SCIENCEOXFORD

Primary Science Teaching Trust

Thinking Doing Talking Science

Focused recording

Thinking Doing Talking Science

Creativity

Practical Prompts for Thinking

Questions - pupil & teacher

Practical Investigations

talking

Higher order thinking

doing

Bright Ideas Time

Practical Problem solving

Health & Safety

The activities you will be undertaking today have been risk assessed using guidance provided by CLEAPSS.

When planning to repeat any of the activities we are showcasing today, you must consult the risk assessment advice provided by your employer and adjust it to suit the needs of your class.

It is likely that your employer has identified CLEAPSS (England, Wales and NI) or SSERC (Scotland) as the source of H&S advice they want you to follow.

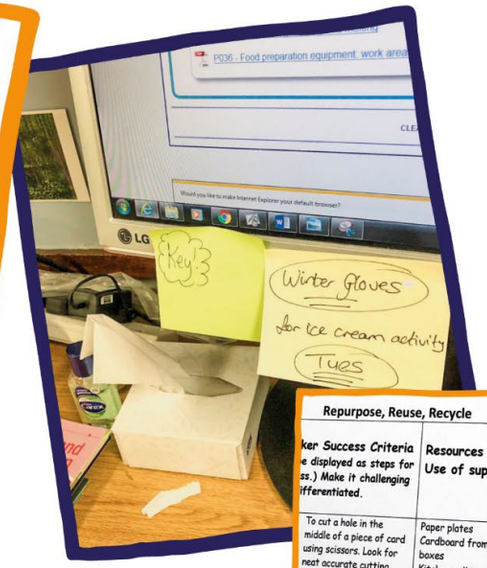
www.cleapss.org.uk	www.sserc.org.uk
primary@cleapss.org.uk	enquiries@sserc.scot
01895 251 496	01383 626 070

If you do not know who provides your school with health and safety advice, ask your Headteacher, employer or business manager.

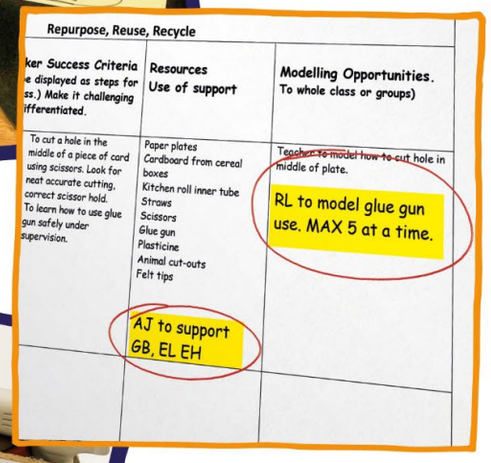
It is your employer's responsibility to provide you with suitable advice and training so that you can manage any risks arising in your lessons appropriately.

Health & Safety – Risk Assessment

Annotated CLEAPSS safety notes document with steps taken appropriate to the cohort



Post-it note reminders of steps to be taken to keep the cohort safe



Planning annotated with steps to be taken e.g. additional supervision/ small group work

IWB of PPT safety procedure slide reminder

Safety reminder sign placed on tables to be seen whilst doing the activity

https://primary.cleapss.org.uk/Resource/P137-How-to-do-a-risk-assessment.aspx

Images courtesy of CLEAPSS

Theme: Earth and Space

The strategies are generic and for all curriculum areas – we are exemplifying them through this topic

Remember:

There are subject knowledge notes and teaching ideas in your **TDTScience Teacher Resources** folder.

Login and download here:
https://tdtscience.org.uk/user-registration-primary

You will find the subject knowledge files in the **General Resources** folder.

Curriculum: Earth and Space

Pupils should be taught to:

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the Sun across the sky.

Astronomers develop theories from observations

There are so many ways of doing science!

Evolution: Darwin developed theories from observations

The Flat Earth model

NC: pupils should talk about how scientific ideas have developed over time.

The Bright Ideas Time

Aim to have a Bright Ideas Time in each science lesson – related to the topic area

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

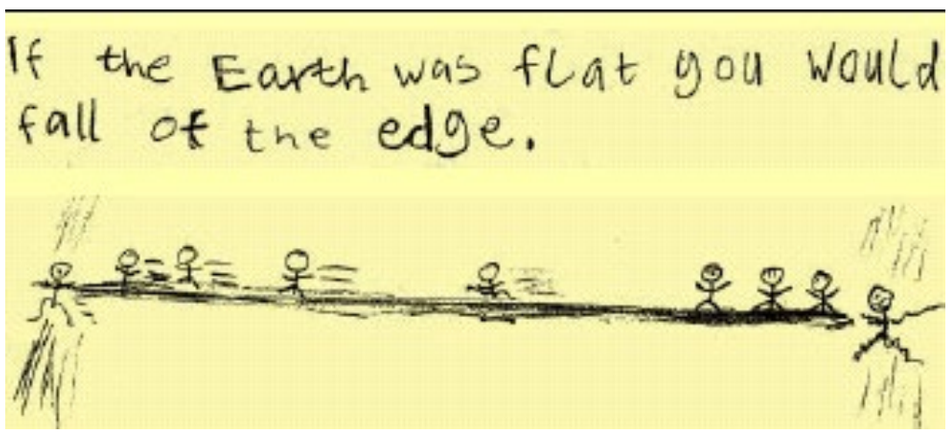
A HOT Question

You are not allowed pictures from space!

How do you know that the Earth is a sphere?

