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:

OXFORD BROOKES UNIVERSITY

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. 1707-171

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

Intervention

21 primary schools

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

Try out and evaluate

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.

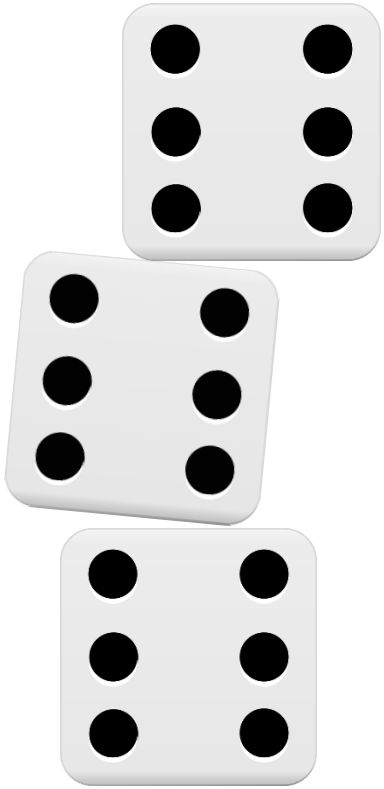
The programme had a particularly positive effect on girls and on pupils with low prior attainment.

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.

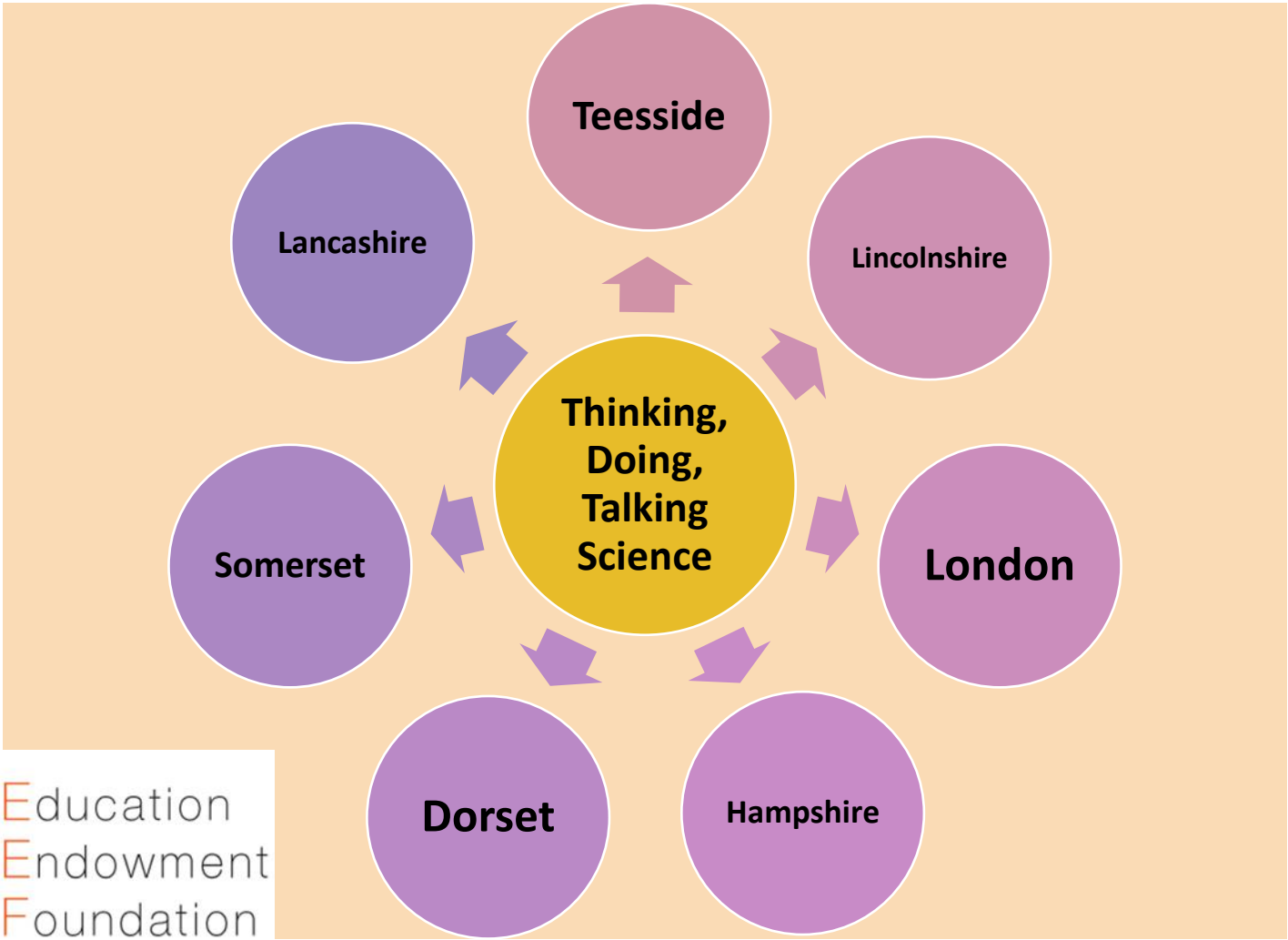
Further evidence?

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.

Education Endowment Foundation

Effectiveness Trial 2016- 2018

200 schools



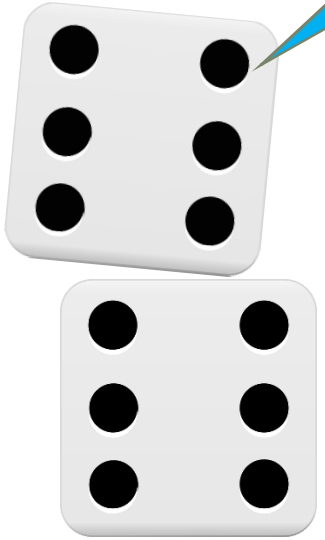
Education Endowment Foundation

WIN, WIN!

