



Thinking, Doing, Talking Science Building Your Good Practice

TDTScience is an ethos for primary science which, thanks to over 20 years of research supported by the PSTT and the Education Endowment Foundation, has significant evidence to show that it really works in terms of improving children's attainment and engagement. It is an inclusive approach, building on the best practice of teachers, which combines creativity with rigour. At its heart is the provision of more opportunities for deeper thinking, through facilitated discussion and purposeful practical work, to build science skills and understanding. This workshop will share the key strategies and provide information on how teachers can access TDTScience CPD and resources.



Thinking, Doing, Talking Science

Building Your Good Practice

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TDTScience built on previous research:

An Oxford Brookes University research project with 16 primary schools in 2002-04 found that the following approaches led to increased pupil engagement & achievement:

- More questioning
- Deeper thinking
- More discussion
- Less writing
- More practical activity



Mant, J., Wilson, H. & Coates, D. (2007) 'The Effect of Increasing Conceptual Challenge in Primary Science Lessons on Pupils' Achievement and Engagement' in the International Journal of Science Education 29(14), 5 November, 2007, pp. 1707-1711

Thinking, Doing, Talking Science

The Efficacy Trial: 2013-15



The core aim was to enhance participating teachers' skills to:

- improve the level of conceptual challenge in primary science by the encouragement of pupils' higher order thinking

The Efficacy Trial 2013-15 Oxfordshire



42 primary schools

Phase 1

Phase 2

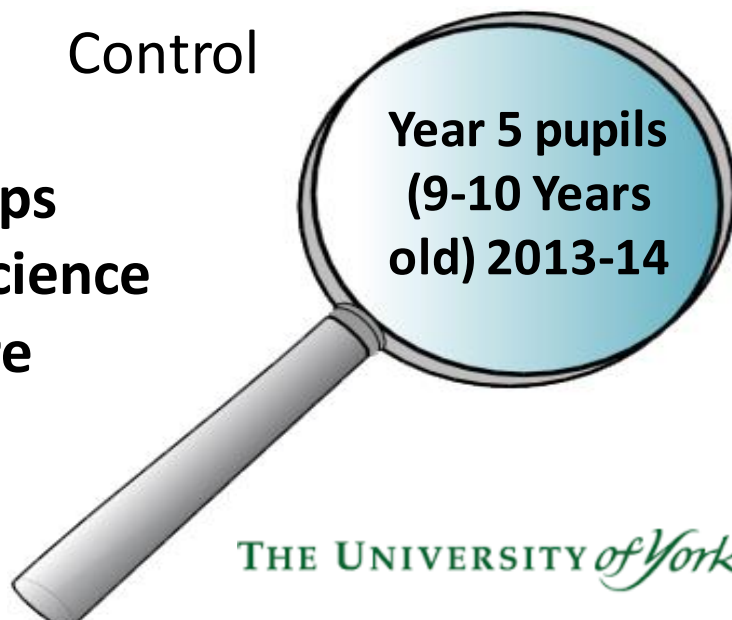
21 primary schools

21 primary schools

Intervention

Control

**All Year 5 pupils in both groups
completed a post intervention science
test & attitude questionnaire**



Year 5 pupils
(9-10 Years
old) 2013-14

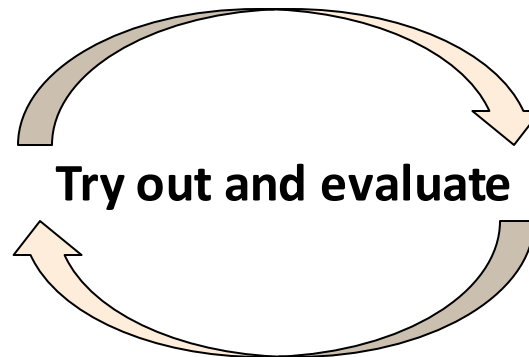
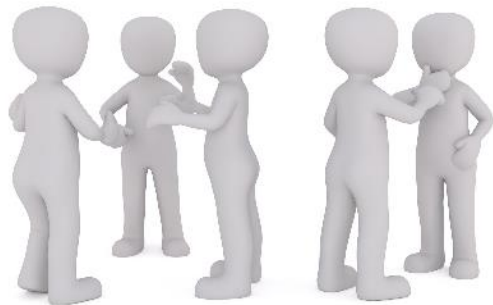


Education
Endowment
Foundation

THE UNIVERSITY of York

Repertoire of strategies

Share good practice



The Results



Thinking, Doing, Talking Science appeared to have a positive impact on the attainment of pupils in science. Overall, Year 5 pupils in schools using the approach made approximately three additional months' progress.

The approach had a positive impact on pupils' attitudes to science, science lessons, and practical work in particular.

The programme had a particularly positive effect on girls and on pupils with low prior attainment.

<https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/thinking-doing-talking-science>



“It’s fantastic when our evaluations produce solid evidence that a particular approach has a positive impact on attainment. It’s especially rewarding when they boost children’s attitudes towards learning too. But the reality of robust educational research is that these results are the exception and not the rule.”



**Sir Kevan Collins,
EEF CEO 2011 - 2019**

WIN, WIN, WIN!



Pupils' attainment increases



Pupils' enjoyment increases



Teacher's enjoyment increases



They find science a lot more fun, it's far more interactive, conversational and they say it's fun!

The children have a 'buzz' about science - very confident to express opinions, speculate and give justifications as to why they think as they do.



The less able children are better engaged with their science learning and able to explore concepts practically.

The pupils have more enthusiasm, deeper understanding and higher order thinking.

Further evidence?

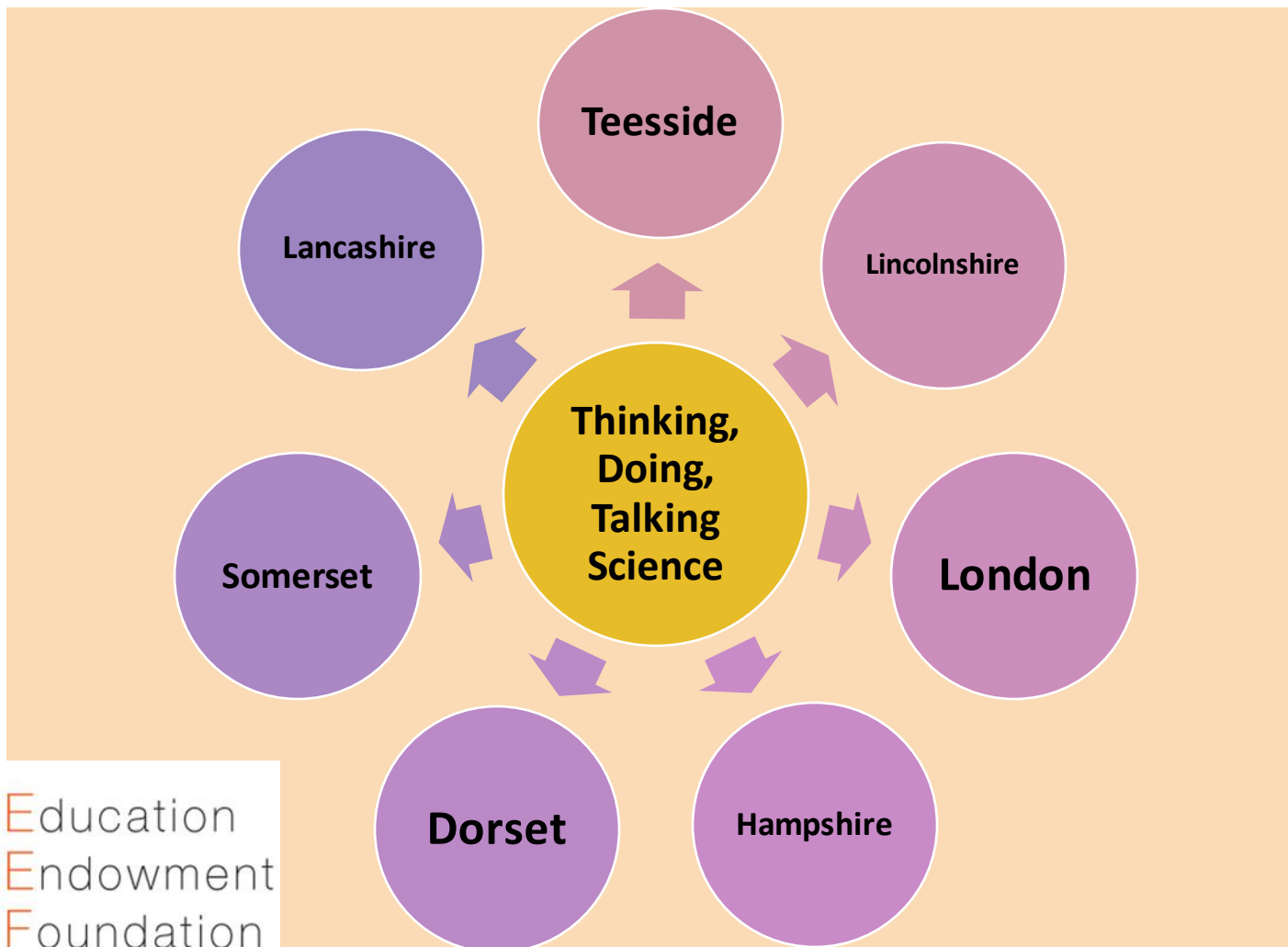
This project will test a more scalable model of the approach, with the teacher training being delivered by training partners rather than the developer team from Science Oxford and Oxford Brookes University.



