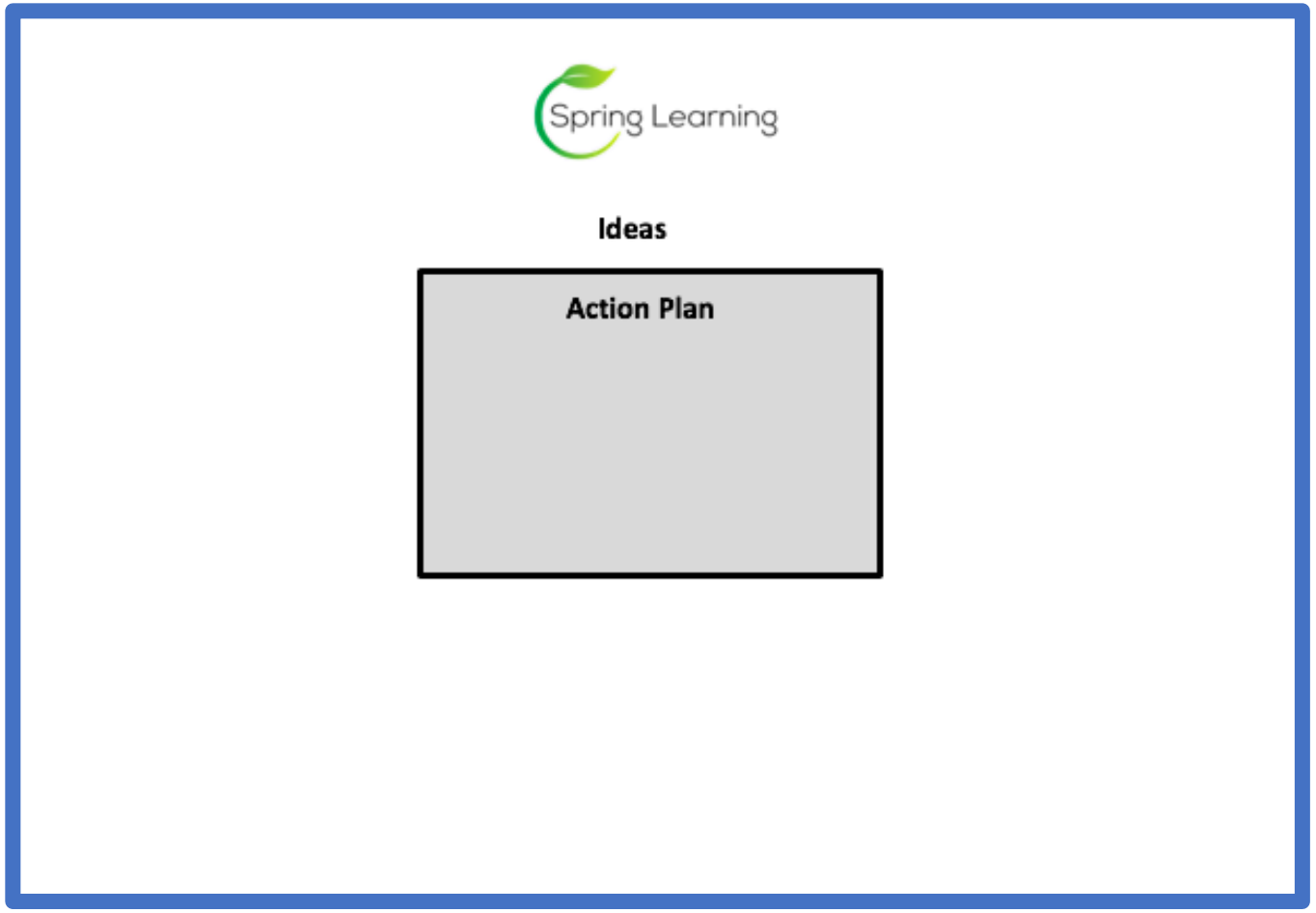
Action planning and evaluations



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