Very positive feedback from teachers & pupils

Remained a promising project

Learnt & made changes



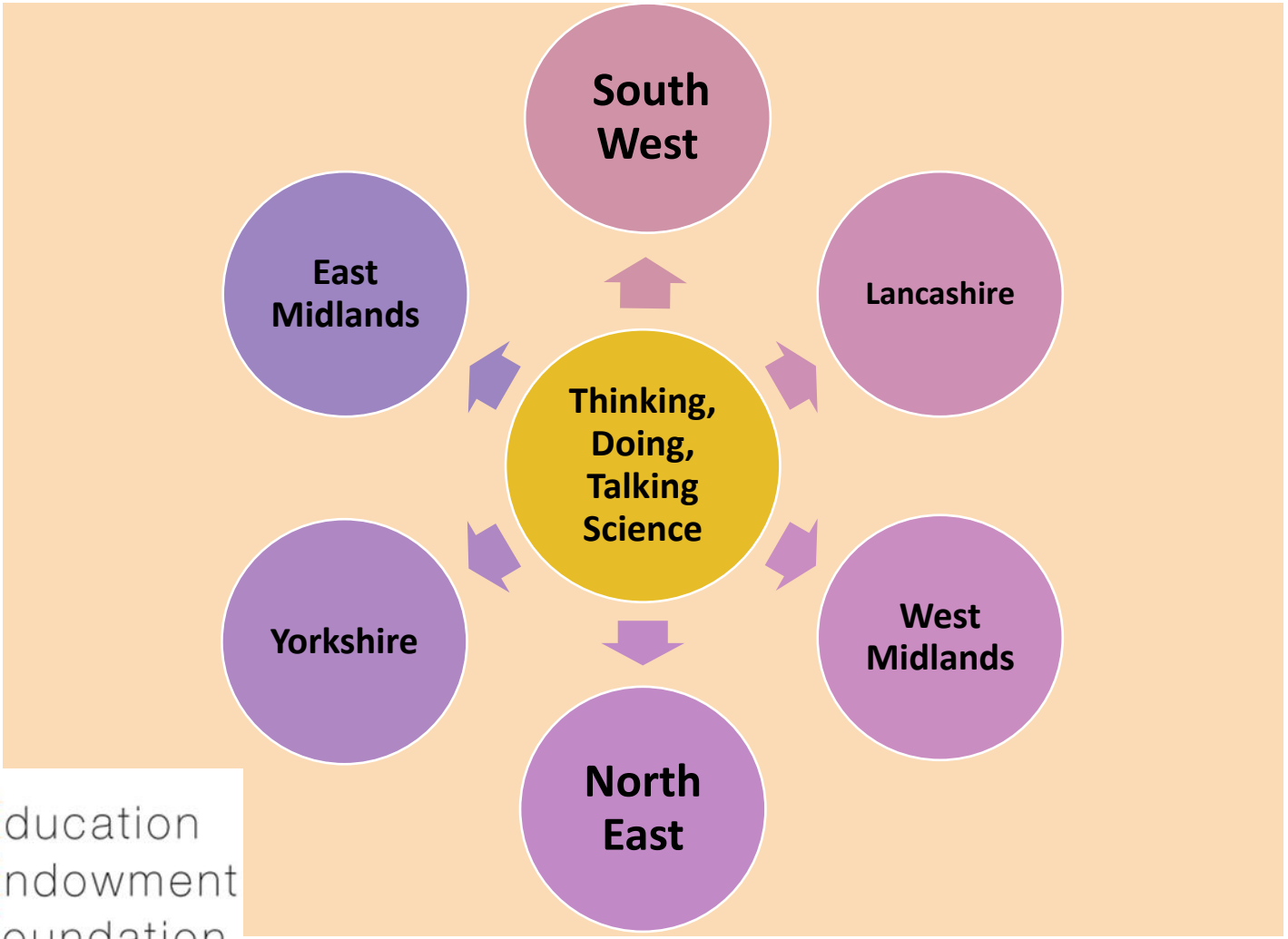
Pupils' enjoyment increases

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



Education Endowment Foundation

Focused recording

Creativity

Questions - pupil & teacher

Practical Prompts for Thinking

Practical Investigations

Higher order thinking

talking

doing

Bright Ideas Time

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

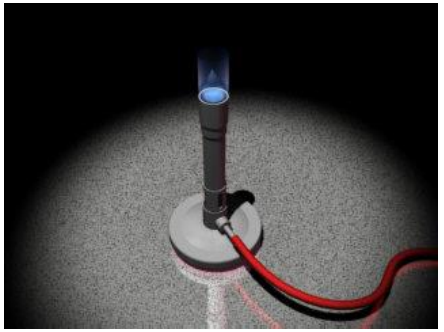
Low: Foundation

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:

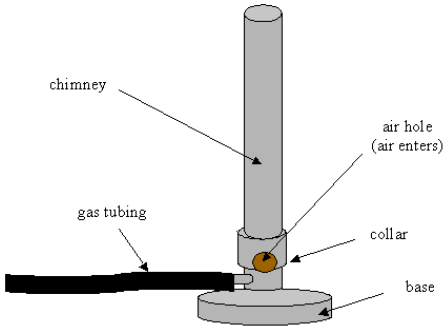
A Draw and label the Bunsen burner

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?