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Effectiveness Trial 2016- 2018

200 schools



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WIN, WIN!



Very positive
feedback from
teachers & pupils

Remained a
promising project

Learnt & made
changes



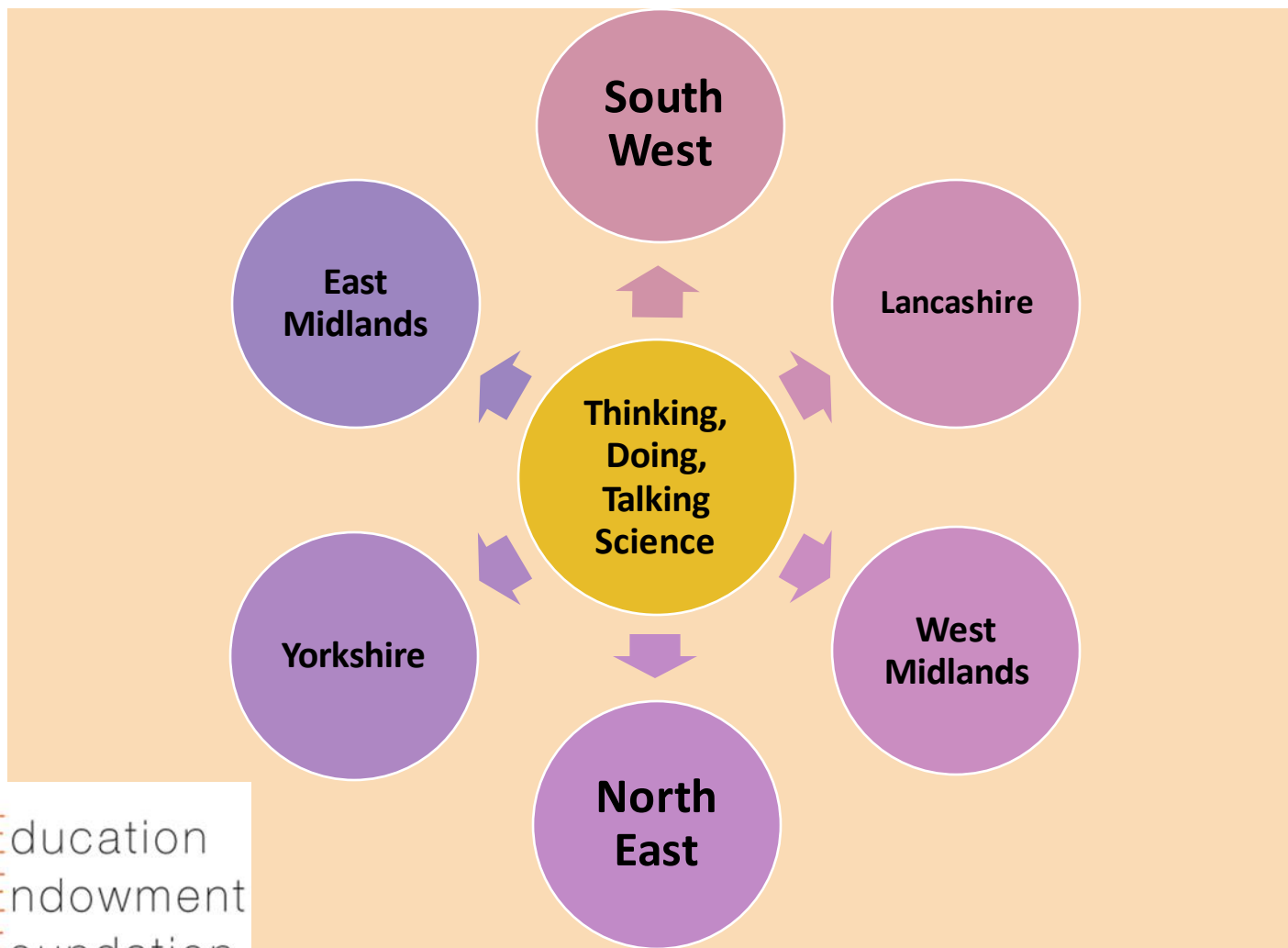
Pupils' enjoyment increases

Teacher's enjoyment increases

<https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/thinking-doing-talking-science-effectiveness-trial/>

Effectiveness re-trial 2021- 2023

180 schools



Focused recording



Creativity



talking

**Practical Prompts
for Thinking**

**Questions - pupil
& teacher**

**Higher order
thinking**

**Bright Ideas
Time**

**Practical
Investigations**



doing

**Practical Problem
solving**



Bloom's Taxonomy



High:

evaluation - judging, rating and giving opinions

synthesis - hypothesising, showing originality by creating, inventing and composing

analysis - categorising and comparing; distinguishing between fact and opinion or relevant and irrelevant information

Middle:

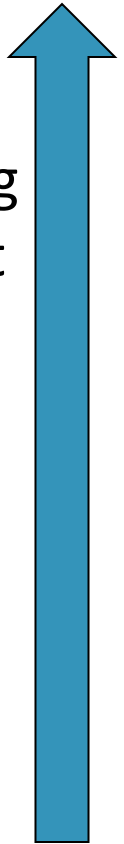
application/use - transferring knowledge from one situation to another similar one

Low:

Foundation

comprehension - summarising and putting ideas or information into other words

knowledge - remembering, reciting or listing facts



Sort into higher order or lower order

- A. Draw and label the Bunsen burner.
- B. How do you change the colour of the flame?
- C. Light the Bunsen burner by closing the hole in the column, turning on the gas and lighting a match near it.
- D. What safety precautions would you suggest? Why?
- E. Why does the flame change colour?
- F. Why is there a hole in the column that can be opened or closed?
- G. Learn the safety rules for a test.
- H. What happens to the gas?
- I. Copy the safety rules into your book.
- J. What is a flame?