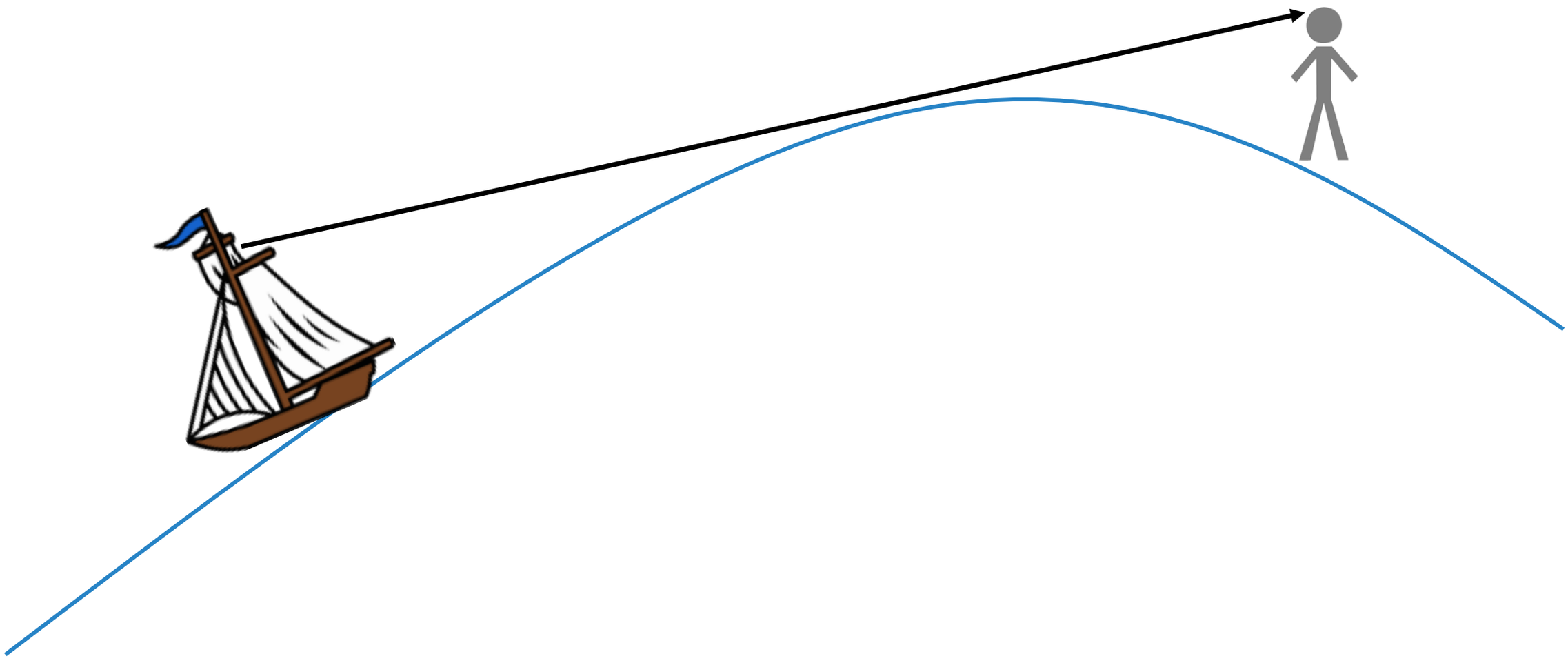
‘If it’s flat, when you make the foundations for a temple why doesn’t it go through?’

‘Why doesn’t water fall off the edge if the Earth is flat?’



Among the good reasons:

First see the top of the ship as it approaches



‘Because gravity comes from the centre of the earth, because a sphere is the smallest shape you can make from the centre, it would most likely be pulled up into a sphere.’

Wow! This 10 year old is right. Can you work out what he is saying?

Amazing Higher Order Thinking

Skinny questions:

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

So, was that a big/rich question?

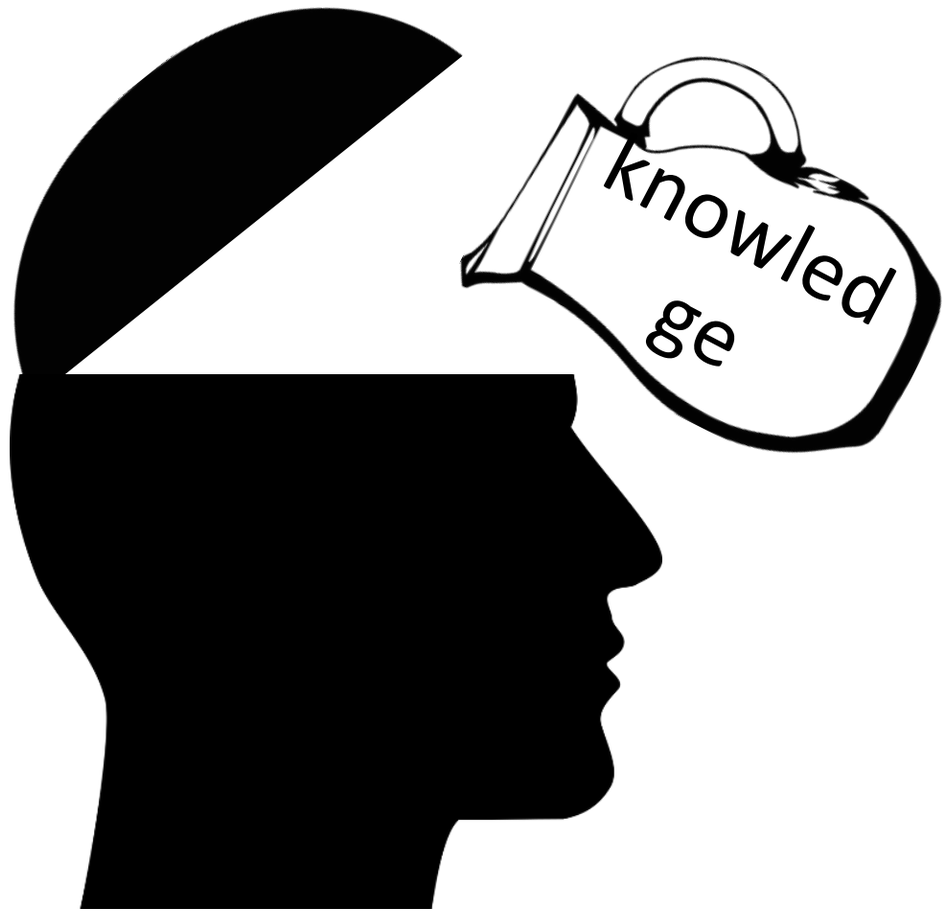
Rich questions:

- 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

The constructivist view of learning: the child has pre-existing ideas which you have take account of.



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

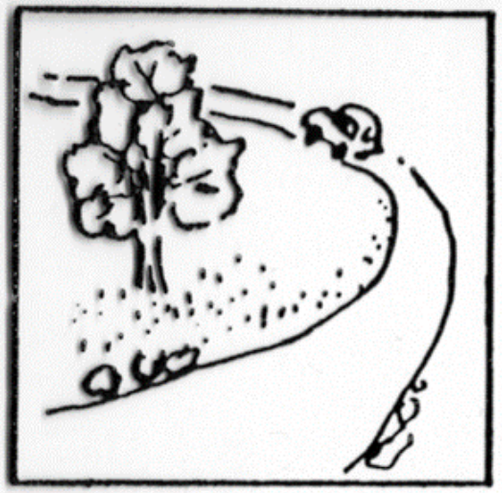
Some of these pre-existing ideas may not be the accepted scientific views!

Can’t just pour knowledge in.

So, it is important to elicit their existing understanding.

