

## Depth of learning leading to greater depth learners: A Science focus.

### Introduction

Since the removal of levels in 2016 and the move towards pupils either meeting the 'expected standard' or working 'at greater depth within the standard', questions have been raised about what greater depth looks like particularly in a system where schools have had the autonomy to devise their own systems and define, for the most part, what children should be able to achieve in the years where there is no formal end of key stage assessment. For us, the schools who form the Inspire Partnership multi-academy trust, this came to the forefront of our minds during Woodhill Primary School's Ofsted inspection of Summer 2016. Leaders were quizzed about whether our year 3 children were at the expected standard in Geography; about whether there were any children who were working at greater depth in French or in Art and how we knew. The short answer is...we didn't. No-one did. Apart from a handful of checklist style statements produced by the DFE for Writing, 'Greater depth' was new-new to everyone. Never an organisation to stand still, we set off on our journey to define and later exemplify greater depth, first in English and Maths, and then other curriculum areas.

As a trust, we pride ourselves on the collaborative nature of our work, and like everyone else have spent the last couple of academic years, working together to define 'Greater depth' in all curriculum areas and across all year groups. To understand what it means to be 'working at greater depth', one has to first provide opportunities for deeper learning. So what is deeper learning? And how can it be defined? Before tackling these questions, we as a group of schools realised that in order to plan for greater depth we had to have the curriculum to enable opportunities for rich, purposeful learning. Our curriculum working party have been leading the way with a curriculum designed to ensure that the principles of the work we do reinforces the messages to our staff that depth of learning is about topic choices which promote relationships, curiosity, seeking meaning and enabling children to follow their passions.

Transforming children's lives  
through partnership and collaboration

Put simply we believe depth of learning can be achieved when:

- Children form a relationship with their learning and therefore being zealous about this learning;
- The learning has human significance so it's relevant to the future decisions and the active contribution our children can make to the world; Learning that teaches the children how to live as well as how to learn.
- Collaboration is at the heart learning. Discussion, debate, communication, creativity and critical thinking skills are all valuable currency in an increasing complex world
- Deeper thinking and reflection are prominent aspects of the Curriculum design. Teaching children how to reflect, explain, justify, question are key to lesson design. Learning must be slowed down and focus much less on coverage.

As our work around depth of learning leading to greater depth developed, we established a number of working parties, including one with a Science focus. A shared vision around depth of learning having deep roots in collaboration, reflection, justification and the learning not only needing to be purposeful but also relatable was clear from the offset and crucially these aspects lend themselves well to Science and to all aspects of scientific enquiry and to 'working scientifically.'

### **Teaching children to reflect, explain, justify and question are key to lesson design.**

Key to this piece of work, to enabling children to think deeper and therefore to learn at greater depth were the teachers in our schools; talk had to be a huge feature and scaffolds and frames whether in the form of questions or sentence starters would support this journey. The first challenge was to provide these and in the same way that we had implemented them in English, Maths and whole class reading, to then successfully introduce them, making them the norm in our classrooms just as they had been (and continue to be utilized so successfully) in the aforementioned subject areas. This led to focussed thought provoking questions being used, each one relevant to a different area of the 'Working Scientifically' element of the National Curriculum and each strand, each question age appropriate. A sample can be found below.

## Transforming children's lives through partnership and collaboration

For example in Key Stage 1...

Observing closely, using simple equipment	What do you notice? What might happen if you...instead of...? Why do you think...happened?
Performing simple tests	How could you test...? Why did you...? Why wouldn't you...? What would happen if you...?
Identifying and classifying	Why did you put... in this group? Where would...go in your groups? Explain your thinking. Why wouldn't...go in this group?
Using their observations and ideas to suggest	What did you discover? Who might need to use your findings? Why do you think this? How would you prove this idea is right?

... Lower Key Stage Two...

Gathering, recording Classifying and presenting data in a variety of ways to help in answering questions	What would be the benefit of repeating your test results? How could I improve my recording? (give example table) How could I present my results in a clear way? Would you use a pictogram, bar graph or line graph to present your ideas? Why?
identifying differences, similarities or changes related to simple scientific ideas and processes	How would this be different if _____? I think that .... Use your results to explain if I am likely to be right or not? How could I prove it? How would your results apply to _____?
using straightforward scientific evidence to answer questions or to support their findings.	Bob thinks... Use your results to justify if he is right or wrong.