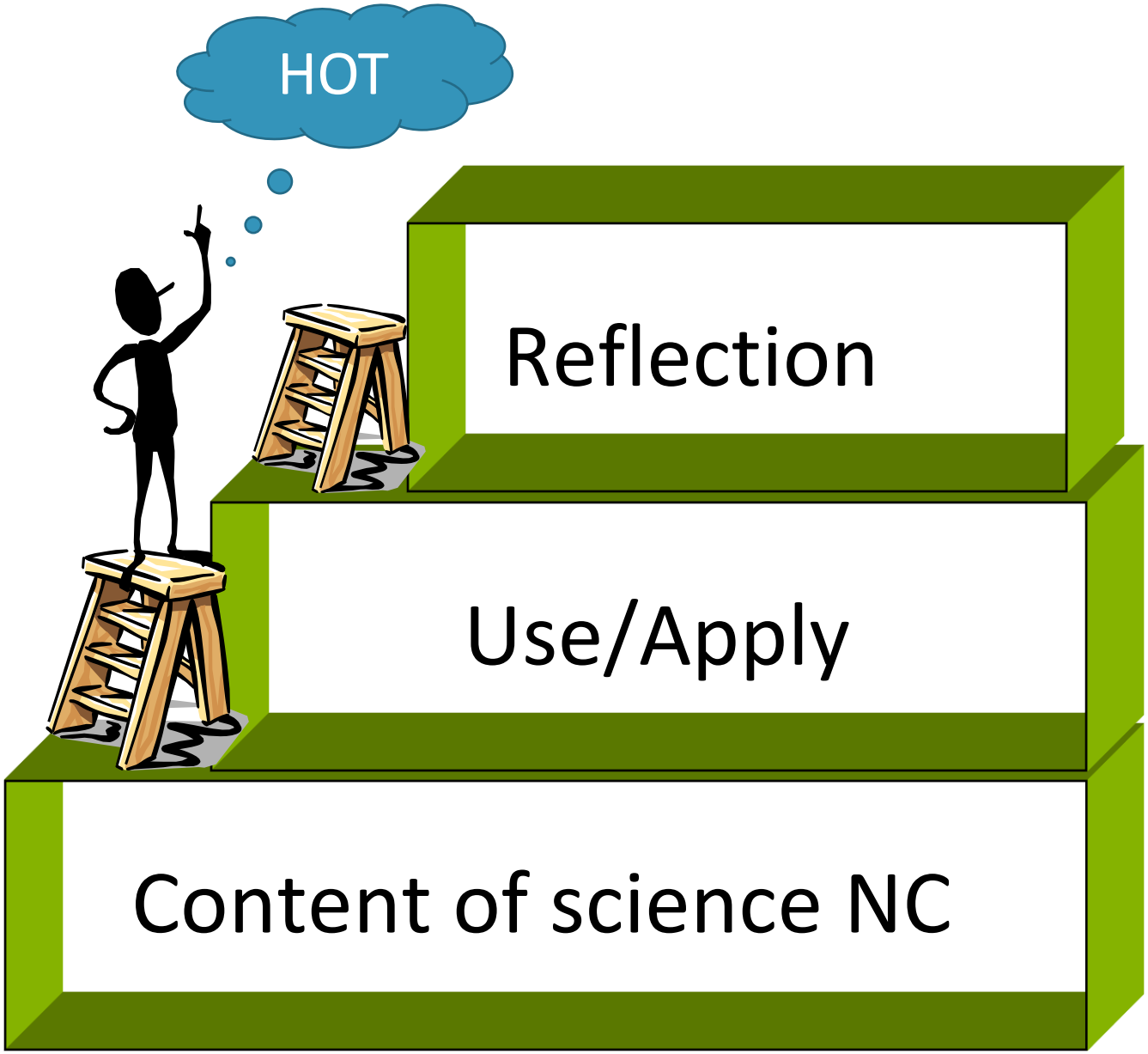
J What is a flame?

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.’

Lewis and Smith (1993, p.136)


HOT
Reflection
Use/Apply
Content of science NC

Focused recording

Creativity

Questions - pupil & teacher

Practical Prompts for Thinking

Practical Investigations

Higher order thinking

talking

doing

Bright Ideas Time

Practical Problem solving

The Bright Ideas Time

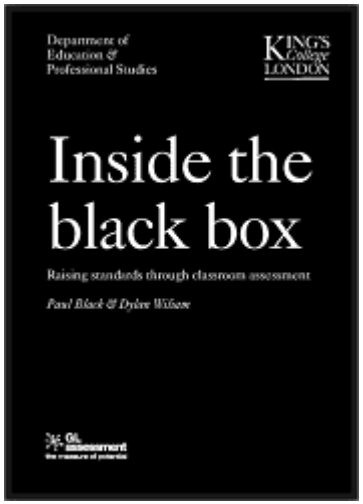
Aim to have a Bright Ideas Time in each science lesson

Science Inside the Black Box

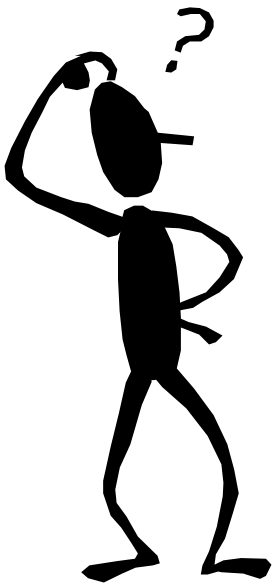
Black & Harrison, nferNelson

The essential ingredients:

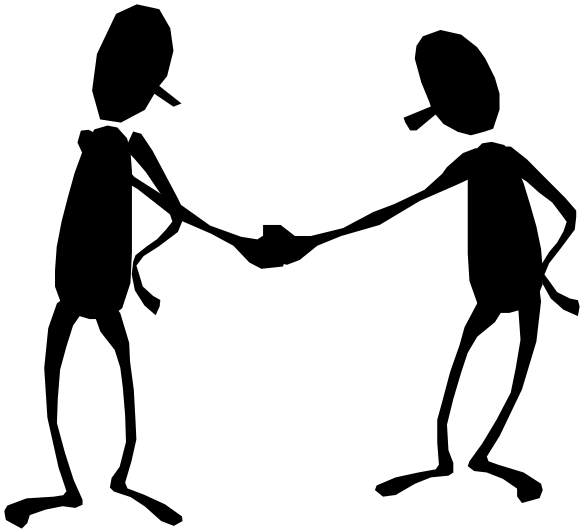
- Challenging activities that promote thinking & discussion
- Rich questions
- Strategies to support all learners in revealing their ideas
- Opportunity for peer discussion about ideas
- Group or whole-class discussions which encourage open dialogue



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!

Can't just pour knowledge in.

So it is important to elicit their existing understanding.