The child believes the Earth is flat ***and***

(a)

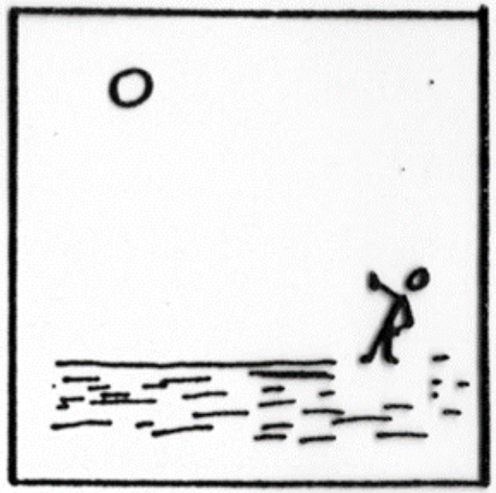


. . . the Earth's roundness is just the roads' curves

(b)

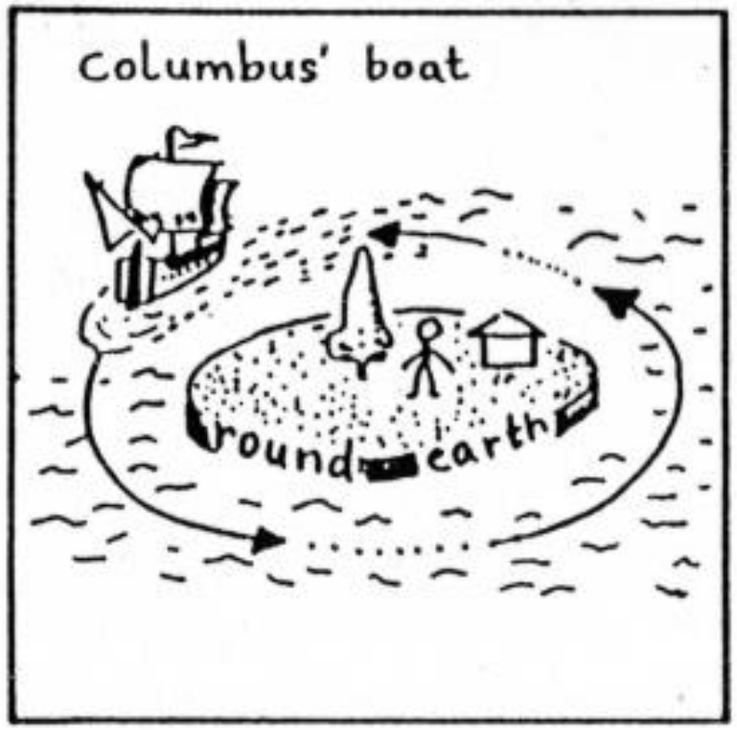
. . . the Earth's roundness is just the mountain's shape.

(c)



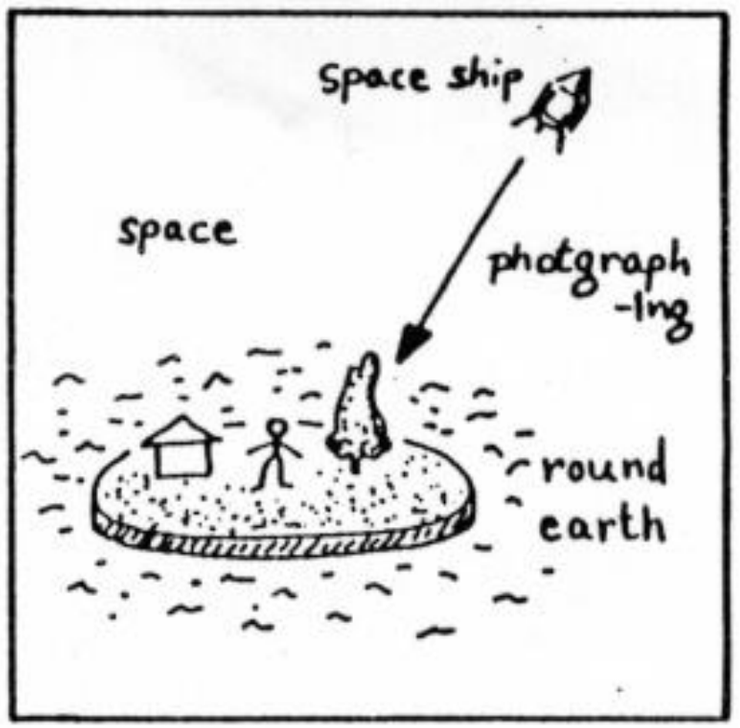
. . . the globe represents some other planet in the sky.

(d)



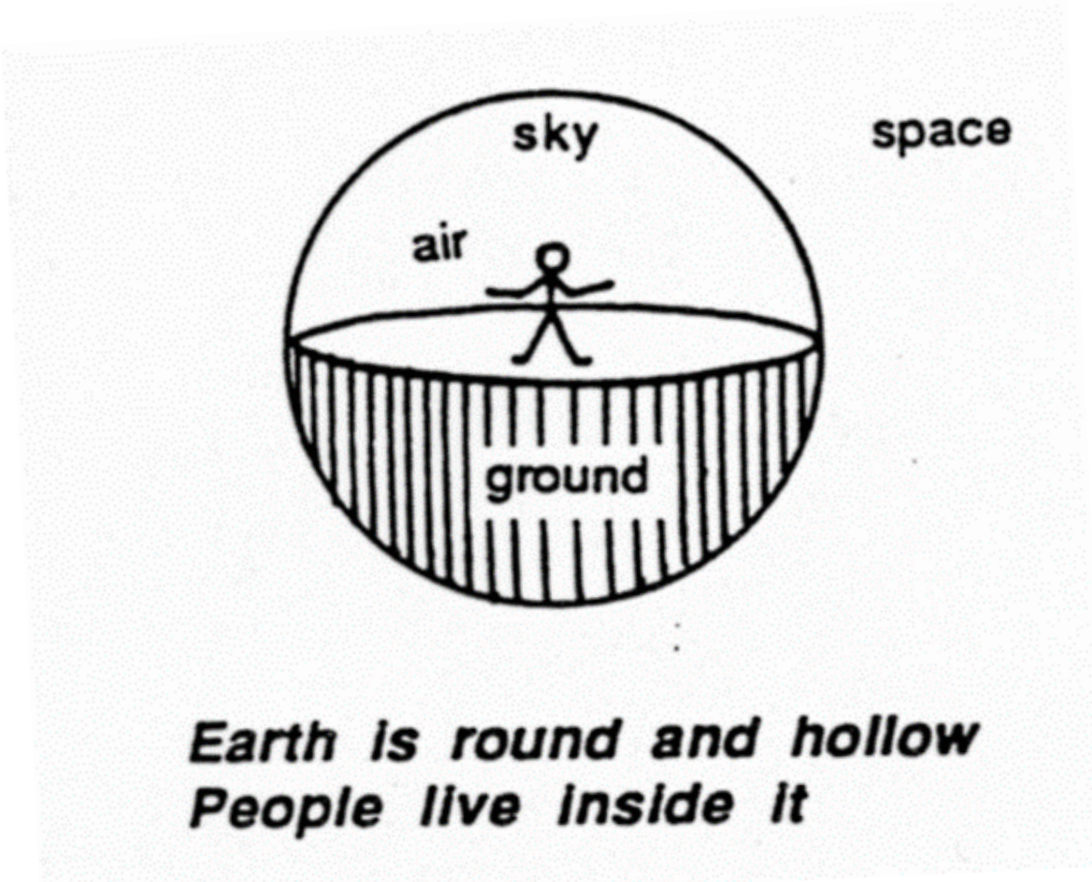
. . . is surrounded by ocean. This is what enabled Columbus to go around it.

