SCIENCE
SCITT Training
Friday 6th March 2020

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Learning Outcomes

- To identify opportunities for “Working Scientifically”
- To develop an awareness of progression of skills of “Working Scientifically”
- To identify the types of questions that could be used, and consider how different ways of asking questions could promote conceptual understanding in science.
- To identify opportunities to incorporate dialogic activities in science teaching.

National Curriculum – Working Scientifically

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.

National Curriculum – Working Scientifically

ASE / King's College Science Investigation in Schools (AKSIS) Project 1998 found that the predominant activity in primary science was ***fair testing***.

The report recommended that ***different types of scientific processes*** should be encouraged.

OLD	NEW
Observation	Observation over time
Fair Test	Comparative and fair testing
Research	Research using secondary sources
Illustration	
Using a model	
Basic Skills	
Exploration	
	Pattern seeking
	Identifying, grouping and classifying

Working Scientifically - What would you do?

The type of investigation can depend on the approach or context taken rather than the curriculum, so it is possible to investigate the same artefact in different ways depending on what is to be achieved.

What is the best cup of tea?

Working Scientifically in Primary Science

Do the tallest children jump the furthest?

What happens to shaving foam over time?

How many ways can you group the objects in the envelope?

Working Scientifically – Progression of skills

Key stage 1 programme of study – years 1 and 2

Working scientifically

Statutory requirements

During years 1 and 2, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking simple questions and recognising that they can be answered in different ways
- observing closely, using simple equipment
- performing simple tests
- identifying and classifying
- using their observations and ideas to suggest answers to questions
- gathering and recording data to help in answering questions.

Notes and guidance (non-statutory)

Pupils in years 1 and 2 should explore the world around them and raise their own questions. They should experience different types of scientific enquiries, including practical activities, and begin to recognise ways in which they might answer scientific questions. They should use simple features to compare objects, materials and living things and, with help, decide how to sort and group them, observe changes over time, and, with guidance, they should begin to notice patterns and relationships. They should ask people questions and use simple secondary sources to find answers. They should use simple measurements and equipment (for example, hand lenses, egg timers) to gather data, carry out simple tests, record simple data, and talk about what they have found out and how they found it out. With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language.

These opportunities for working scientifically should be provided across years 1 and 2 so that the expectations in the programme of study can be met by the end of year 2. Pupils are not expected to cover each aspect for every area of study.

Working Scientifically – Progression of skills

Lower key stage 2 programme of study

Working scientifically

Statutory requirements

During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Notes and guidance (non-statutory)

Pupils in years 3 and 4 should be given a range of scientific experiences to enable them to raise their own questions about the world around them. They should start to make their own decisions about the most appropriate type of scientific enquiry they might use to answer questions; recognise when a simple fair test is necessary and help to decide how to set it up; talk about criteria for grouping, sorting and classifying; and use simple keys. They should begin to look for naturally occurring patterns and relationships and decide what data to collect to identify them. They should help to make decisions about what observations to make, how long to make them for and the type of simple equipment that might be used.

Working Scientifically – Progression of skills

Upper key stage 2 programme of study

Working scientifically

Statutory requirements

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

Notes and guidance (non-statutory)

Pupils in years 5 and 6 should use their science experiences to: explore ideas and raise different kinds of questions; select and plan the most appropriate type of scientific enquiry to use to answer scientific questions; recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why. They should 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. They should make their own decisions about what observations to make, what measurements to use and how long to make them for, and whether to repeat them; choose the most appropriate equipment to make measurements and explain how to use it accurately. They should decide how to record data from a choice of familiar approaches; look for different causal relationships in their data and identify evidence that refutes or supports their ideas. They should use their results to identify when further tests and observations might be needed; recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact. They should use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas and should talk about how scientific ideas have developed over time.