The Odd One Out

Explorify uses TDTS research

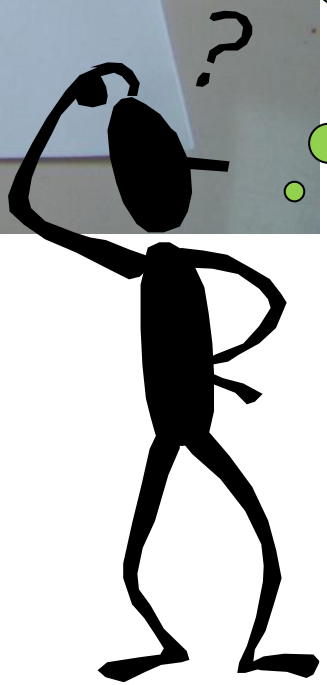
Explorify…

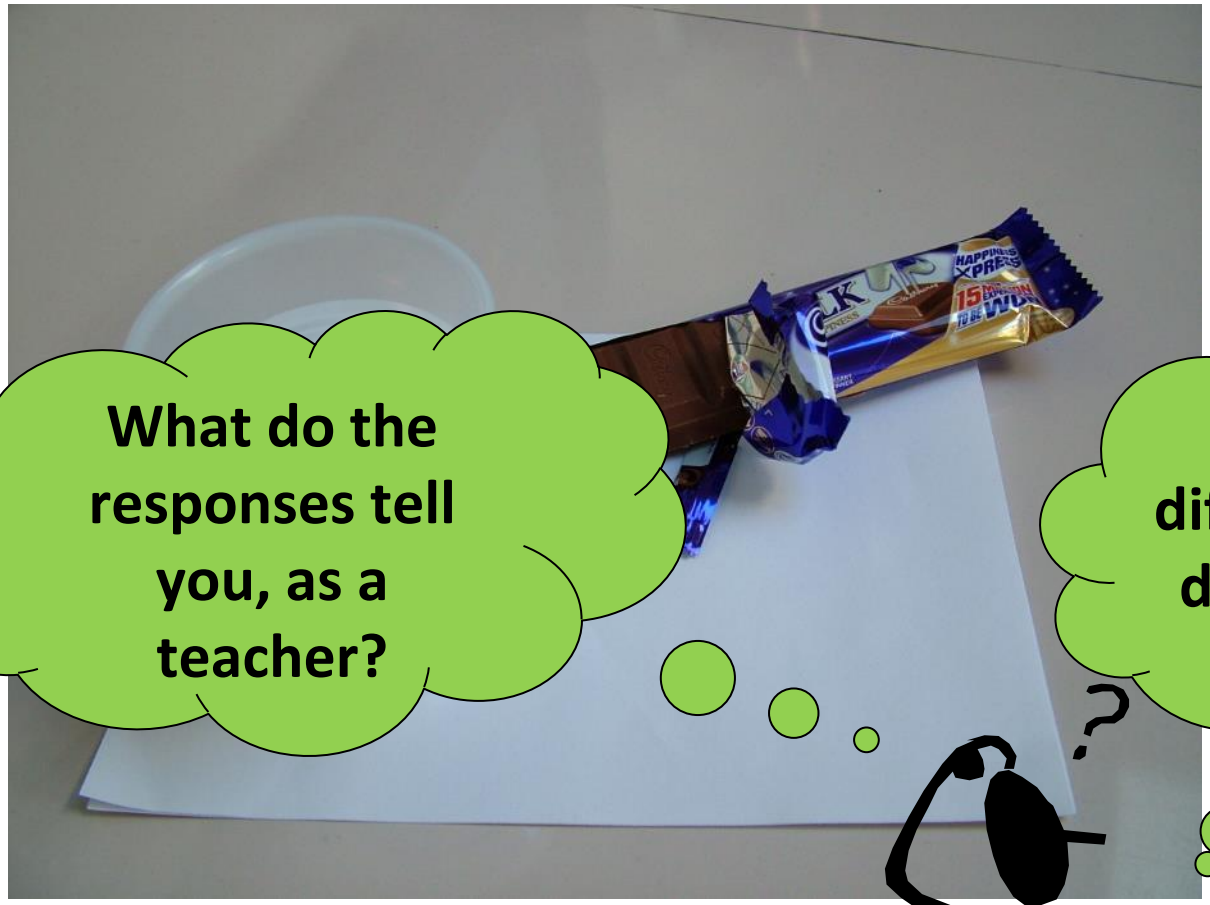
Do you use the Odd One Out already?

B3/10

Thinking Doing Talking Science

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 ?

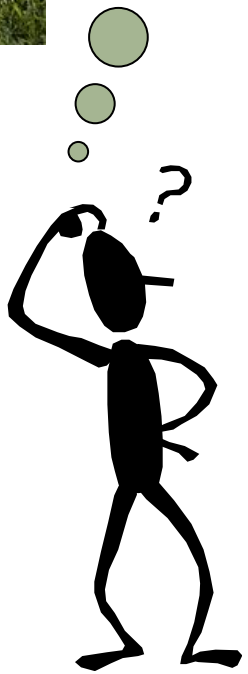
What lesson might this lead into?

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 skateboard as it has 4 wheels