(e)



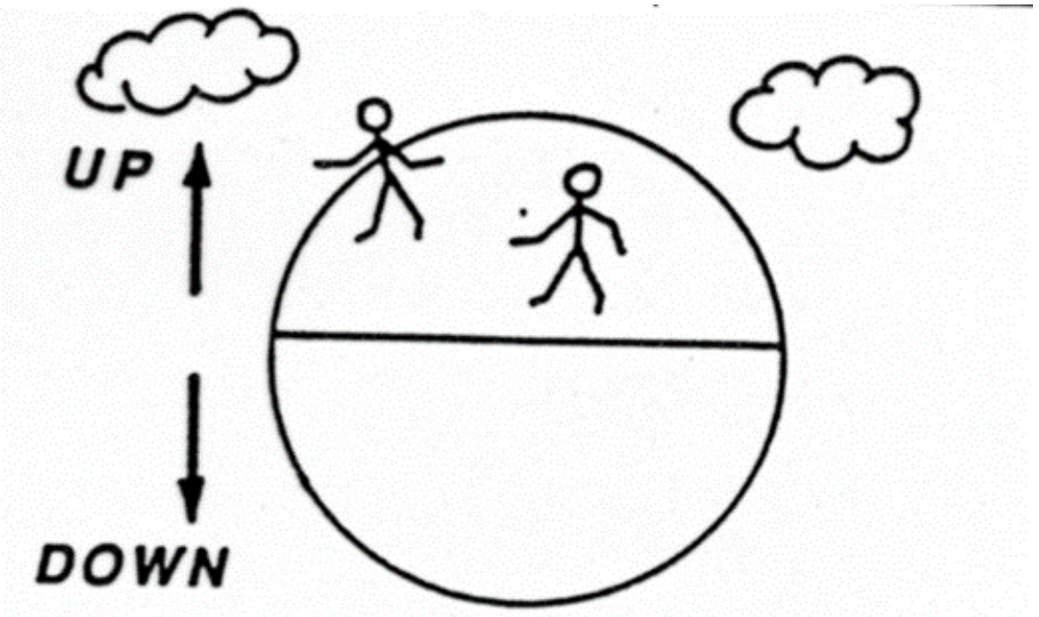
. . . is surrounded by ocean. The round shape of this flat Earth is seen in photographs taken from space.

Some of the **common misconceptions** shown by children cont'd:



Earth is round and hollow
People live inside it

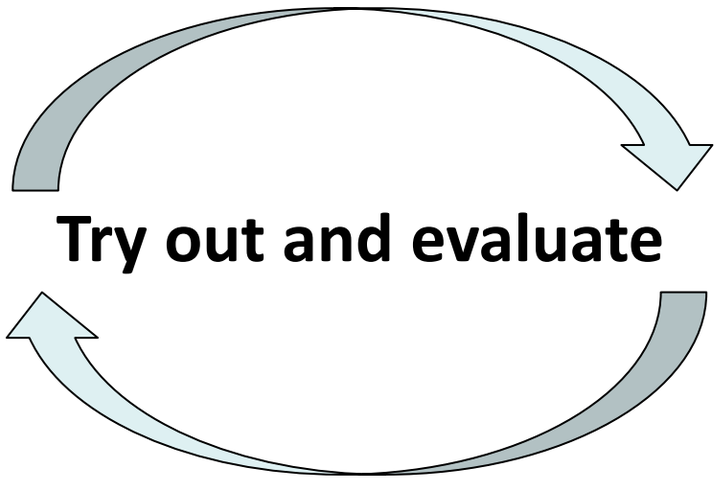
Do you have an up/down?



Earth round ball but people only live on the top half with their heads pointing to the north pole

Sharing of Good Practice

Repertoire of strategies



You were asked to:

- Give feedback on a HOT Question

In groups of four, share which **HOT Question** you tried and how it went in terms of:

- Children's responses
- Children's learning
- Children's behaviour

We will ask for feedback from each group

Further thinking about questioning

As teachers, you ask so many questions during the day!

Your questions have so many different purposes.

Individually, list the different types of questions that you use within the classroom, i.e. what are the questions for?

Each person - share one of your answers

What do you notice?

Would you like to come out from under the table?

Is that really how we behave?

Alistair, where is your pencil?

Obviously required at times!

Research on questioning
R. Alexander (2006)
N.B. observations, not criticisms:

- Most of the questions asked were of a low cognitive level designed to funnel pupils' respon quired answer..

Might be OK?

- Open questions made up 10% of the questioning ex

Purpose of questions?

- Rarely were teachers' questions used to assist pupils to more complete or elaborate ideas.

Using HOT?

- Most of pupils' exchanges were very short – answers lasting on average 5 secs & limited to 3 words or fewer 70% of time.

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

EEF Questioning Tool (2022)
Metacognition and Self-regulated Learning report (2018, 2021)

Metacognitive and Self Regulation Guidance report → explicitly teaching pupils to plan, monitor and evaluate their learning can increase pupil independence

How?

- **Support pupil independence through questioning**
- **Guide teacher practice with pupil prompt questions**

EEF Questioning Habits Tool (2021)

Examples:

- Planning the task – *What resources will you need?*
- Monitoring the task – *Is the strategy you have chosen working or do you need to try something else?*
- Evaluating the task – *Do you need more/less support next time?*

https://educationendowmentfoundation.org.uk/news/updated-resource-supporting-independence-through-questioning-a-planning-tool

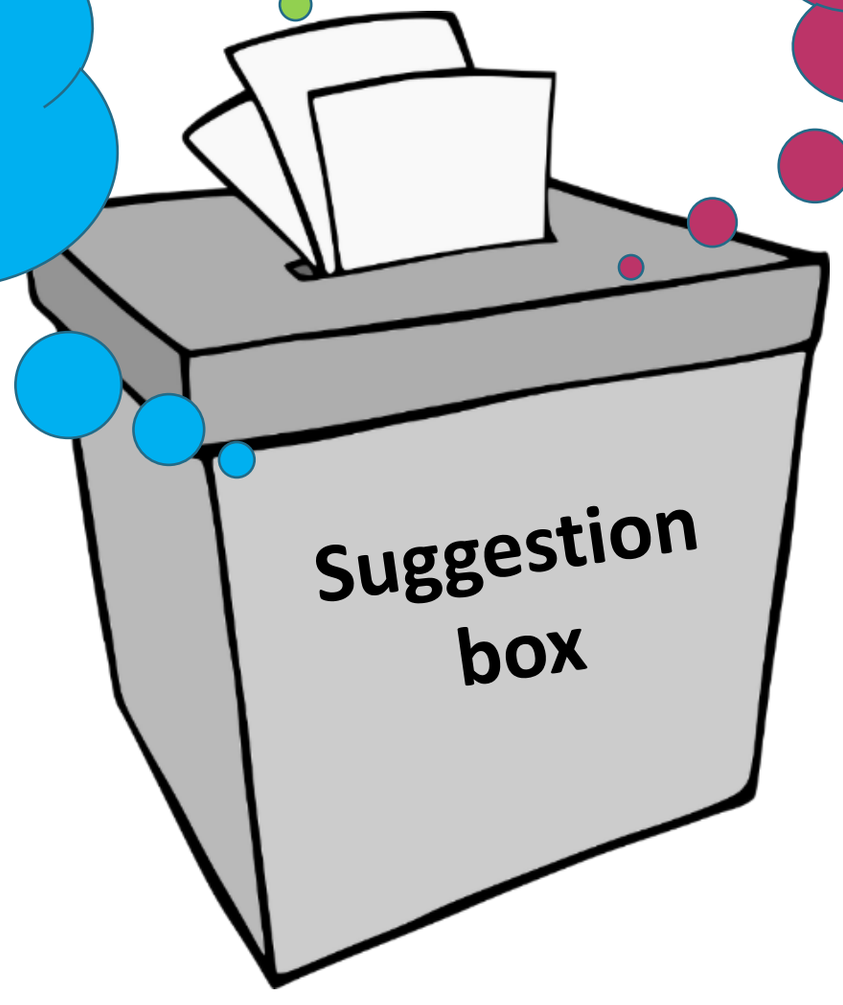
How can we do better?