Working Scientifically
Progression in Experimental Skills and Investigation

Experimental skills and investigation

5-7 year olds	2. Ask questions 3. Make observations using simple equipment 4. Recording data
7-9 year olds	1. Use results to make predictions for new values 2. Ask relevant questions 3. Carry out simple investigations 3. Take measurements using a range of equipment 4. Record data in a variety of ways
9-11 year olds	1. Use test results to make predictions to set up further tests 2. Plan investigations to answer questions 3. Take repeated measurements using a range of equipment, considering accuracy and precision 4. Record data in ways of increasing complexity
11-14 year olds	1. Make predictions 2. Plan investigations to answer questions considering safety 3. Take reliable results using a range of equipment, considering reliability of method and suggesting possible improvement 4. Record data gathered using more than one techniques

Working Scientifically
Progression in Analysis and Evaluation

Analysis and evaluation

5-7 year olds

1. Identify and classify
2. Use observations to answer questions

7-9 year olds

1. Present data in a variety of ways
2. Answer questions giving explanations
3. Make simple predictions based on results
4. Suggest simple improvements

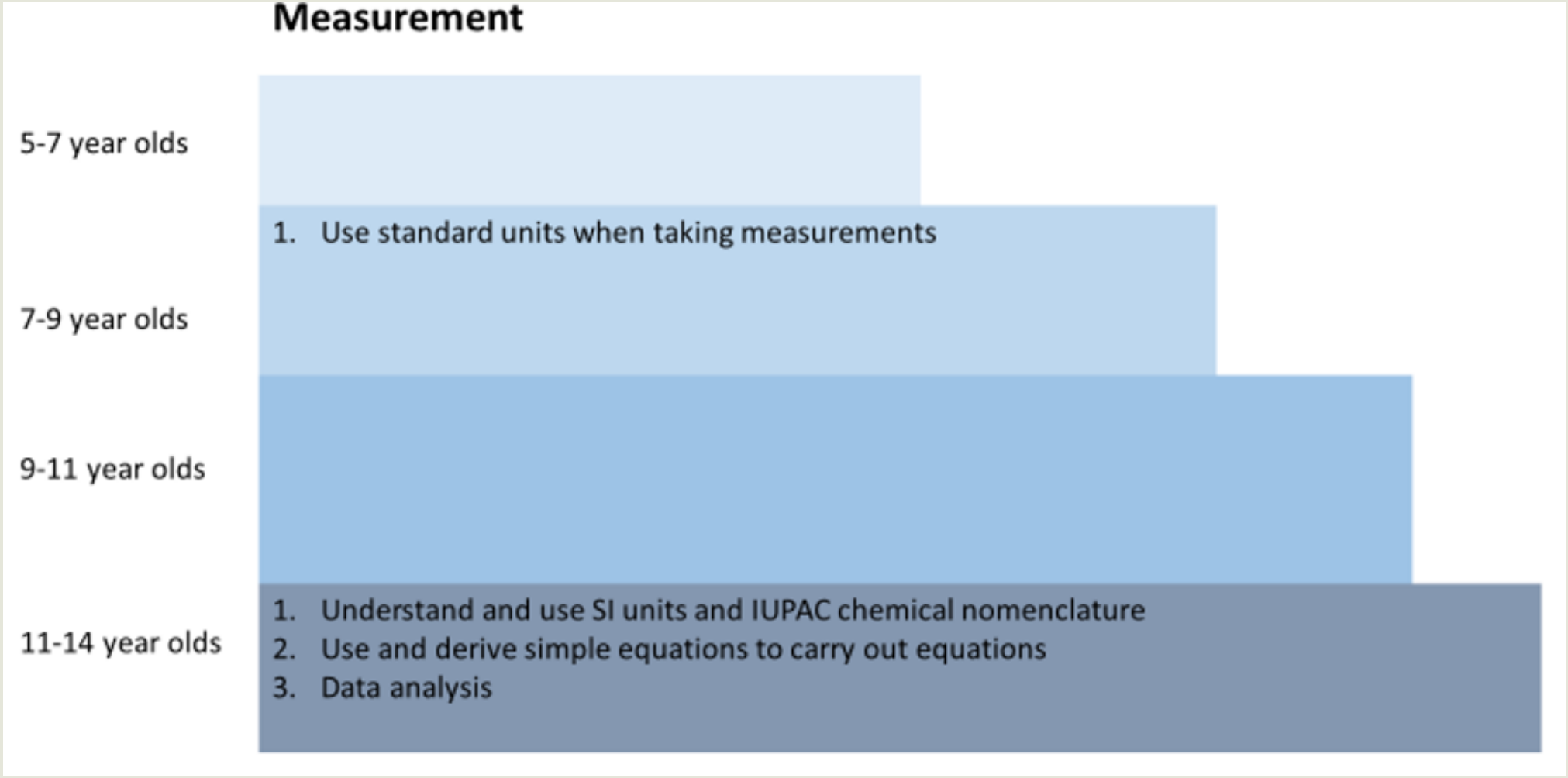
9-11 year olds

1. Present data in ways of increasing complexity
2. Use data to give a scientific conclusion
3. Use results to set up further investigations
4. Suggest improvements to increase degree of trust in results