The scooter as you balance on one foot

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

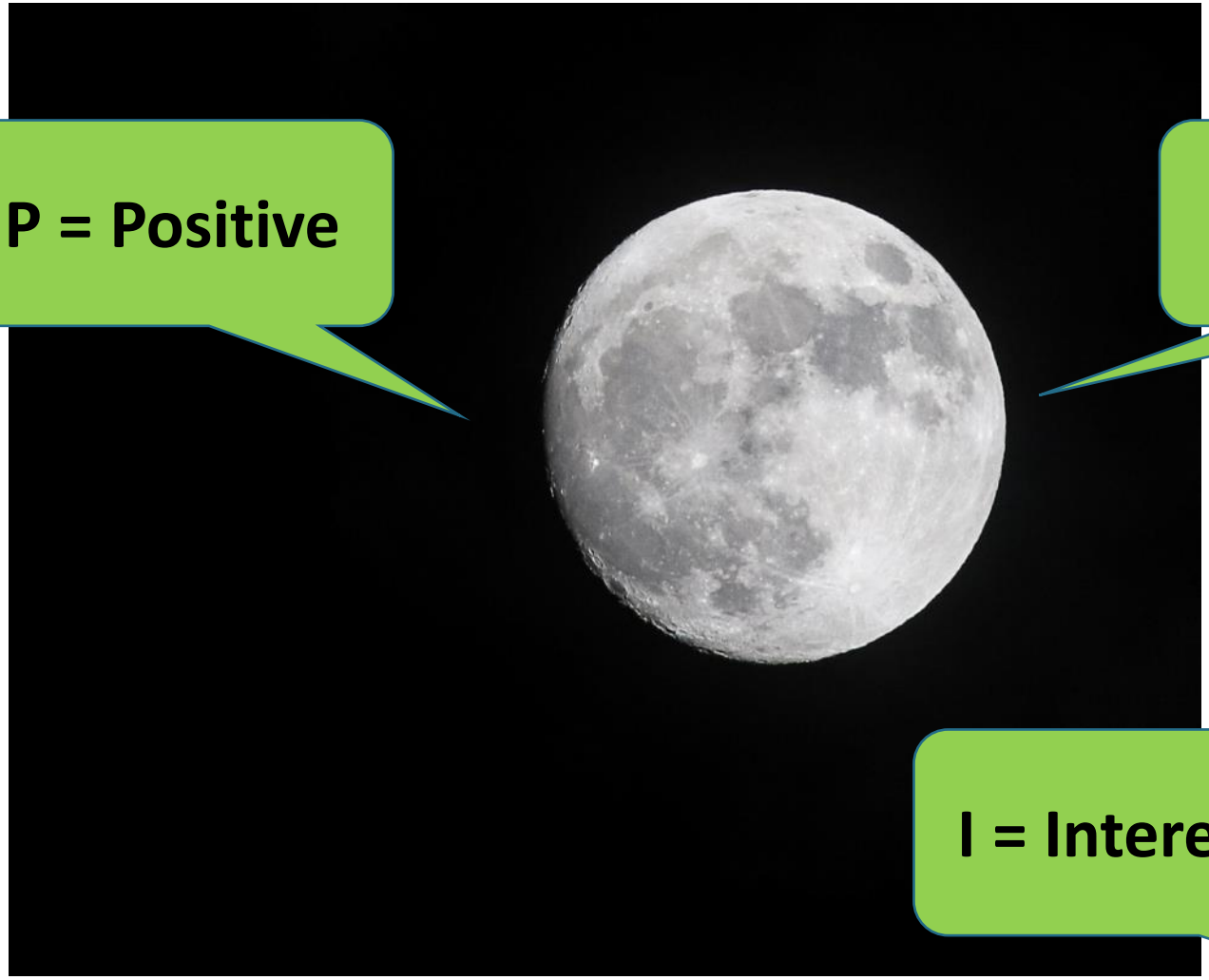
Pupils' responses: Cumnor Primary

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

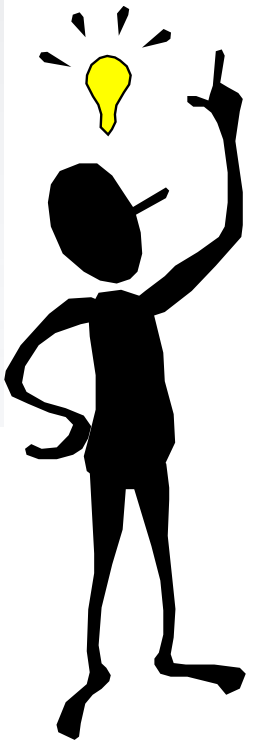
More PMIs

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

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

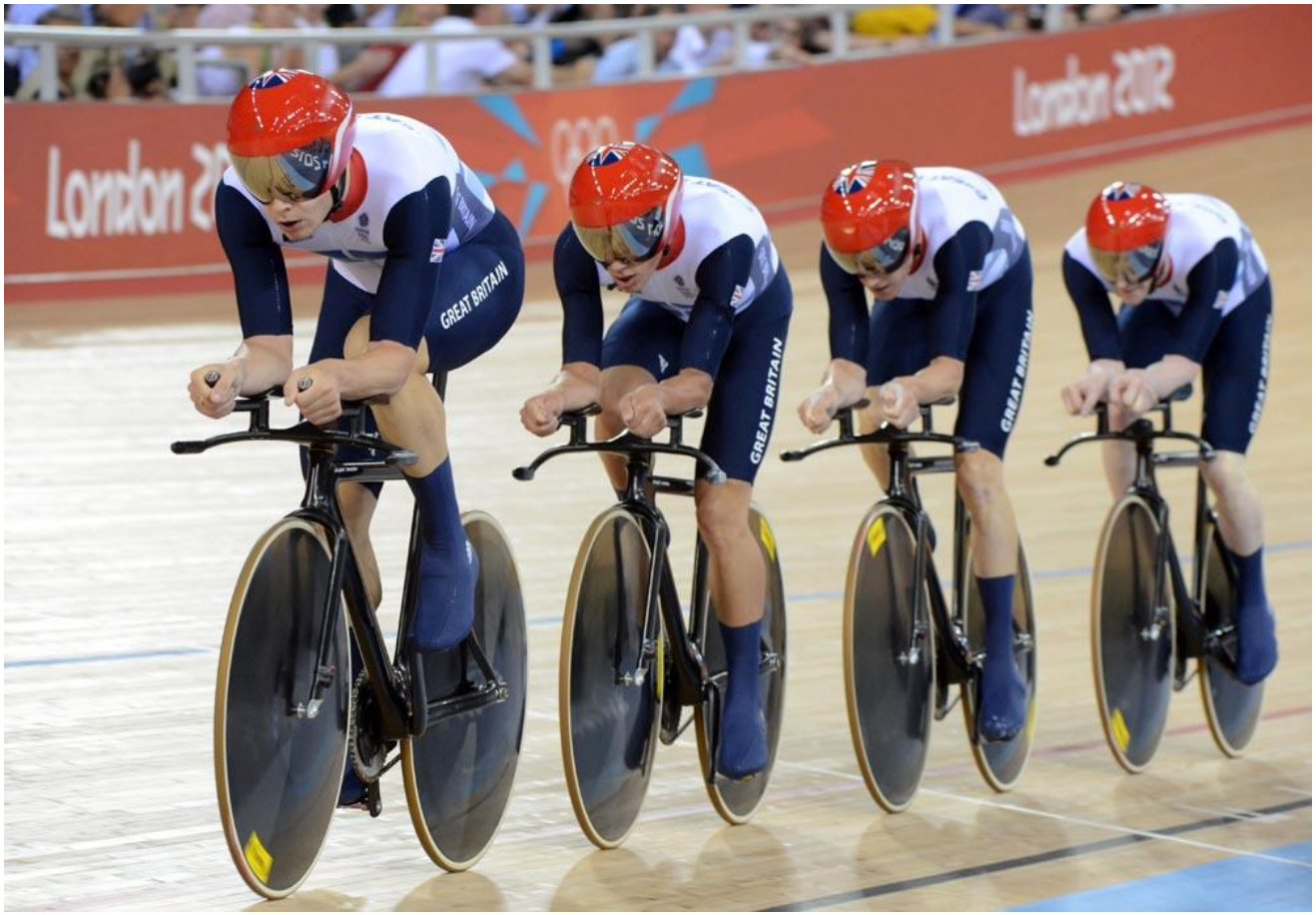
'Pencils produce gravity but not enough to attract anything.'