Plan one or two higher order/rich questions per lesson

Use the **HOT Question** sometimes in the Bright Ideas Time

Highlight where the HOT is being encouraged in your planning

Other ideas?



The Bright Ideas Poster

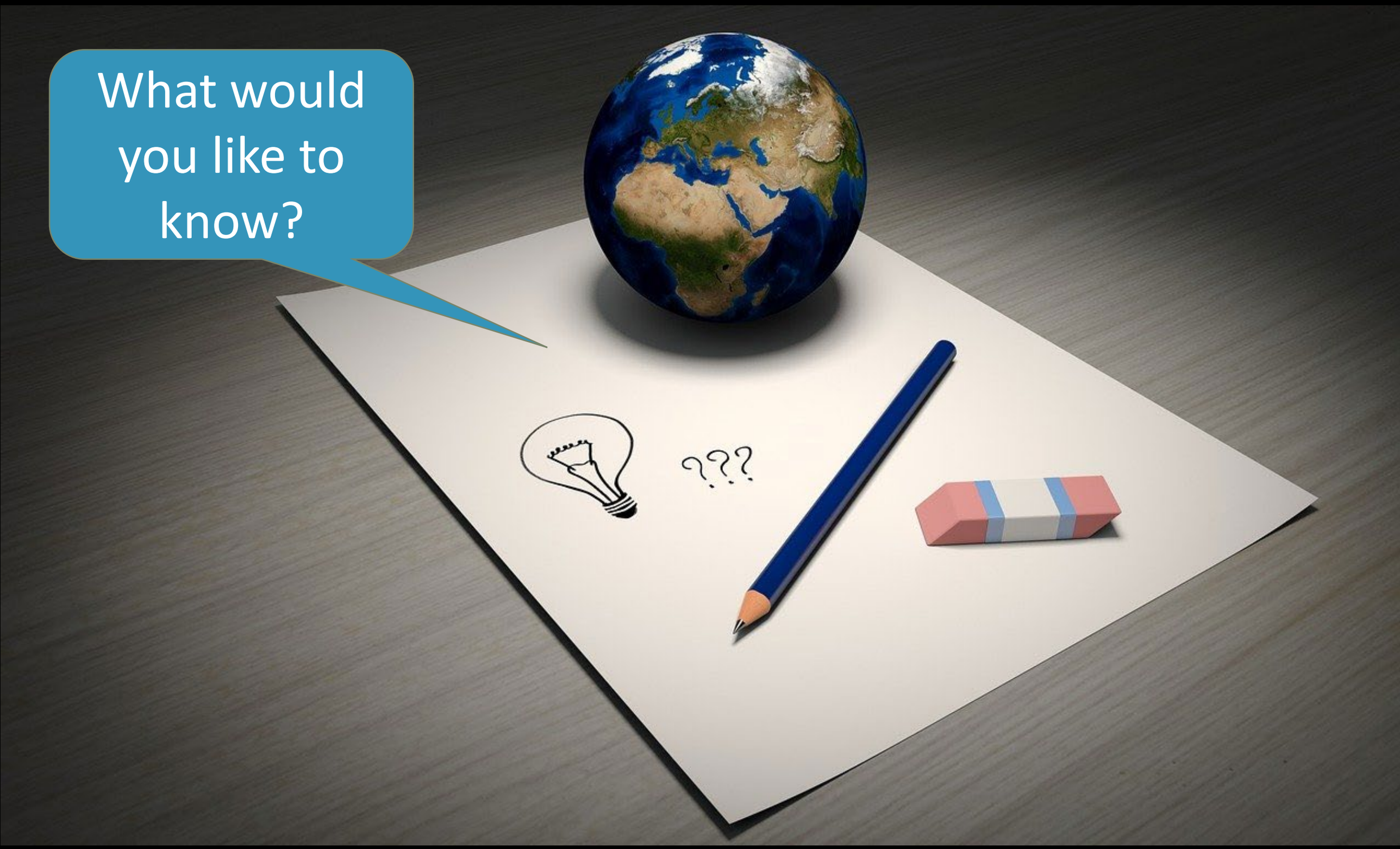
When questions arise in the classroom that no-one can answer put them here…

The Light Bulb Award

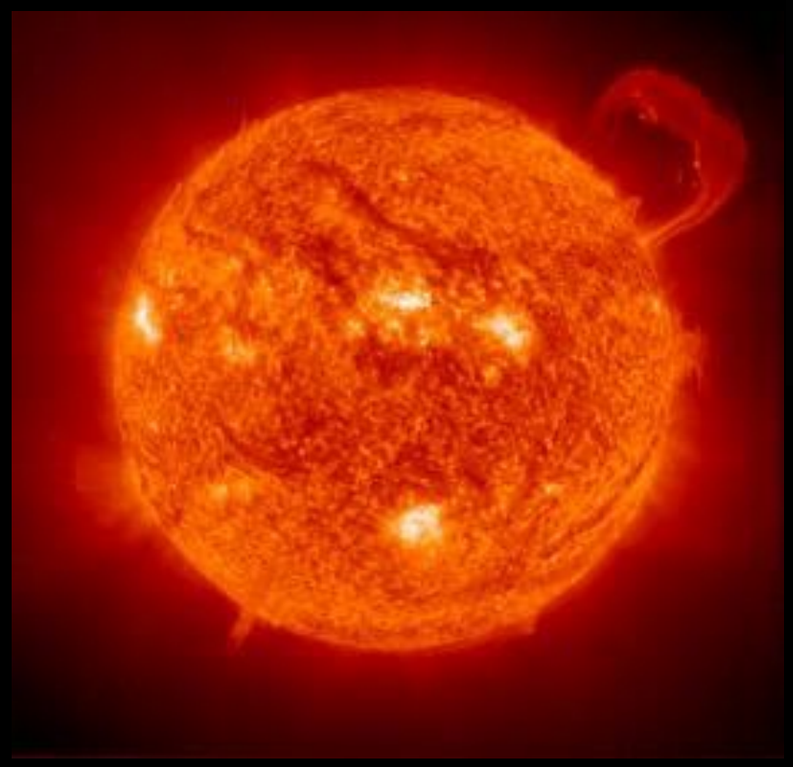
I asked the best question this week

My question was …

Encouraging children to question



What would you like to know?