...And Upper Key Stage Two

<p>using test results to make predictions to set up further comparative and fair tests</p>	<p>Explain your thinking using what you already know.          ___ thinks ___ will happen. Do you agree?          Explain.          How would you improve the test to make sure your results are accurate?          What questions have arisen from this enquiry?          How would you answer/test them?          I know want to know ___. How could I prove this right or wrong?</p>
<p>identifying scientific evidence that has been used to support or refute ideas or arguments.</p>	<p>___ thinks ___, use your results to explain whether they are right or wrong.          How did ___ prove ___?          Use your learning to explain...          How could you prove.... Is right or wrong?          Is one piece of evidence enough to justify an idea? Explain your thinking.</p>

Credit: Jodie Waterton (Woodhill Science co-ordinator)

**Collaboration is at the heart of learning. Discussion, debate, communication, creativity and critical thinking skills are all valuable currency in an increasing complex world.**

By everyone pulling in the same direction, the creation of and sharing of resources and striving towards greater depth, teachers become even more empowered to take risks, to think outside the box, to innovate. It's that innovation that makes them think beyond the surface of their existing knowledge and to have no other choice than to make links, to reason scientifically and to justify their opinions skillfully using scientific vocabulary.



Transforming children's lives  
through partnership and collaboration

***'Most great learning happens in groups. Collaboration is the stuff of growth.'***  
**Ken Robinson**

The above image (R) encapsulates many of the elements we believe to comprise 'deeper learning'. The children are exploring 'Sound' in Year 4 and as an introduction, discuss and debate how the sound is created when attached to various fruits and vegetables. They then used the skills of reflecting, questioning and explaining their reasoning using appropriate scientific vocabulary.

On this occasion, a year 4 child offered this reflection 'It was fascinating to hear the different sounds that the fruits made. Because the potato was quite dense it took longer for the sound to go through it and the pitch was much higher with the broccoli.'

**Deeper thinking and reflection are prominent aspects of the curriculum design. Teaching children how to reflect, explain, justify, question are key to lesson design. Learning must be slowed down and focus much less on coverage.**

Learning prompts are used frequently in order to challenge the children's thinking and to think outside the box, justifying their responses, often when there are multiple possible responses to a question or statement. For example, the use of 'odd one out' tasks where children were given three materials to ponder, as detailed below encourage the children to make links using their pre-existing scientific knowledge and provide reasons for their responses. The use of 'Odd one out' in Science encourages children to think carefully, considering scientific reasoning for the responses often with scenarios where the answer is not always clear, or where there is more than one possible response or solution.

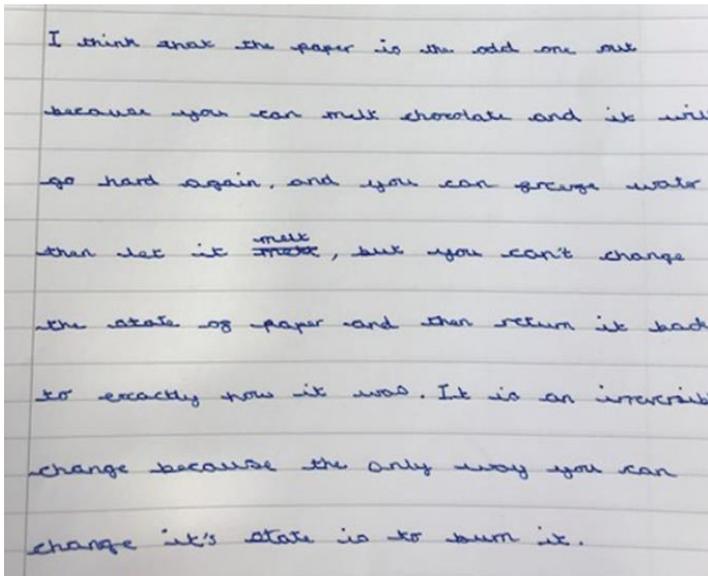
**Challenge:**

Which object is the odd one out? Why? Is there more than one object that could be the odd one out? Prove it.