'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?

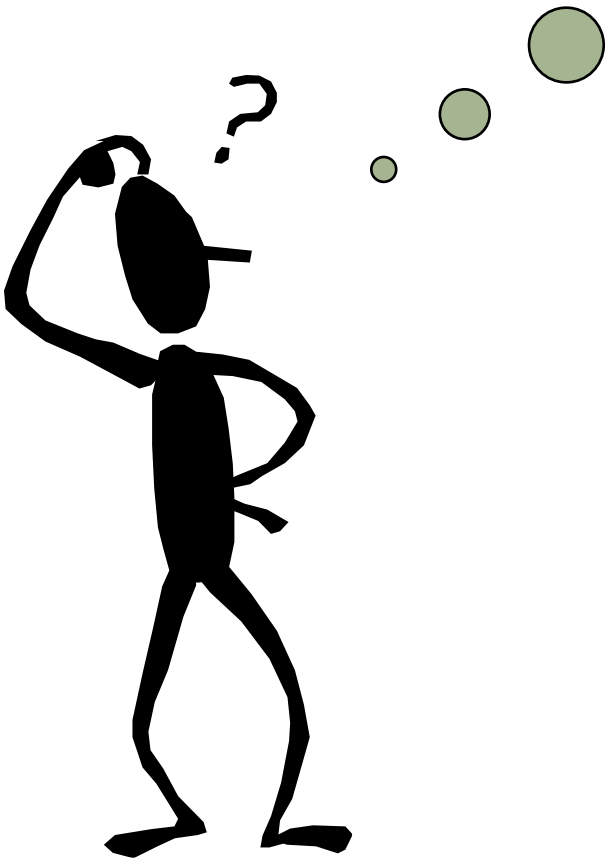


The Big Question

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

How do you handle a 'wrong' answer?

Keep it verbal

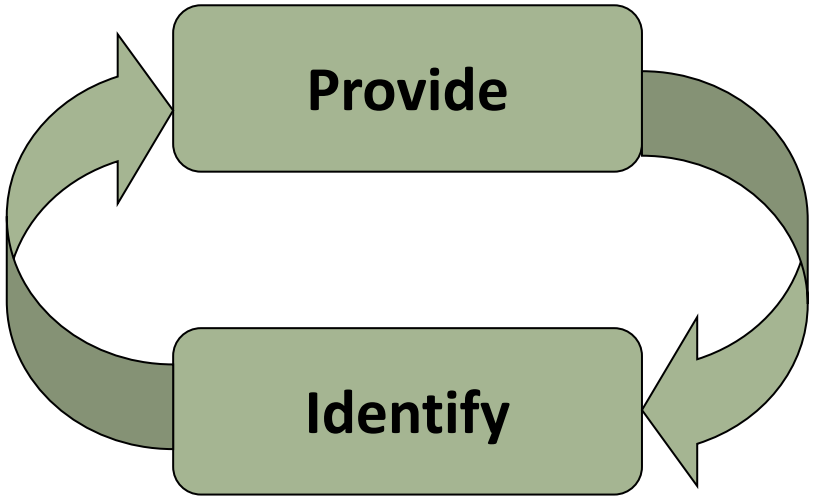
When first started bright ideas time the children`s responses were limited as they wanted to just find the right answer. Now their responses draw on lots of their previous knowledge and question the world around them a lot more.

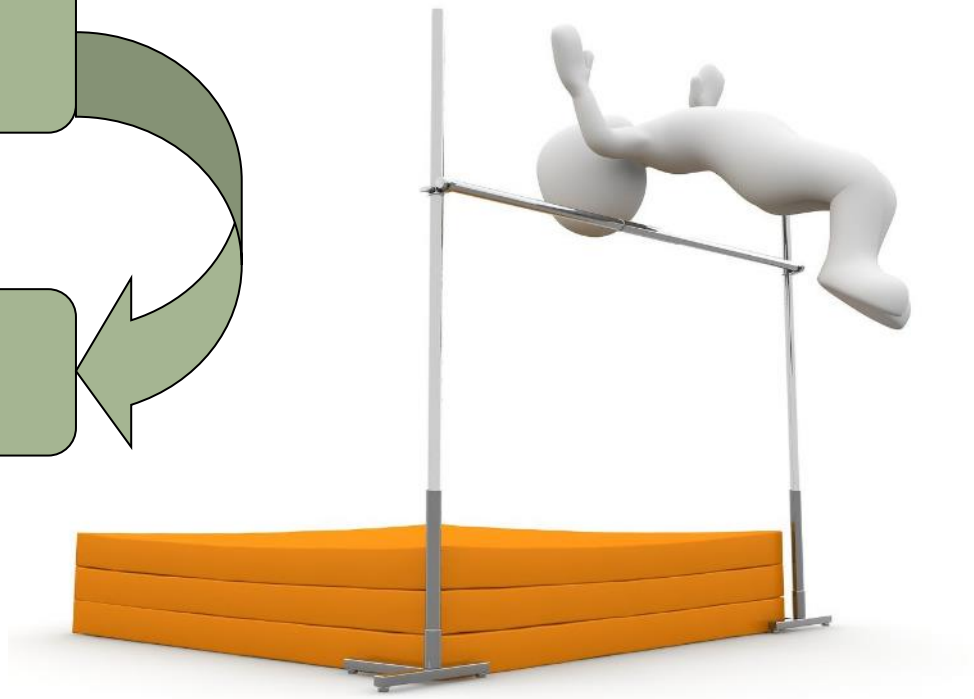
More children seem to be more inclined to take part in class discussions when we have a go at the bright ideas sessions, generally more often when they are asked to justify an answer rather than looking for a correct response.

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

Questions - pupil & teacher

Practical Prompts for Thinking

Practical Investigations

Higher order thinking

talking

doing

Bright Ideas Time

Practical Problem solving

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.