What does this child know to have asked this question?

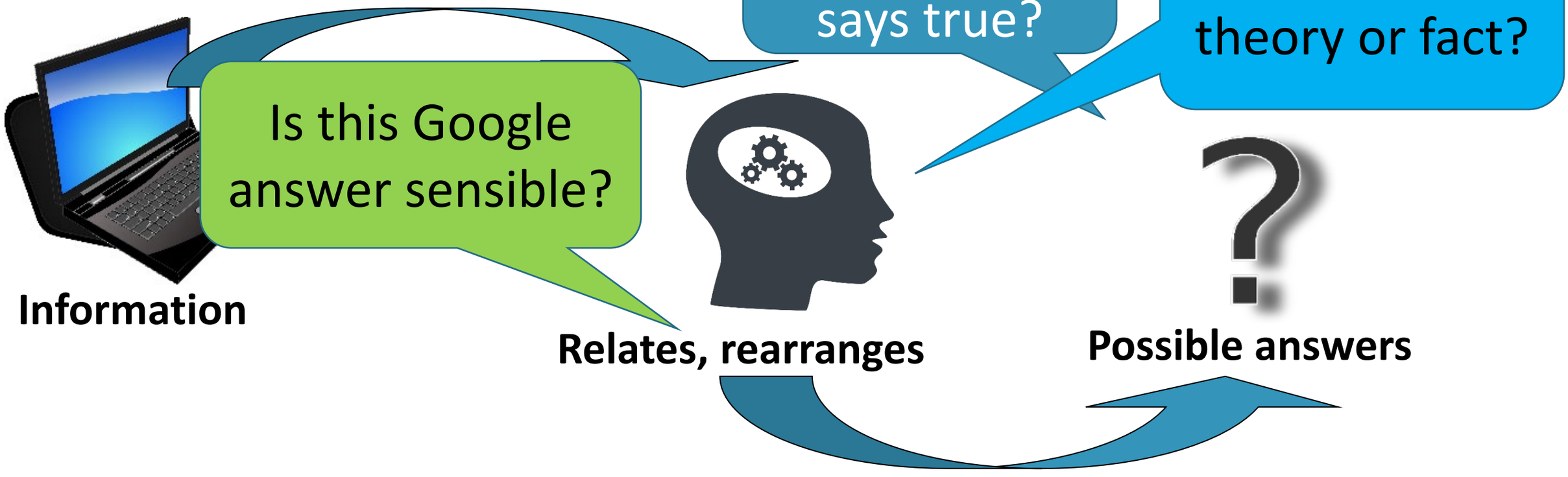
Higher order thinking here?

How come the Sun burns in space if there is no oxygen?

Earth image - © NASA/Apollo 17 crew

Another definition of Higher Order Thinking:

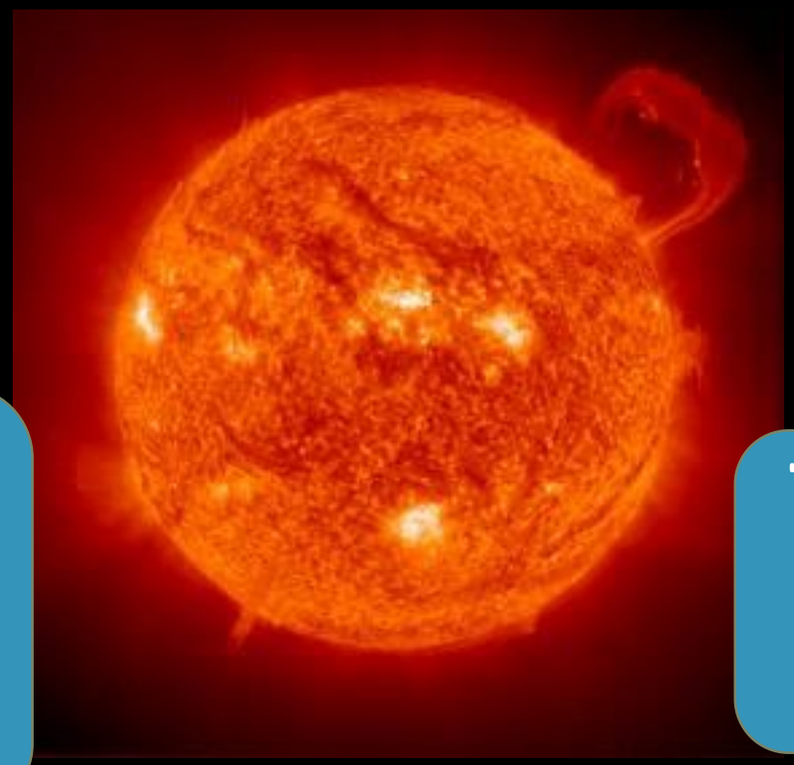
‘Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations.’



Lewis and Smith (1993, p.136)

Encouraging children to question

What would you like to know?



An assessment tool - ask children to put their names by their questions

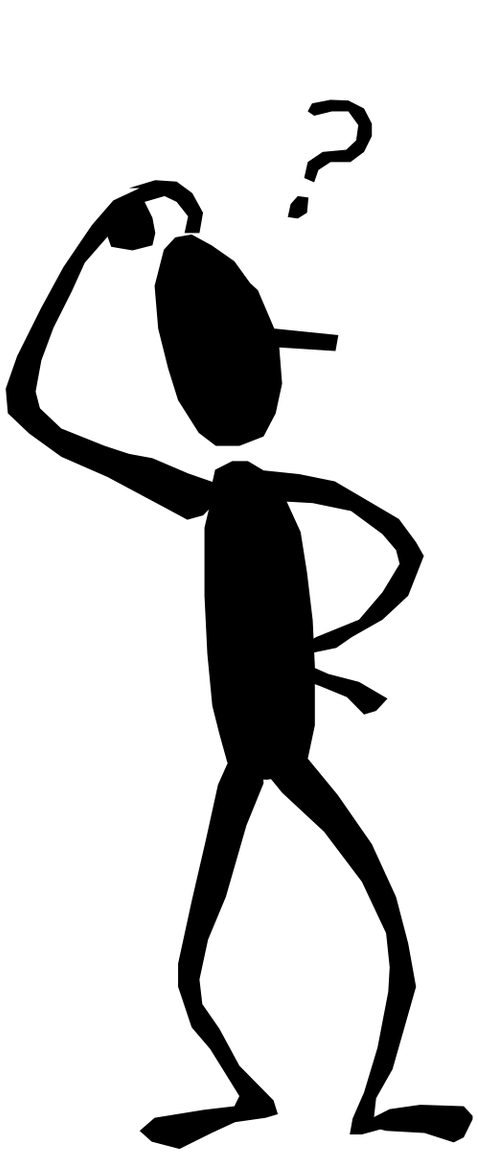
The answer? Research from secondary sources?