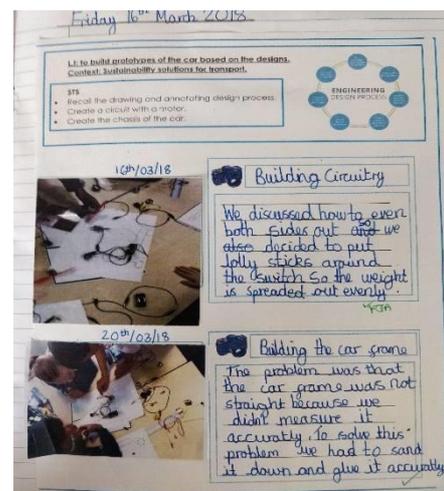
In the example (below), the child uses their knowledge of materials of properties to justify why there could be more than one solution. The child uses scientific vocabulary such as 'state' and 'irreversible' when giving their reasons in the explanation.



Further opportunities for children to think deeper can be provided through seemingly routine scientific investigations within the working scientifically aspect of the National Curriculum.

In the following example from year 5, the children had been making links within and across subjects as part of their STEM week project to design and create a car using learning from D&T and electricity learning from their Science unit.

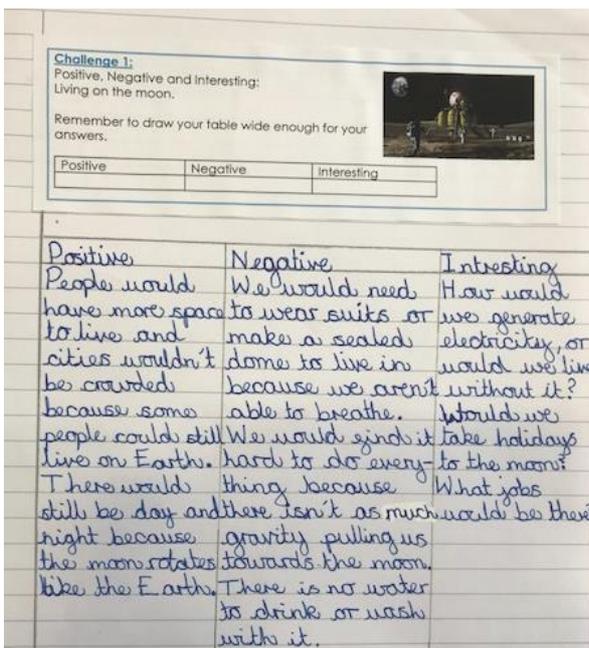
This child has reflected and evaluated their work using relevant scientific vocabulary. She has then suggested how to improve her work to create an all-round better product and has justified her opinions about how this could be achieved appropriately.



Other learning tasks which have been used across key stages one and two to promote deep learning include 'Positive. Negative. Interesting.' When given a Scientific focus, as this child has below with the forces topic, children have to think critically to consider aspects of Science that fit into each of the three headings.