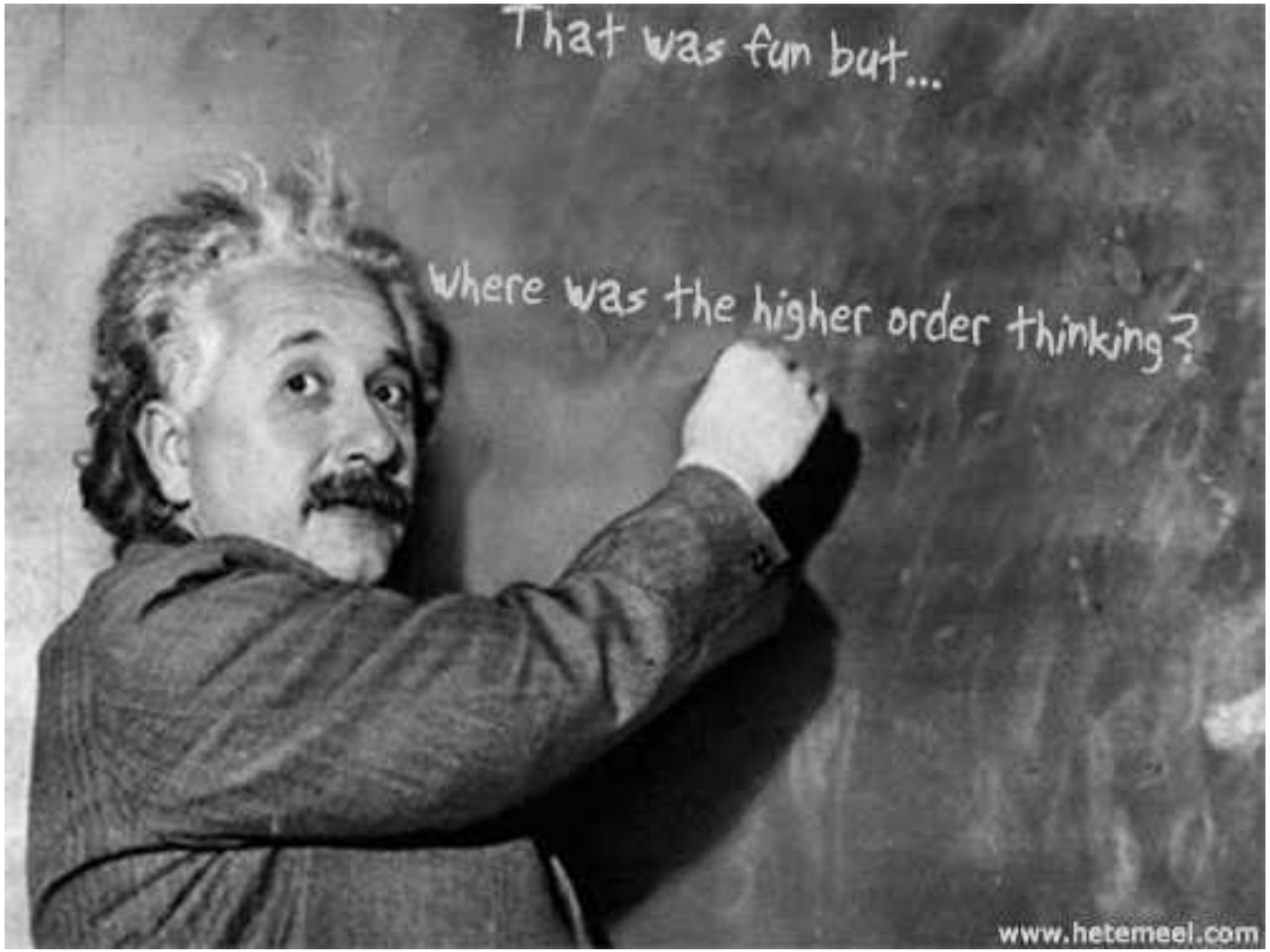
Create an animal …

…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.


That was fun but...
where was the higher order thinking?
www.hetemeel.com

What would be the learning objective(s)?

How would you assess the learning objective?

Focused recording

Creativity

Questions - pupil & teacher

Practical Prompts for Thinking

Practical Investigations

Higher order thinking

talking

doing

Bright Ideas Time

Practical Problem solving

Focus the recording on the learning objective

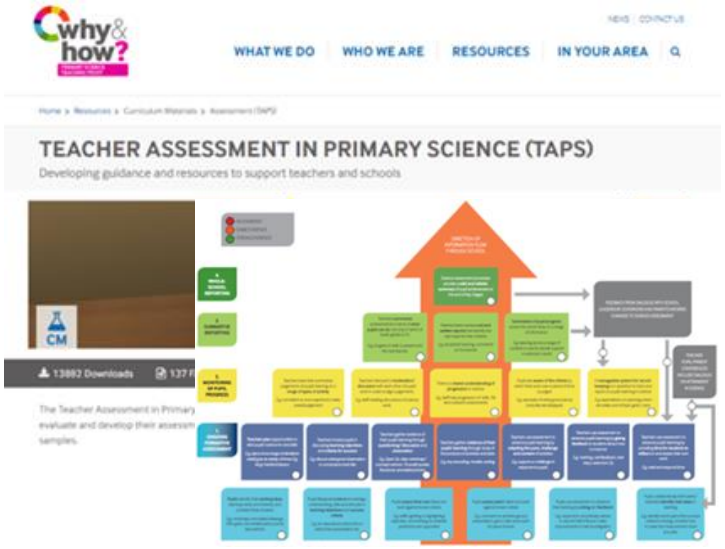
What and how do I record?