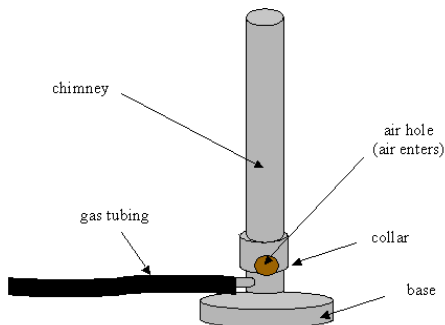


Lower Order:

- A Draw and label the Bunsen burner
- C Light the Bunsen burner by closing the hole in the column, turning on the gas and lighting a match near it
- I Copy the safety rules into your book
- G Learn the safety rules for a test
- B How do you change the colour of the flame?

Higher Order:

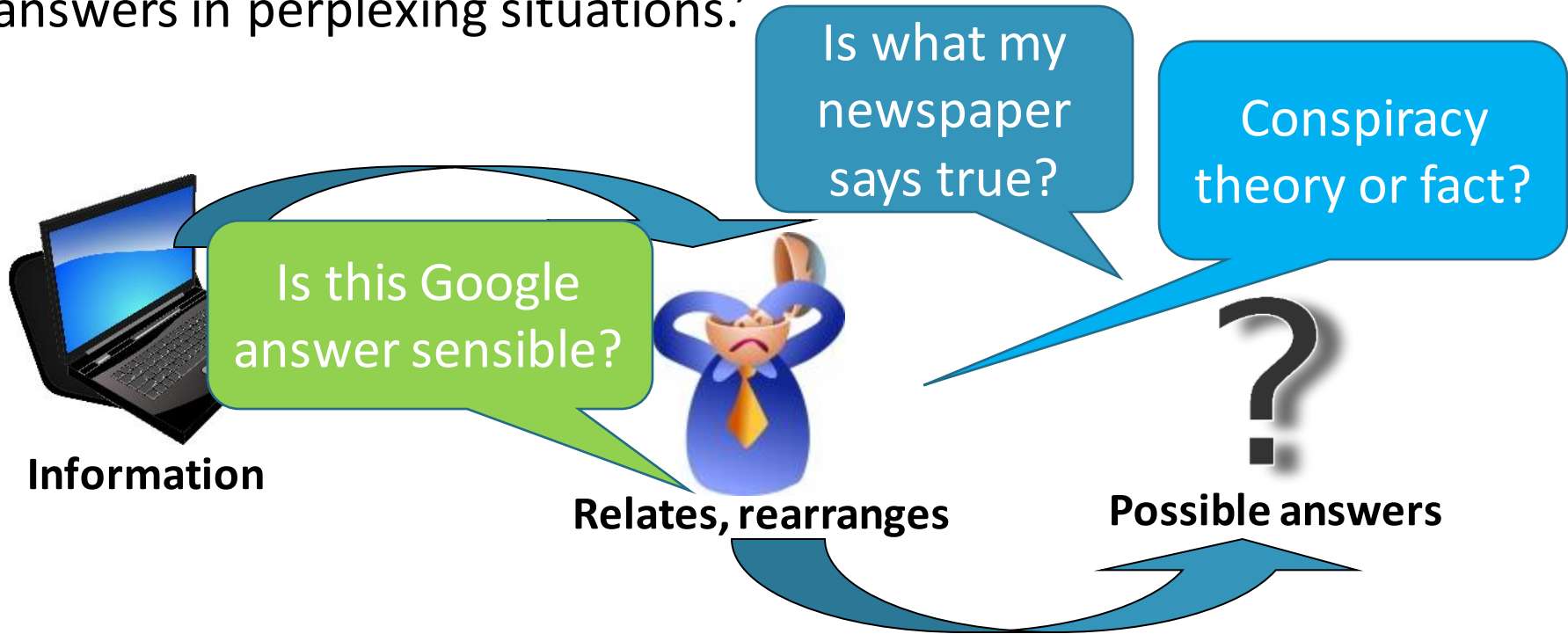
- E Why does the flame change colour?
- F Why is there a hole in the column that can be opened or closed?
- H What happens to the gas?
- D What safety precautions would you suggest? Why?
- J What is a flame?

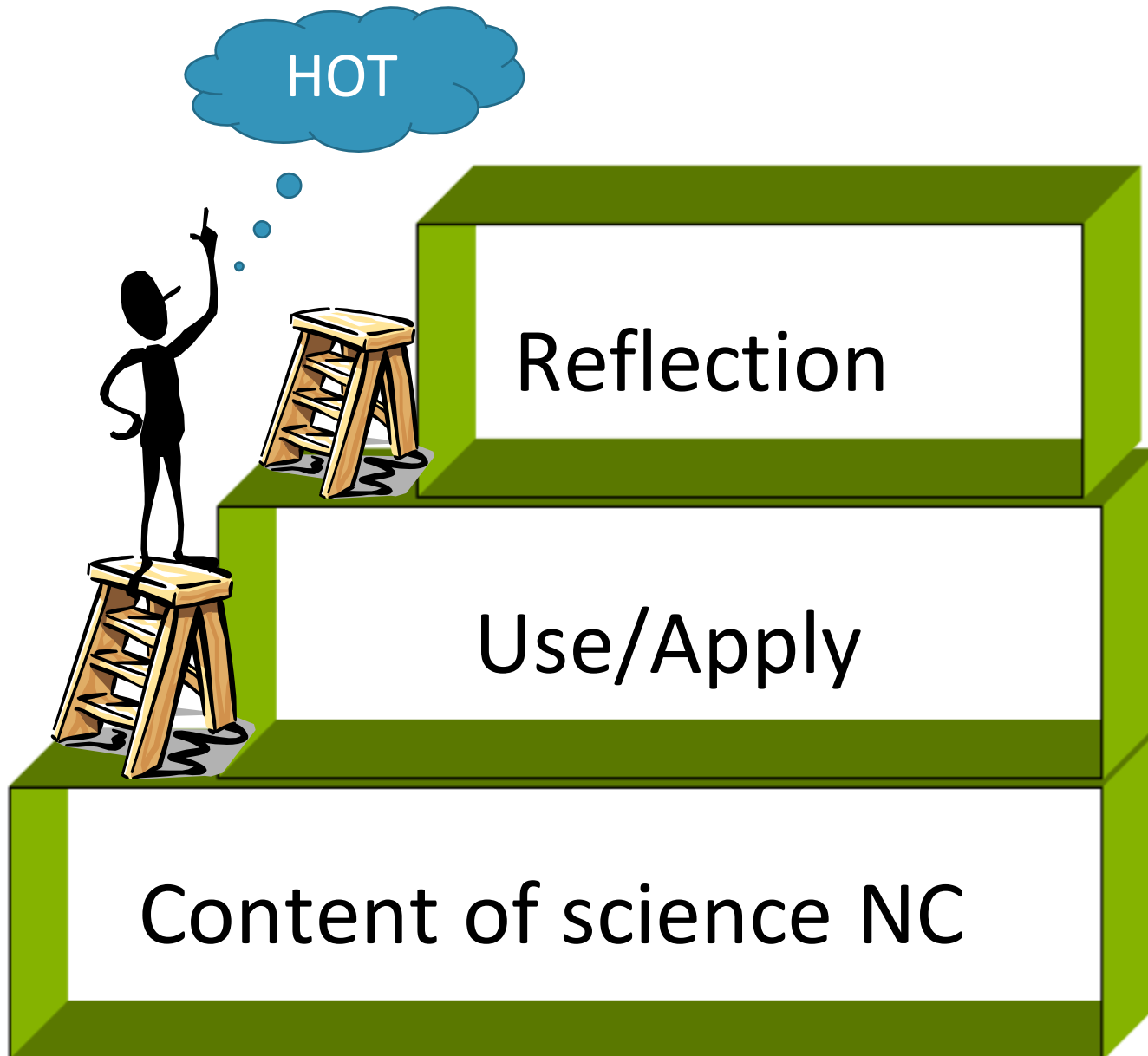


Do you agree?