How come the Sun burns in space if there is no oxygen?

Earth image - © NASA/Apollo 17 crew

A HOT Question

What causes day and night to occur?

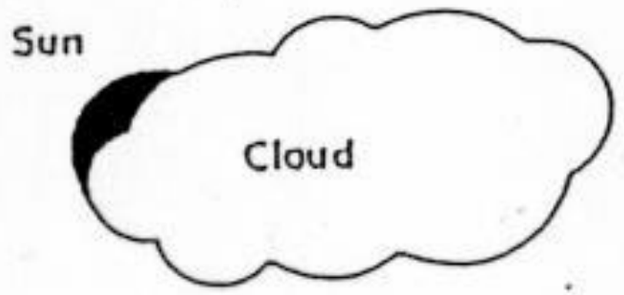


Act your understanding out in pairs!

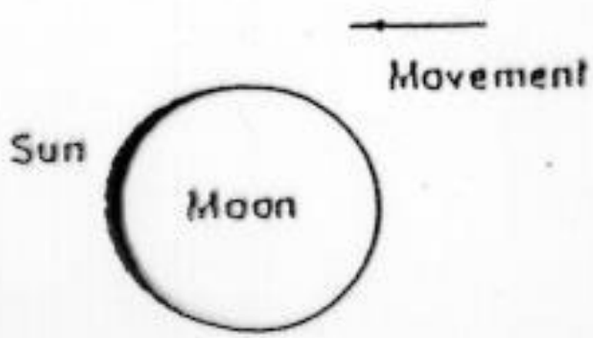
Pupils' notions about day and night

Notion 1
Sun goes behind hill

Notion 2
Clouds cover the Sun



Notion 3
Moon covers the Sun



A HOT Question

Why don’t we sense the motion?


Thinking
Doing
Talking
Science


Thinking
Doing
Talking
Science

The Moon takes approximately 28 days to orbit the Earth.

- **A ‘moonth’**

Act it out!

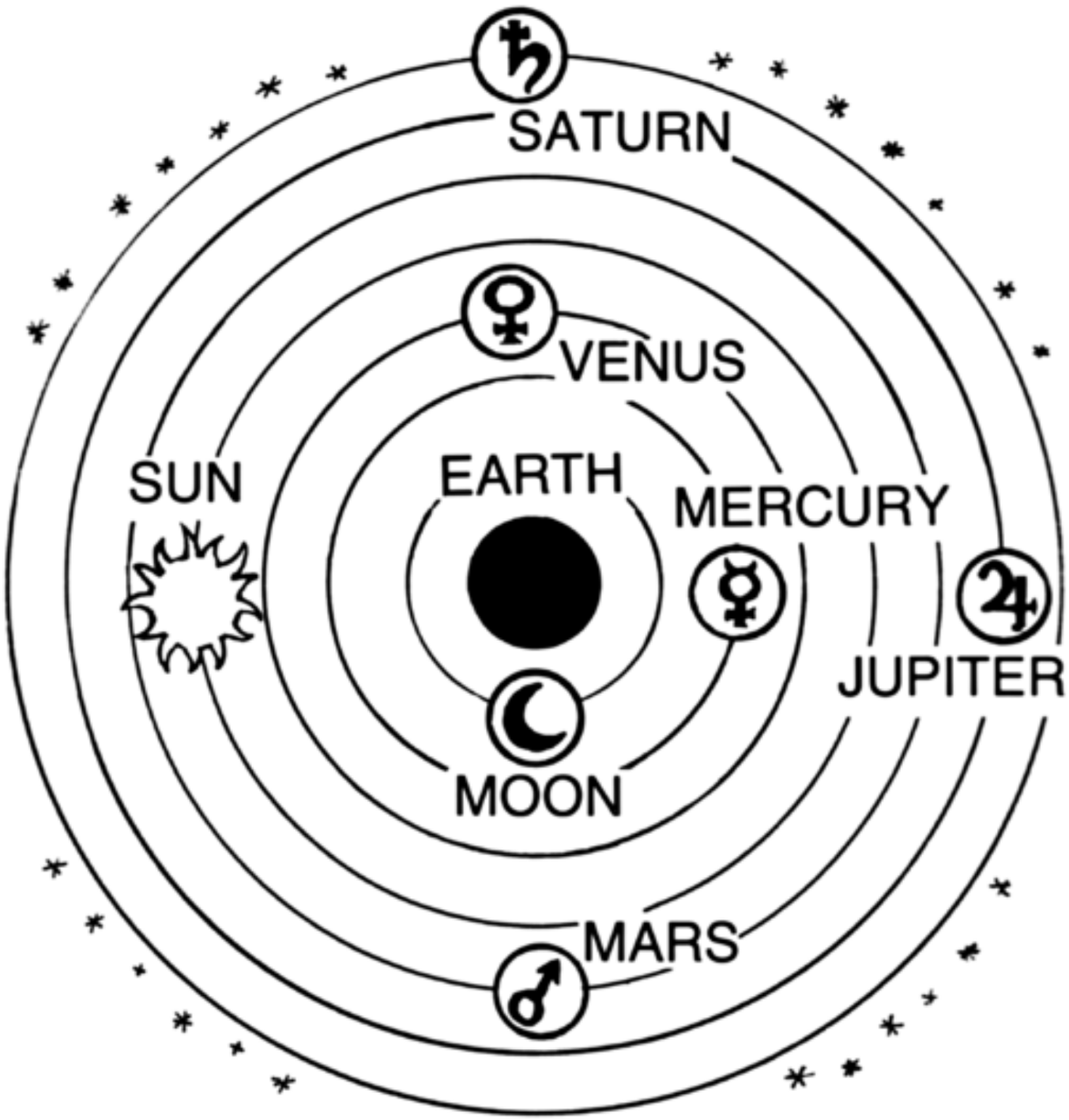
The Moon

The Sun & the Moon look the same size in the sky. Why?

Different size spheres – try it!

The diameter of the Sun is 400 times the diameter of the Moon, but it is also 400 times further away! So, the Moon perfectly covers the Sun in a total solar eclipse.