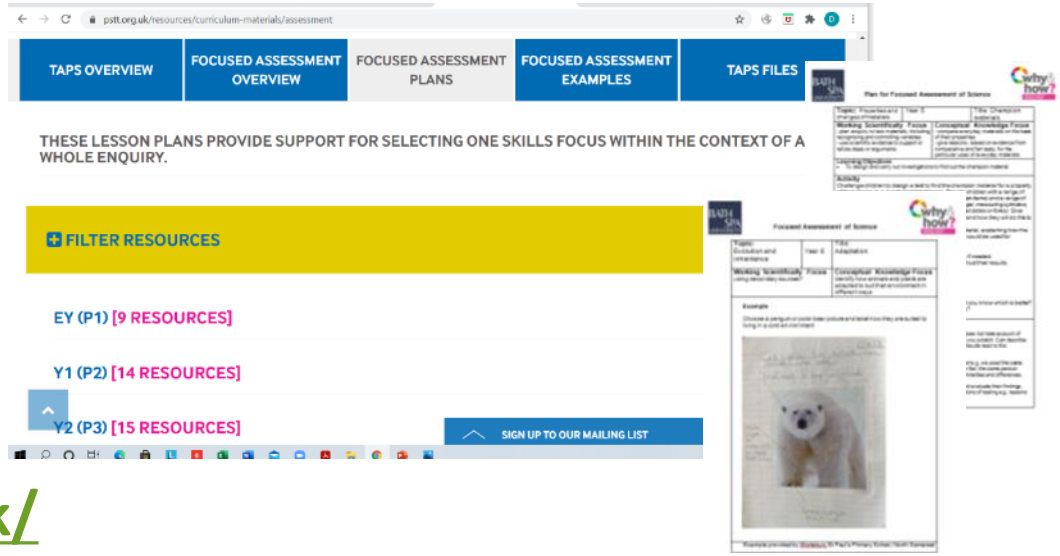
Focusing the recording releases the time for the thinking, doing and talking.

Focusing the recording produces sharply assessable work

Teacher Assessment in Primary Science (TAPS)

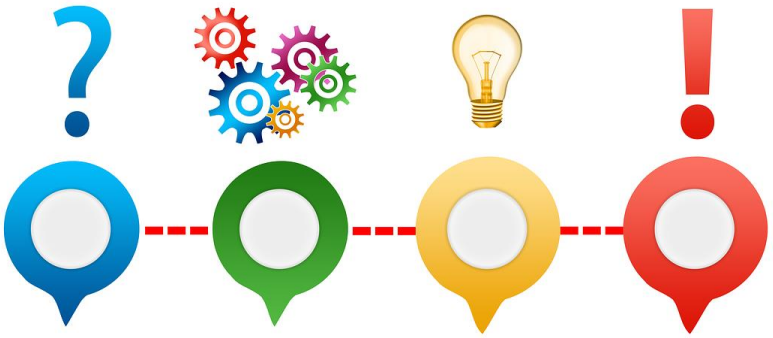
- Aiming to develop support for valid, reliable and manageable science assessment which will have a positive impact on children's learning.
- Free online resources:
  - Pyramid school self-evaluation tool with examples of practice in schools
  - Focused assessment database with plans and examples of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





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

Which practical?

Practical

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

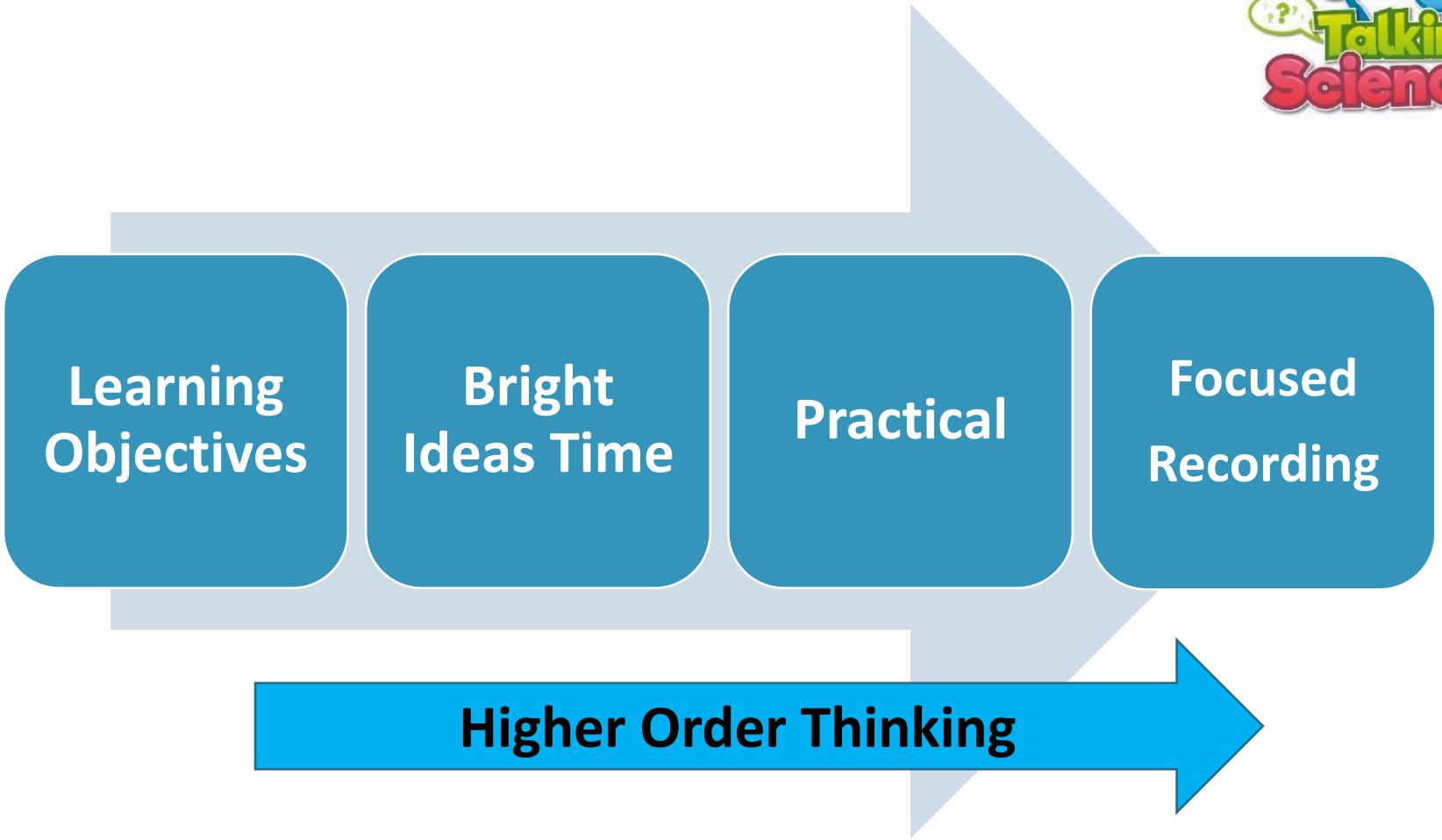
HOT

Skills *and* understanding

What are the learning objectives?

Focused recording

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