Another definition of Higher Order Thinking:

‘Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations.’

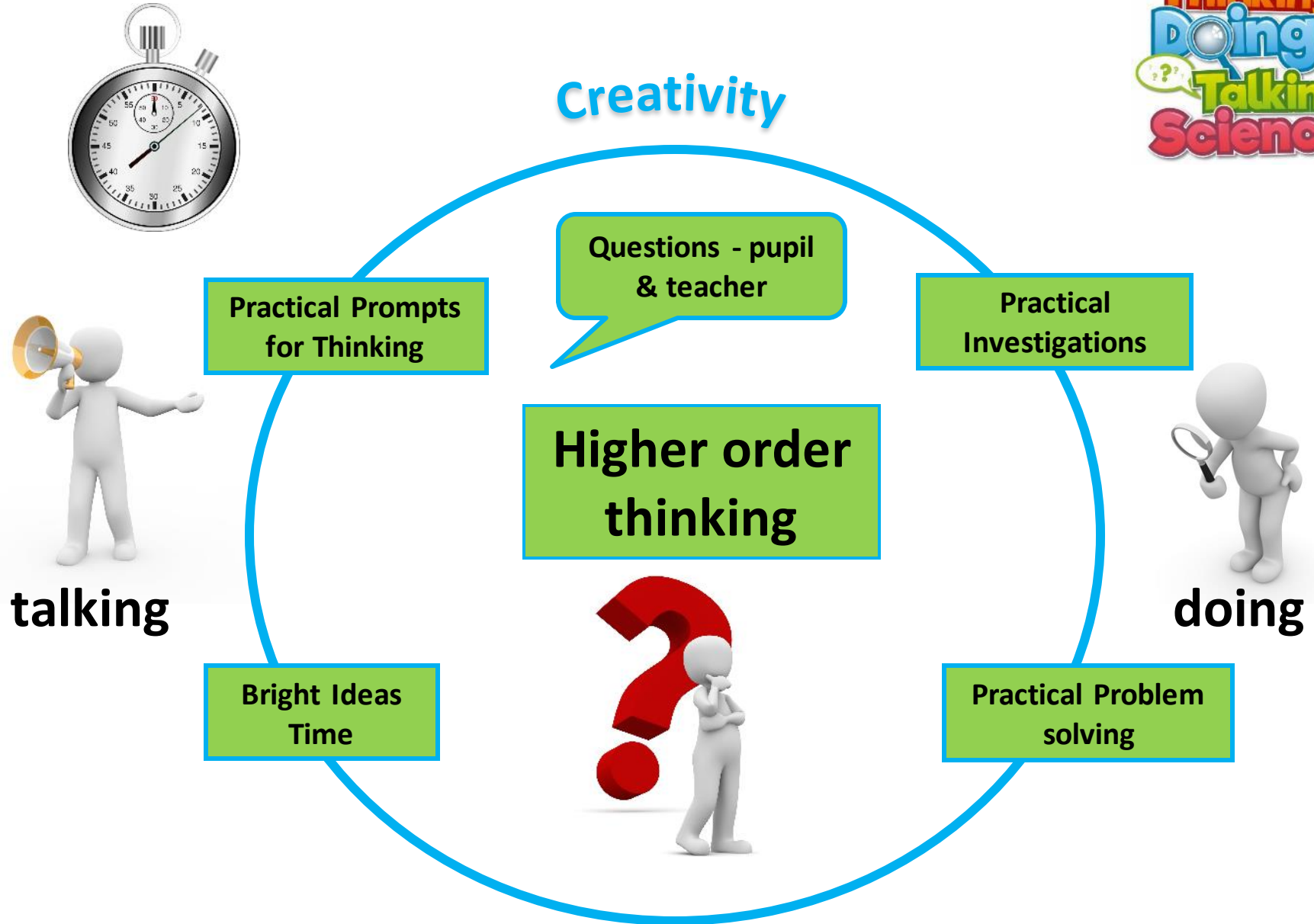




Focused recording



Creativity



The Bright Ideas Time



**Aim to have a
Bright Ideas Time in
each science lesson**

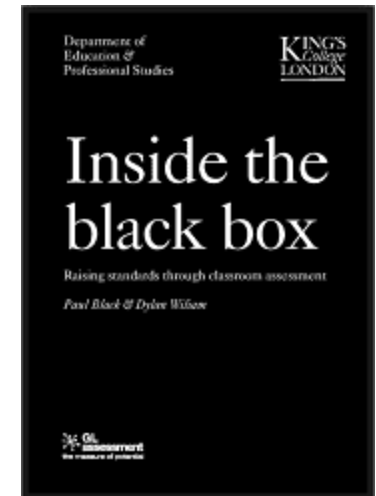
Science Inside the Black Box

Black & Harrison, nferNelson

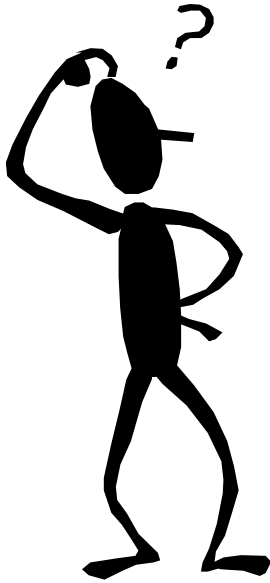


The essential ingredients:

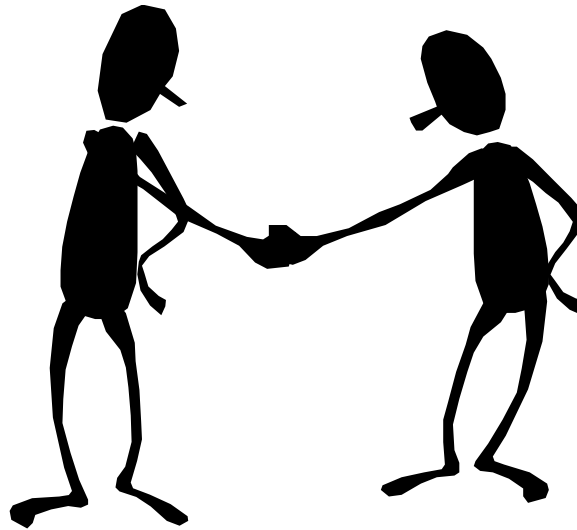
- Challenging activities that promote thinking & discussion
- Rich questions
- Strategies to support all learners in revealing their ideas
- Opportunity for peer discussion about ideas
- Group or whole-class discussions which encourage open dialogue



Thinking time



Think



Pair



Share

The constructivist view of learning: the pupil/person has pre-existing ideas.



Pupils do not come to science lessons with an empty head – they have already thought and know a thing or two.

Some of these pre-existing ideas may not be the accepted scientific views!

So it is important to elicit their existing understanding.

Can't just pour knowledge in.