11-14 year olds

1. Present data choosing appropriate method
2. Draw conclusions based on data giving reasoned explanations in relation to prediction
3. Identify further questions arising from their results
4. Evaluate data taking into account potential sources of error
5. Apply mathematical concepts and calculate results

Working Scientifically
Progression in Analysis and Evaluation



Talk for Learning in Science

- Communication and reflection.
- Learning through interaction with others.
- Acquisition and development of scientific vocabulary.

Talk for Learning in Science

Talk for Learning in Science

"Talk has always been one of the essential tools of teaching and the best teachers use it with precision and flair. But talk is much more than an aid to effective teaching. Children, we know now, need to talk, and to experience a rich diet of spoken language, in order to think and to learn. Reading, writing and numeracy may be acknowledged curriculum "basics", but talk is arguably the true foundation of learning."

Professor Robin Alexander

Alexander, R. (2012) *Towards Dialogic Teaching*, 4th Edition.

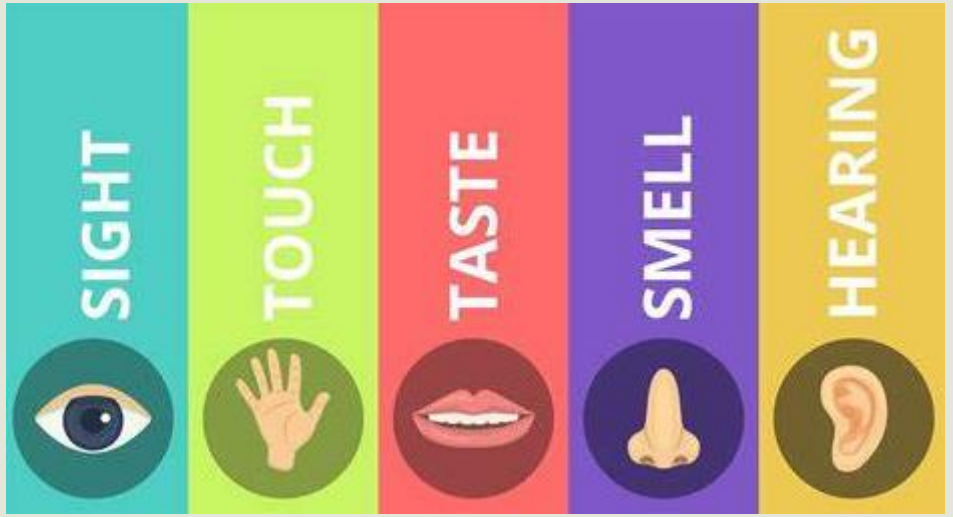
What is Dialogic Teaching?

- Teaching that leads to effective classroom discussions and, ultimately, to deeper learning.
- Sustained contributions from children, with children listening and responding to their peers.
- Teacher scaffolds children to express their ideas and generates a linked discussion.
- Children have “thinking time”
- They have access to each other’s ideas in the same way as exploratory talk, but ideas are moved in a purposeful direction by the teachers intervention and questioning.

How can we encourage talking in science?

Concept Cartoons

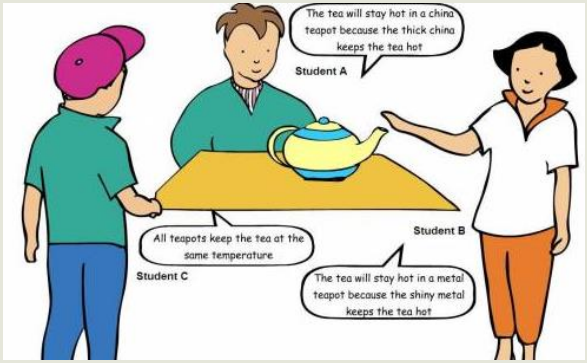
Puppets



Sensory Stimulus

Concept Cartoons in Science

- Created by Brenda Keogh and Stuart Naylor in 1991
- Cartoon characters sharing differing viewpoints about everyday situations.
- Designed to intrigue, provoke discussion and stimulate thinking.
- Often include a common misconception.
- Useful assessment tool at start of topic.