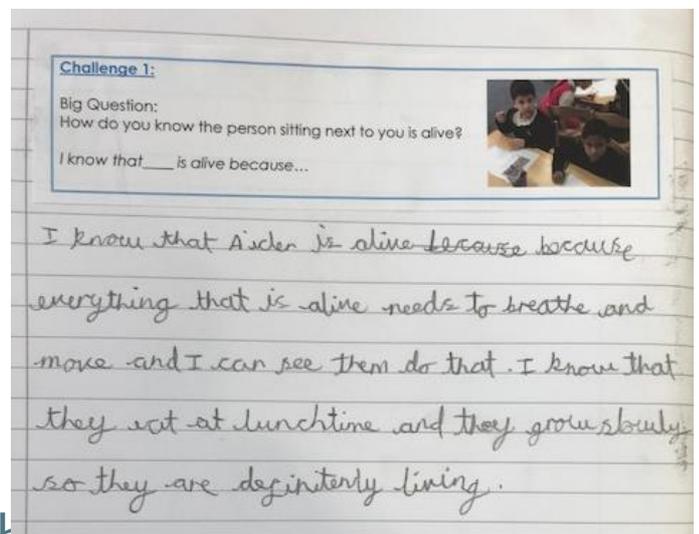
*A world without gravity.*

Positive	Negative	Interesting



Here, during learning about 'Earth and Space', the child has considered the different pros, cons and curiosities about living on the moon. This enabled the child to draw on scientific knowledge such as the difficulty one might have breathing in space as well as further practical issues relating to electricity and jobs. They have also made a connection to day and night and the role the earth and sun have in this.

Then, there's the idea of a 'Big question' which leads children to reason scientifically about challenging ideas or concepts. Some of the examples below, when posed at the correct time can lead to rich discussion where children can then agree with, challenge or build on the opinions of their peers, all of which helps to deepen the learning experience of the children as scientists.

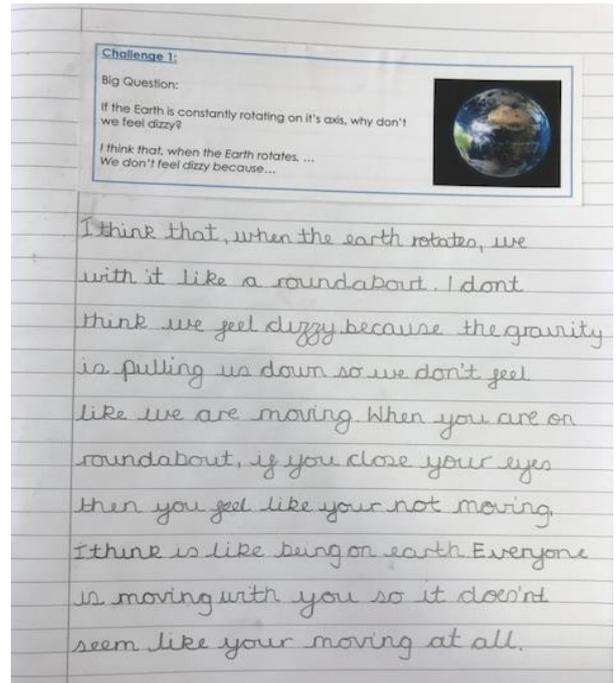
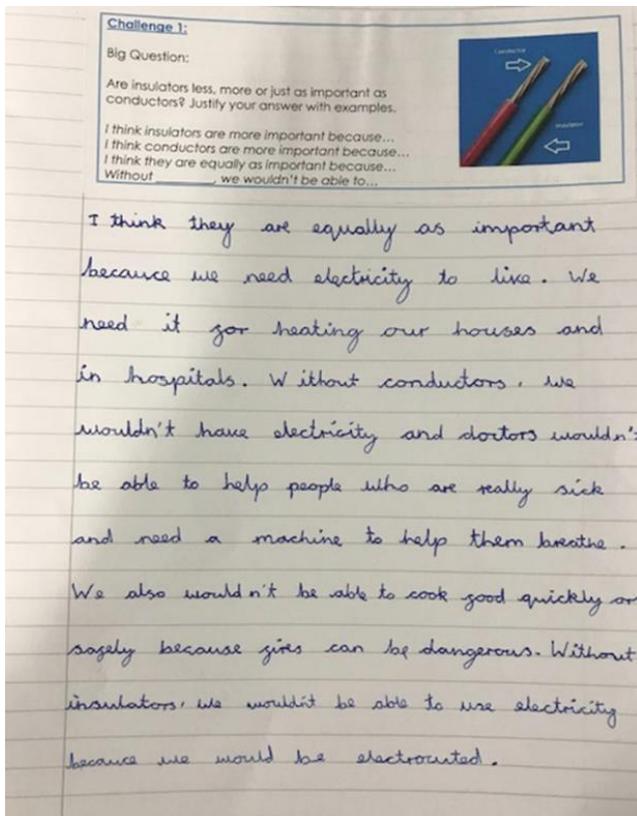




[www.inspirepartnership.co.uk](http://www.inspirepartnership.co.uk)

In the above example from Year 1, the child has drawn on his knowledge about living things by making a connection between scientific characteristics of living things such as being able 'to breathe and move' and forging that link between lunchtimes and the fact that children grow taller.