The Odd One Out



Explorify uses
TDTS research

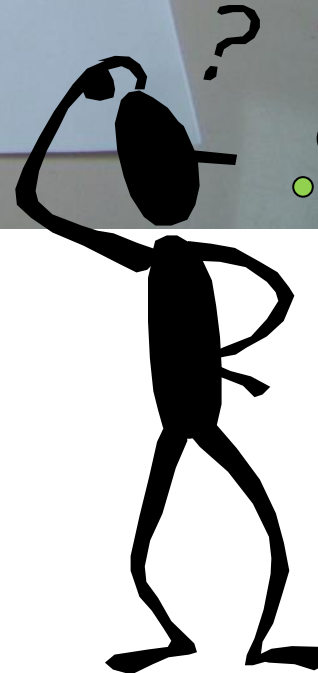
Explorify...

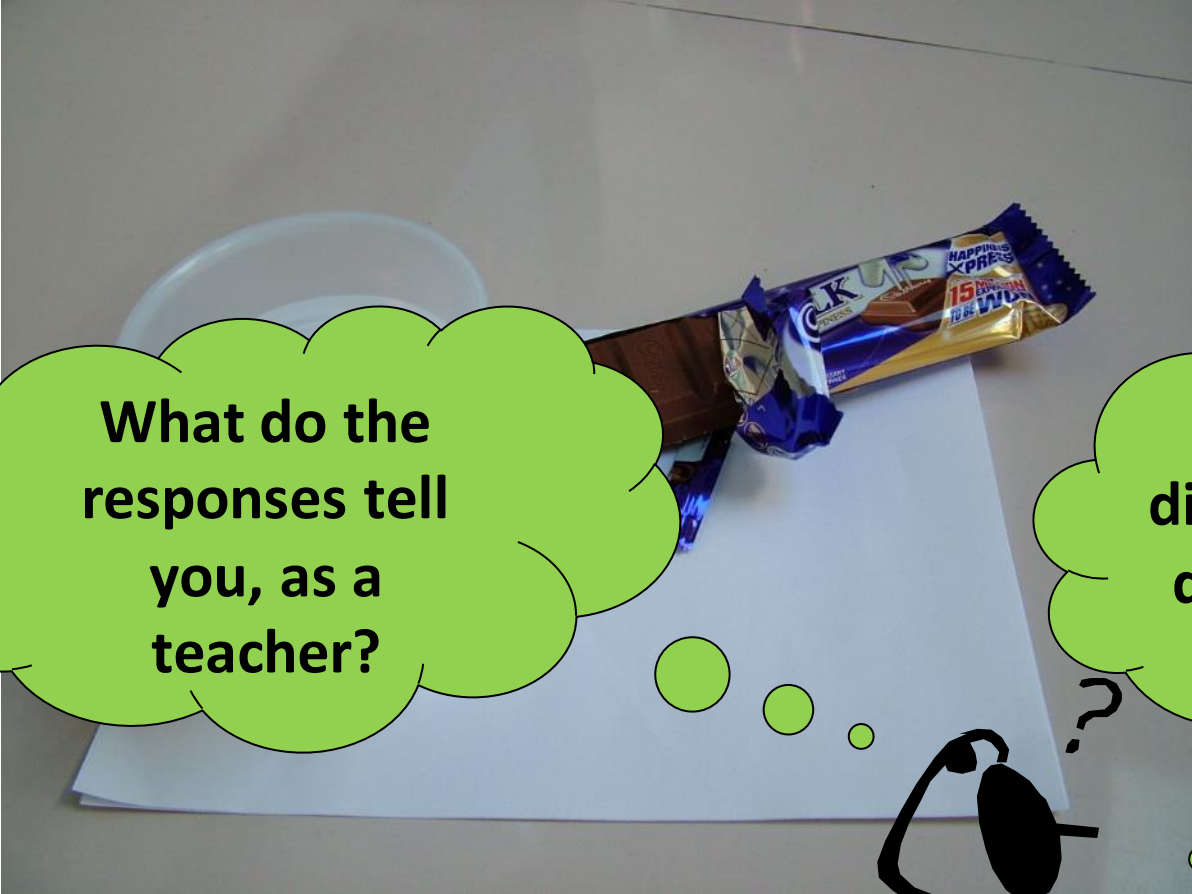
Do you use
the Odd One
Out already?





Which is the
odd one out
& why?

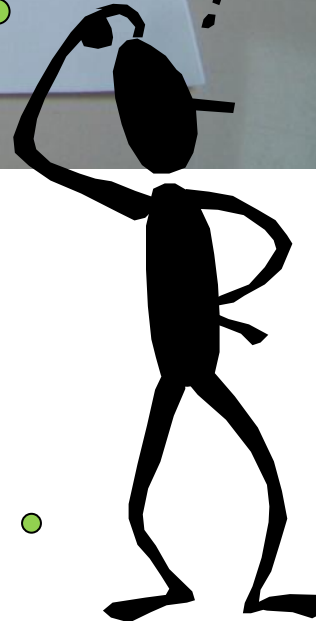




What do the
responses tell
you, as a
teacher?

What was
different about
doing an Odd
One Out ?

What lesson
might this
lead into?



Which is the Odd
One Out and why?





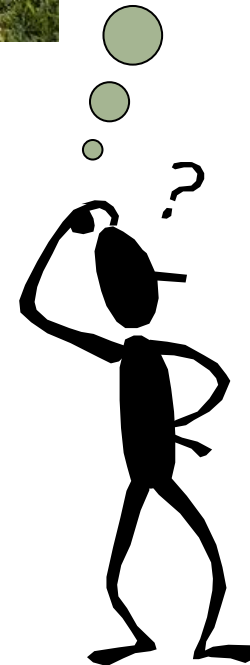
Which is the Odd One Out and why?





Which is the
odd one out
& why?

Think of 2
reasons for
each



The Odd One Out

At the beginning of a forces topic



The ice skate
as it is sharp



The scooter as you
balance on one foot

The skateboard as it
has 4 wheels



Pupils' responses: Cumnor Primary

The Odd One Out

Near the end of the forces topic



The ice skate has less friction – you can't stop



The scooter as you need to apply more force with your foot



Assessment of progression

Pupils' responses: Cumnor Primary

Discussions which then arose:

- How do you stop when you are ice skating?
- Why doesn't ice melt when you skate on it?
- Which is quicker? (Talked about friction)
- Which is harder to stay on? (Led to discussion about balanced forces)



PMI

Living on the Moon



P = Positive



M = Minus

I = Interesting

PMI

Bees become extinct





The chocolate teapot



Living on the Moon



**An eye in the middle
of your hand**



Plants can walk

More PMIs



A world without friction



What if?

<https://explorify.uk/en/activities/what-if/the-average-lifespan-of-a-human-was-200>

The Bright Ideas Time: the Big Question



There are many opportunities for asking questions and the Bright Ideas Time is one of them



<https://pstt.org.uk/resources/curriculum-materials/bright-ideas>



Skinny questions:

- Check pupils' knowledge
- Often one word answers
- Seeking facts

Rich questions:

- Open ended
- Needs time to think – can't usually answer immediately
- Answers generally require one or more sentences
- Sometimes pupils need to ask other questions to work towards main question
- Tend to prompt further questions
- Need to make links, apply ideas, give reasons



Science Inside the Black Box

Black & Harrison, nferNelson

Squeeze the thinking from the curriculum:



The questions are there for the asking...

A Big Question

What causes gravity?



Some Yr 5&6 pupil responses to 'What causes gravity?'



'Pencils produce gravity but not enough to attract anything.'

'If you push the two books out in a space craft, in a few days they would gradually pull together...where there's no friction.'

'I think it's a force that grows in outer space and it picks up rubble and pulls it together.'