In groups of 3

- Look at the concept cartoon you have been given.
- Discuss different viewpoints.
- Be ready to share your ideas.
- Think about the age range of your children – how could you incorporate this resource into a science lesson?

Explorify

ODD ONE OUT?

What are the barriers that stop children from contributing to whole class or grdiscussions?

Types of Questions

- **Open**

Example: What has happened to your bean since you planted it?

- **Closed**

Example: How much has your bean grown since you planted it?

- **Subject- centred**

Example: Why does sugar dissolve more quickly in warm water than cold?

- **Person-centred**

Example: Why do you think that the sugar dissolves more quickly in warm water than cold?

Types of Productive Questions

- **Attention- focusing**

Have you noticed..?

What do you think of that…?

- **Comparison**

What do you notice is the same / different about…?

- **Measuring and Counting**

How much…?

How long..?

- **Action**

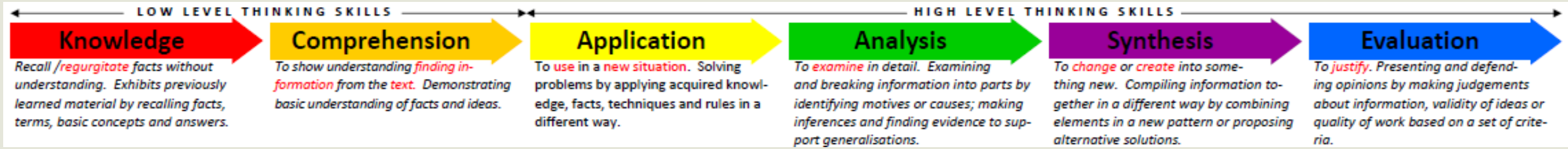
What happens if…?

- **Problem-posing**

Can you find a way to…?

How can you…?

Blooms Taxonomy for Teachers



Questions:

Can you list three ...?
Can you recall ...?
Can you select ...?
How did _____ happen?
How is ...?
How would you describe ...?
How would you explain ...?
How would you show ...?
What is ...?
When did ...?
When did _____ happen?
Where is . . . ?
Which one ...?
Who was ...?
Who were the main . . . ?
Why did ...?

Questions:

Can you explain what is happening . . . what is meant . . .?
How would you classify the type of ...?
How would you compare ...?contrast ...?
How would you rephrase the meaning ...?
How would you summarise ...?
What can you say about ...?
What facts or ideas show ...?
What is the main idea of ...?
Which is the best answer ...?
Which statements support ...?
Will you state or interpret in your own words ...?

Questions:

How would you use...?
What examples can you find to ...?
How would you solve _____ using what you have learned ...?
How would you organise _____ to show ...?
How would you show your understanding of ...?
What approach would you use to...?
How would you apply what you learned to develop ...?
What other way would you plan to ...?
What would result if ...?
Can you make use of the facts to ...?
What elements would you choose to change ...?

Questions:

What are the parts or features of ...?
How is _____ related to ...?
Why do you think ...?
What is the theme ...?
What motive is there ...?
Can you list the parts ...?
What inference can you make ...?
What conclusions can you draw ...?
How would you classify ...?
How would you categorise ...?
Can you identify the difference parts ...?
What evidence can you find ...?
What is the relationship between ...?
Can you make a distinction between ...?
What is the function of ...?
What ideas justify ...?

Questions:

What changes would you make to solve...?
How would you improve ...?
What would happen if...?
Can you elaborate on the reason...?
Can you propose an alternative...?
Can you invent...?
How would you adapt _____ to create a different...?
How could you change (modify) the plot (plan)...?
What could be done to minimise (maximise)...?
What way would you design...?
Suppose you could _____ what would you do...?
How would you test...?

Questions:

Do you agree with the actions/outcomes...?
What is your opinion of...?
How would you prove/disprove...?
Can you assess the value/importance of...?
Would it be better if...?
Why did they (the character) choose...?
What would you recommend...?
How would you rate the...?
What would you cite to defend the actions...?
How would you evaluate ...?
How could you determine...?
What choice would you have made...?
What would you select...?
How would you prioritise...?
What judgement would you make about...?

Before Next Session

- Sign up for free Explorify account.
*https://**explorify**.wellcome.ac.uk*

- Try an **odd one out** or **zoom in zoom out** activity with your class.

- Be ready to share next session.