In this example (R), the child has made connections with their own personal experiences of a time in the park to relate to their knowledge of the earth's rotation and gravity. The ability to make concrete connections demonstrate the child is able to think deeper about a topic or unit.



Getting children to compare the importance of different scientific aspects or processes is also another opportunity that we provide children to think deeper about that area. Modelled responses to these 'big questions' are crucial when setting the expectation as well as providing scaffolds to support the children's ideas.

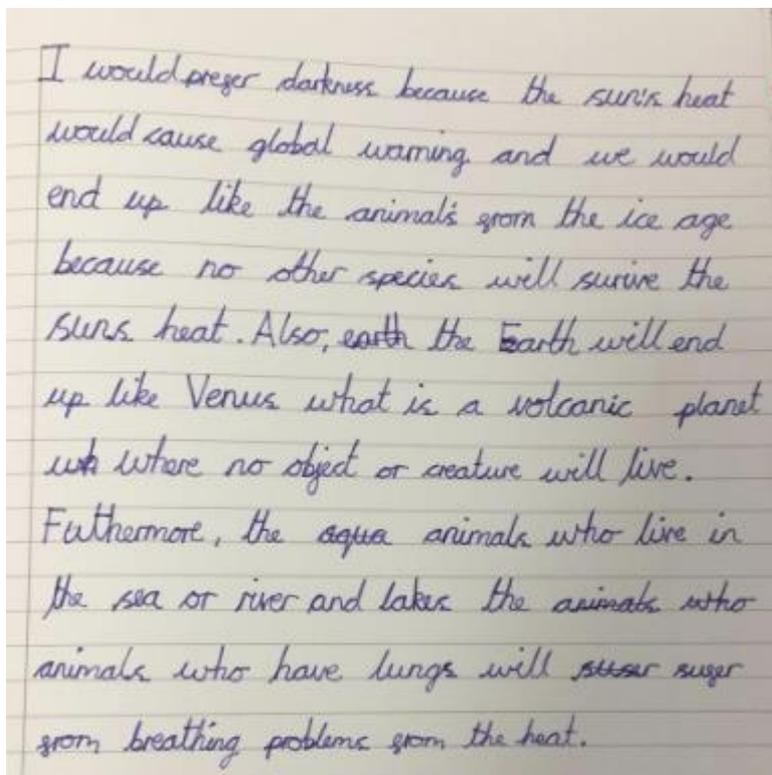
## Transforming children's lives through partnership and collaboration



Further examples of big questions...

- What causes gravity?
- How do you know the Earth is a sphere?
- There are 17 types of penguin on this Earth. Explain why you think this might be.
- (When learning circuits...) What is happening inside the wire?
- If a tree starts life as a tiny shoot, where does the enormous trunk come from?
- Why don't the sun and moon look the same size in the sky?
- I planted a tree in my garden 4 years ago. It now weighs 250kg more. Where did this 250kg come from?
- Is a flame alive?

*Light or dark? Would you prefer a world always in darkness or a world always in light or sometimes in dark and sometimes in light? Explain your answer.*



Here the child (L) has again made connections with existing knowledge, this time about the properties of planets as well as their knowledge and understanding of living things and their requirements to be able to survive.



**Inspire**  
Partnership

[www.inspirepartnership.co.uk](http://www.inspirepartnership.co.uk)

In essence, the above tasks and activities highlight some of the ways that we at the Inspire partnership are enabling our children to thrive as deep learners and thinkers on this journey towards 'greater depth'. Blessed with passionate practitioners and engaged learners, our constant dialogue is focussed on the ever-evolving curriculum and task design. Through the collaboration of our staff and the development of further resources, we will continue to provide rich and meaningful opportunities for our learners to build on knowledge acquired and to continue to develop scientific skills through reasoning, explaining and justifying at relevant points throughout the Science learning journeys we provide.

Transforming children's lives  
through partnership and collaboration