A Big Question

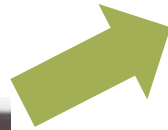


Why do the cyclists and their bikes look like this?



The Big Question

How did
this
happen?



A Big Question



What causes day
and night to
occur?

**Act your
understanding
out in pairs!**



The Bright Ideas Time

Tips & Questions



A Bright ideas Time can be anywhere in the lesson (start, middle, end) – but do include one related to the topic in *every* science lesson

Keep it verbal

How do you handle a 'wrong' answer?



When first started bright ideas time the children`s responses were limited as they wanted to just find the right answer. Now their responses draw on lots of their previous knowledge and question the world around them a lot more.

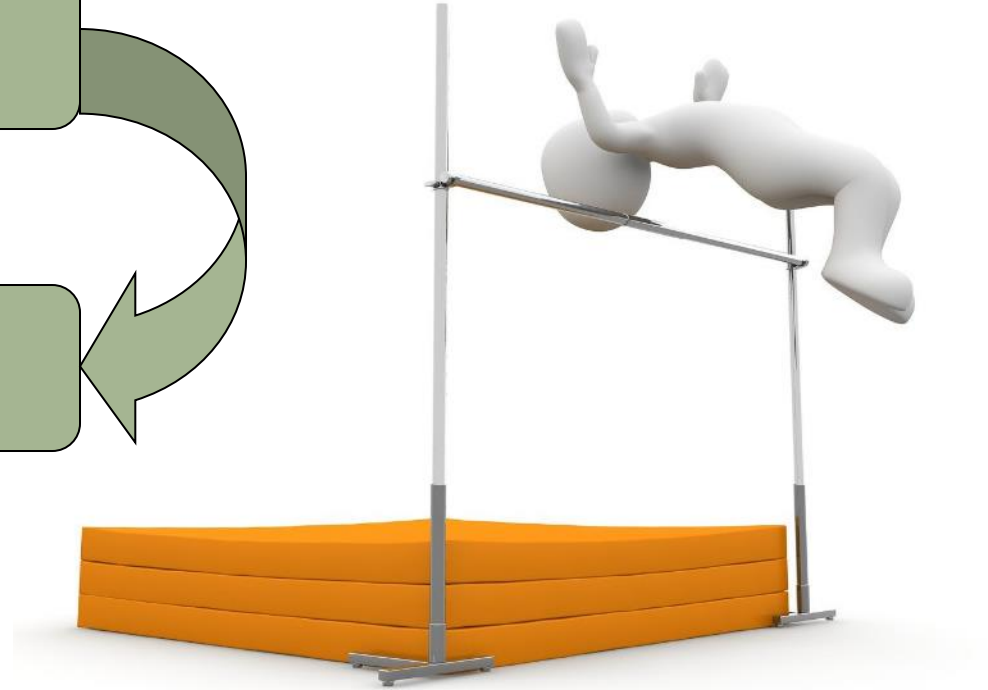
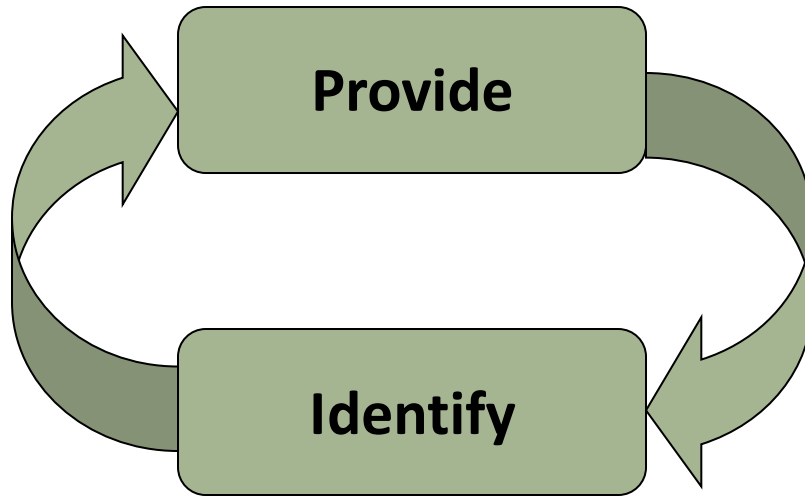
More children seem to be more inclined to take part in class discussions when we have a go at the bright ideas sessions, generally more often when they are asked to justify an answer rather than looking for a correct response.

Have you ever been surprised by who rises to the challenge in science?

Teaching the TDTS way often results in excellent responses from the 'less able'



Sports Model (Freeman)



It is through inclusive challenging lessons that pupils can show their ability

Primary Science Teaching Trust



<https://pstt.org.uk/resources/curriculum-materials/bright-ideas>

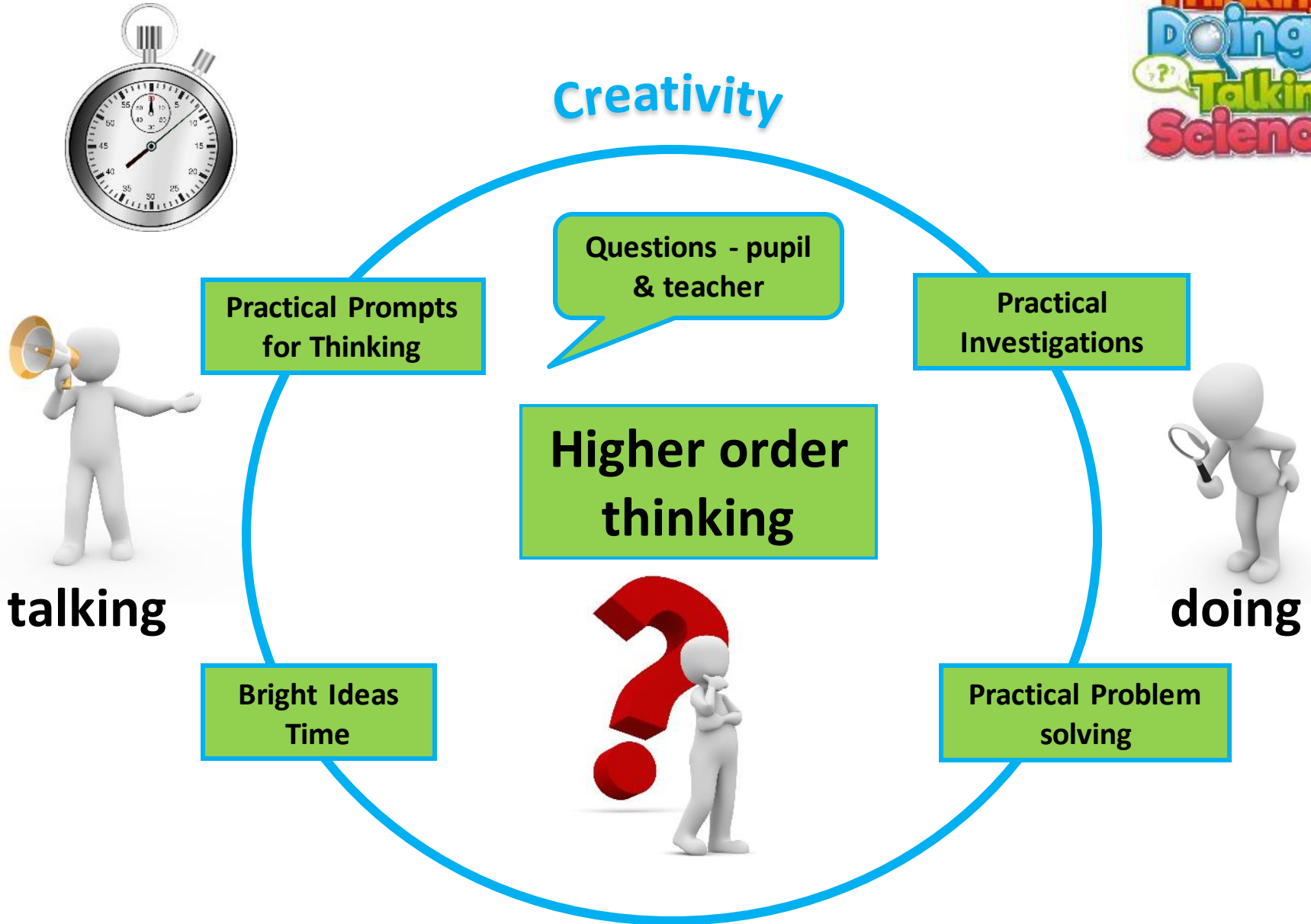
Practical Prompts for Thinking



Focused recording



Creativity



Paper Flowers: exploration



Practical

Which shoes have the best grip?



Plan and carry out
an investigation

Investigate Paper Helicopters



See our lovely
helicopter
template!



What are you going to
test?

Record your results, ready
to share.

This practical, like many of the others, can be
differentiated to suit any age group.

Problem Solving



Protect an egg

Can you *use the materials provided* to protect an egg when it is dropped from a height of 5m?

Practical – pattern seeking

Do people with the strongest legs jump the furthest?

In groups, discuss & plan how to undertake this investigation

Then do it!



Solar System fact cards

Order the cards in terms of distance from the Sun.

Have a look at the cards and check that you understand the 4 different facts for each planet

Keep them in order & look at the other facts on the cards and see if you can find any general patterns.



Create an animal ...



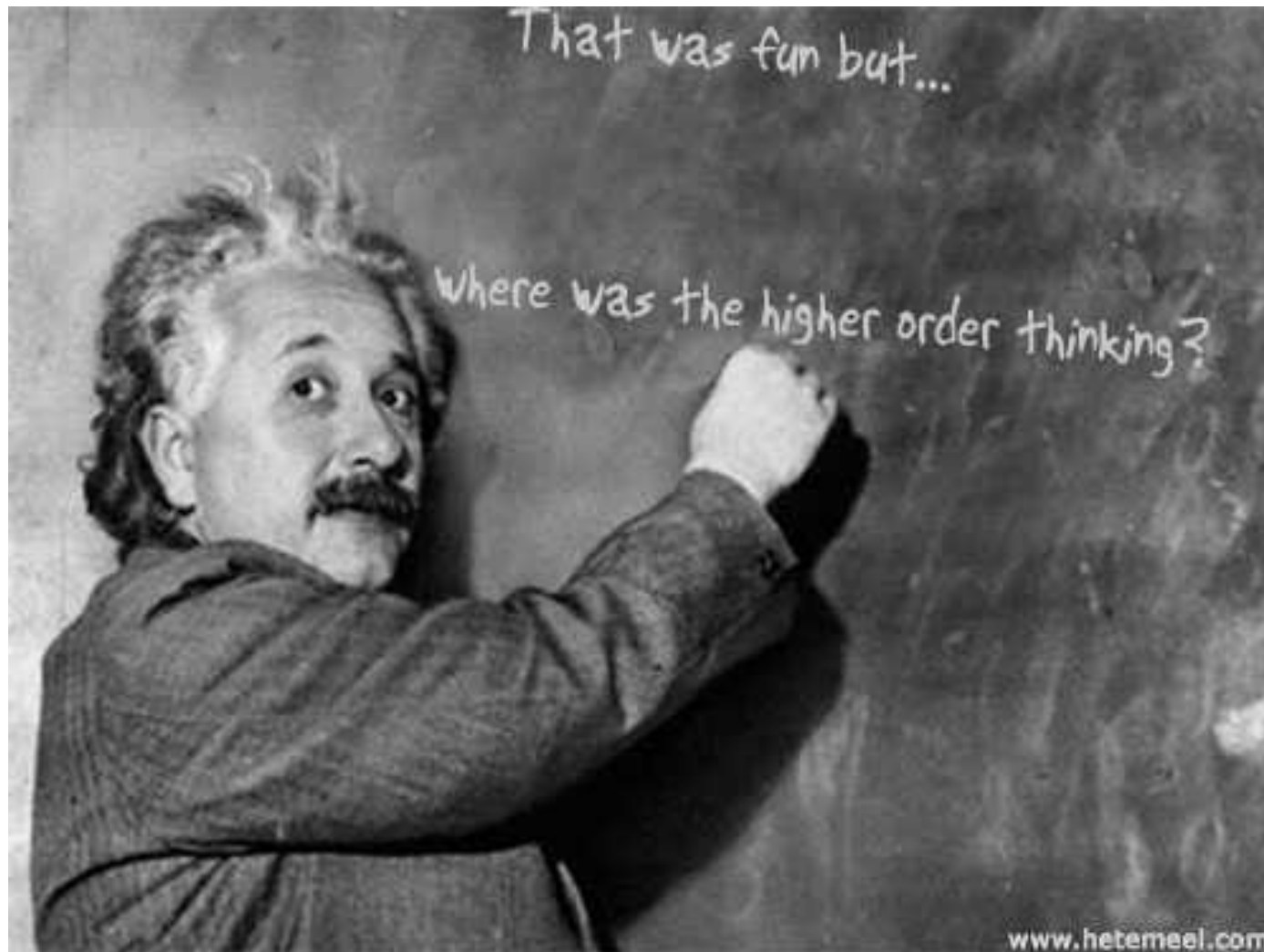
...adapted for a particular environment

Decide (and justify) if your creation is a mammal, an amphibian, an insect or a bird

Now use the playdough to create the stages in its life cycle



Be ready to introduce us to your animal and to explain its adaptations.



What would be the learning objective(s)?

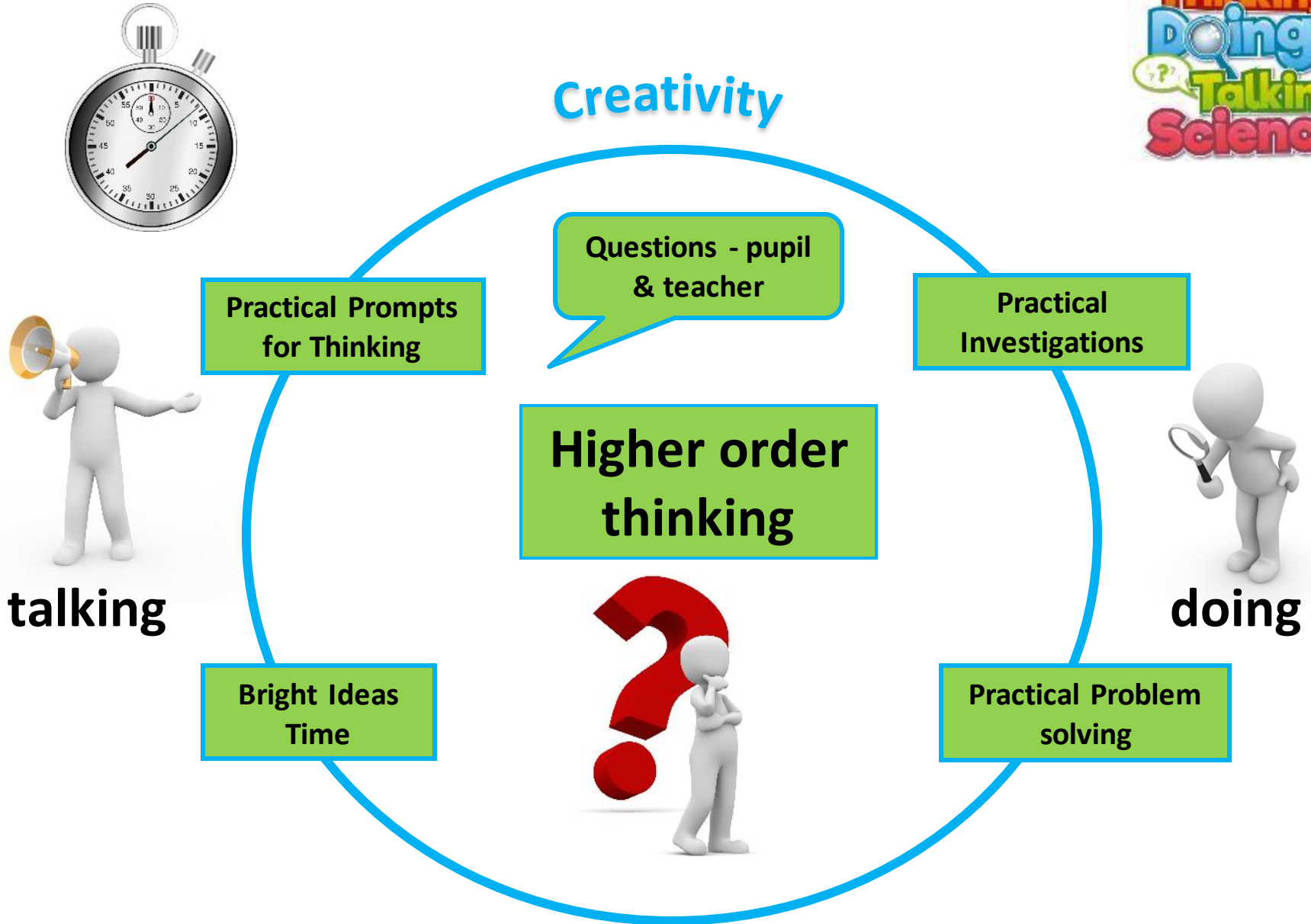
How would you assess the learning objective?



Focused recording



Creativity



Focus the recording on the learning objective

What and how do I record?

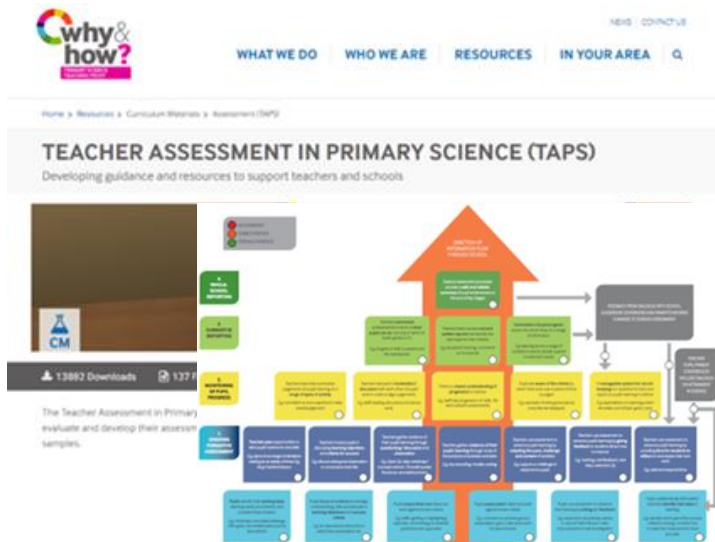
Focusing the recording releases the time for the thinking, doing and talking.

Focusing the recording produces sharply assessable work



Teacher Assessment in Primary Science (TAPS)

- Aiming to develop support for valid, reliable and manageable science assessment which will have a positive impact on children's learning.
- Free online resources:
 - Pyramid school self-evaluation tool with examples of practice in schools
 - Focused assessment database with plans and examples of children's learning



← → C pstt.org.uk/resources/curriculum-materials/assessment

TAPS OVERVIEW FOCUSSED ASSESSMENT OVERVIEW FOCUSSED ASSESSMENT PLANS FOCUSSED ASSESSMENT EXAMPLES TAPS FILES

THESE LESSON PLANS PROVIDE SUPPORT FOR SELECTING ONE SKILLS FOCUS WITHIN THE CONTEXT OF A WHOLE ENQUIRY.

FILTER RESOURCES

EY (P1) [9 RESOURCES]

Y1 (P2) [14 RESOURCES]

Y2 (P3) [15 RESOURCES]

SIGN UP TO OUR MAILING LIST

Plan for Focused Assessment of Science

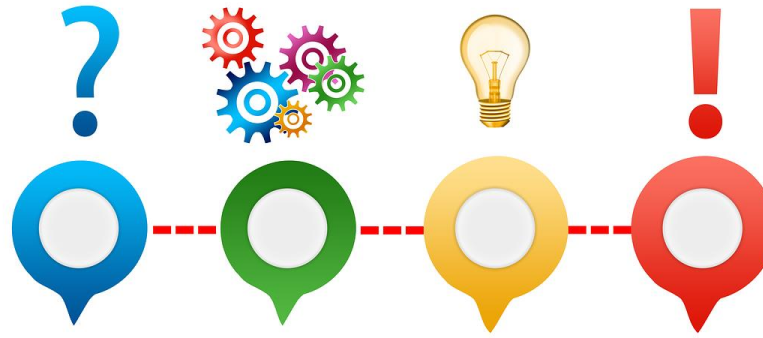
Topic	What we do	Who we are	Resources
What we do	What we do	Who we are	Resources
Who we are	What we do	Who we are	Resources
Resources	What we do	Who we are	Resources

Example

Example products: *Science in Primary School* (TAPS Example)

<https://taps.pstt.org.uk/>

Key questions



- Is the aim of the *lesson* to develop the pupils' skills; knowledge and understanding; or both?
- What will be the focused learning objective(s)?
- Which Bright Ideas Time? Which practical?
- In order to carry out the *practical* successfully:
 - what do the pupils already need to know/understand?
 - and/or what skills do they need to have?
- What will the pupils record?
- What and how will you assess?
- Where and how to encourage pupils' HOTS?

Crafting a lesson

Which BI time?

Bright Ideas
Time

Or a simulation
(acting ideas
out), research
from secondary
sources etc.

Which practical?

Practical

What are the
learning
objectives?

Skills *and*
understanding

Focused
recording

HOT



The TDTS Way



**Learning
Objectives**

**Bright
Ideas Time**

Practical

**Focused
Recording**

Higher Order Thinking



**This is the
TDTS way**

High quality education:

‘The purpose of practical work is clear in relation to curriculum content so that practical activities can be set up and managed to develop pupils’ disciplinary and/or substantive knowledge’ –

Working scientifically and knowledge & understanding

OfSTED 2021

Small Changes...



- More practical activity
- Deeper thinking
- More discussion
- Less writing
- More questioning

e.g. a Bright Ideas Time in every science lesson in the school is a first step



Big Impact



Excellence in teaching is the single most powerful influence on achievement.

John Hattie 2002



Where next with TDTScience?



<https://tdts.org.uk/>

Oxford 4-day course 2023-24 & STEM Learning York course 2024

<https://pstt.org.uk/resources/bright-ideas/>

<https://pstt.org.uk/unique-resources/taps/>

<https://explorify.uk/en/activities>

<https://scienceoxford.com/events/thinking-talking-science-1-bright-ideas-time/>

Online CPD

<https://scienceoxford.com/resources/>

Bright Ideas and Challenges