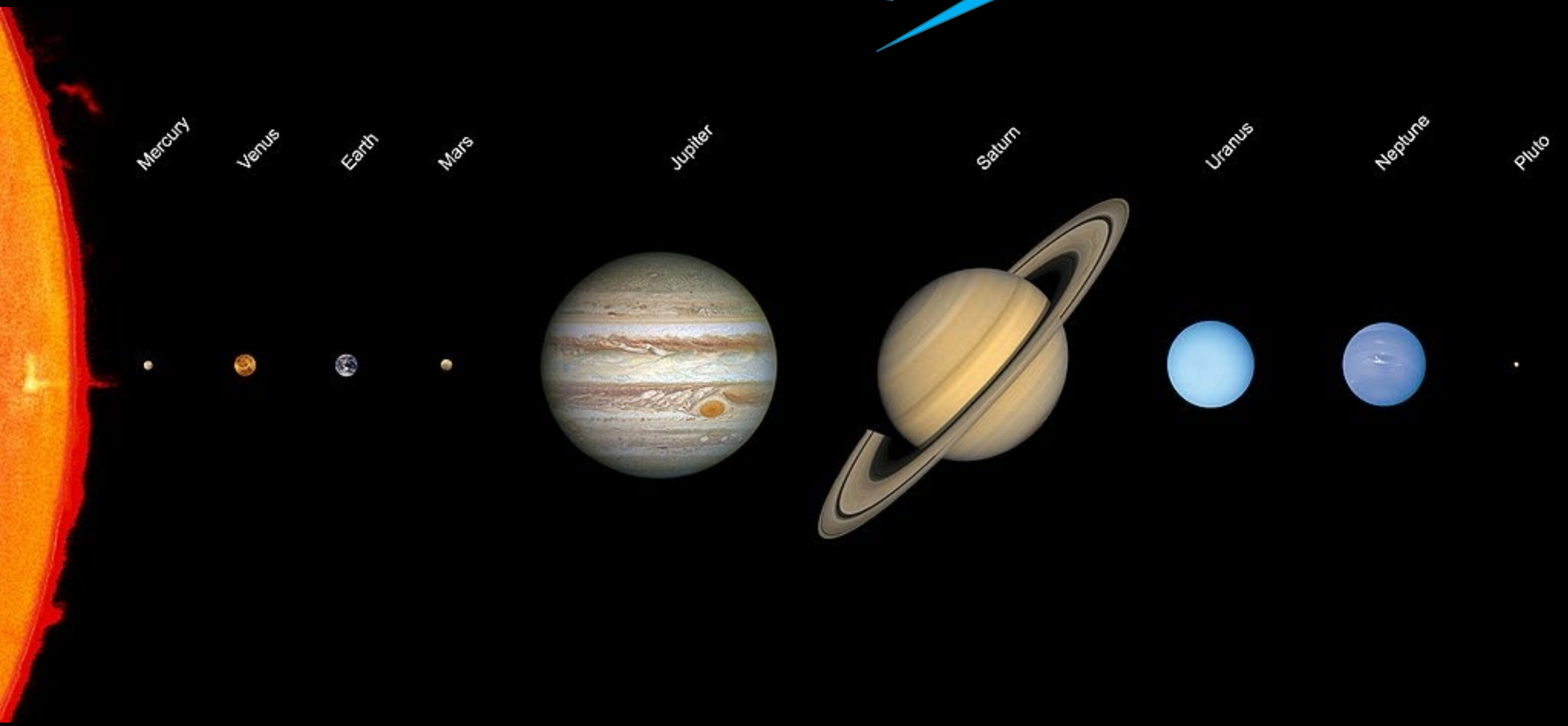
Geocentric model of the Solar System



Helio-centric

Act it out on the playground.

Add in the Moon.



Galileo Galilei

1564 – 1642

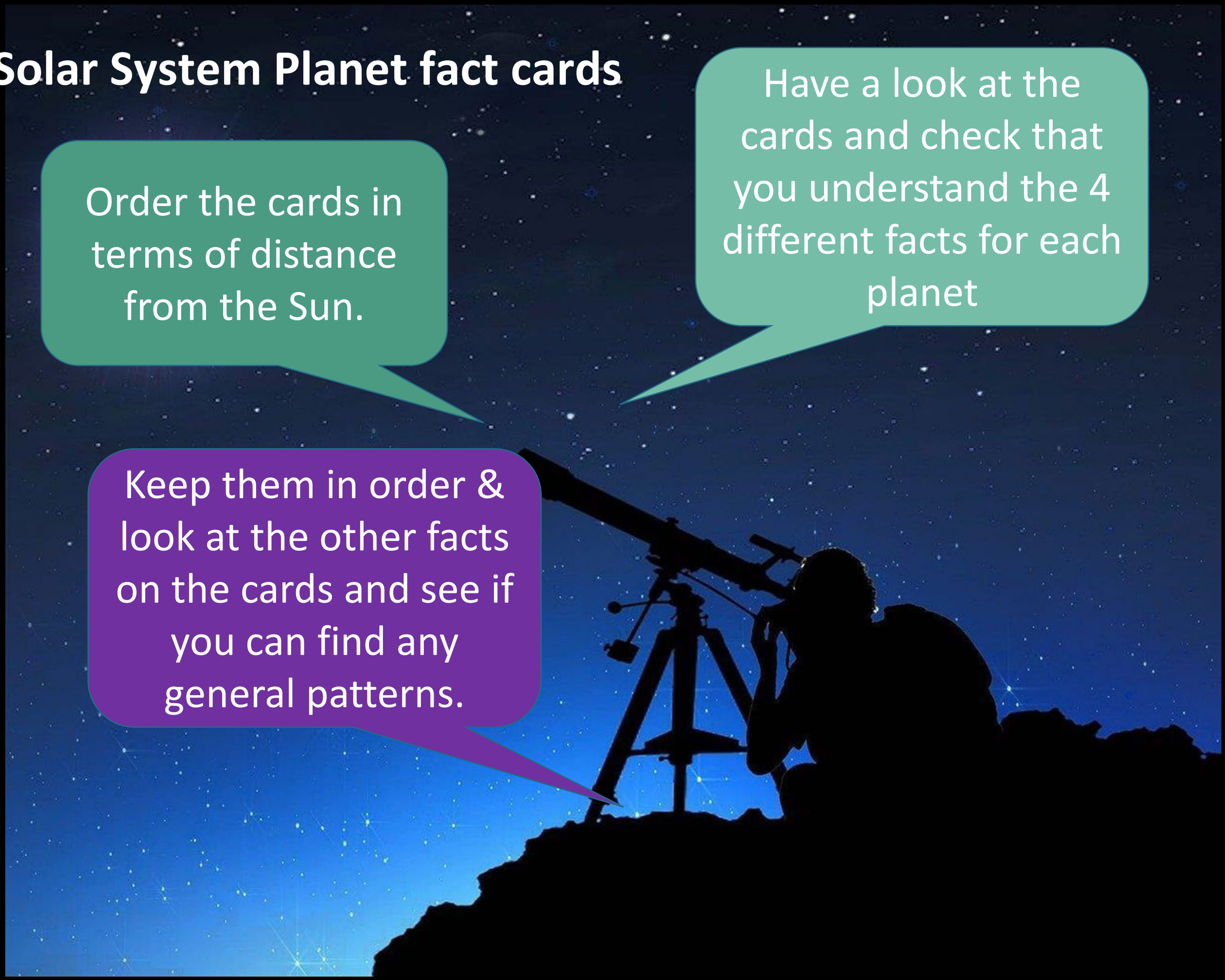
Recommended picture book:
Starry Messenger
Peter Sis

Solar System Planet 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.



Solar System Planet fact cards

Are there any ‘exceptions’ or anomalies, i.e. things that do not fit into a general pattern?

Can you think of an explanation for any general pattern you found?

Can you think of any possible reasons for an anomaly?

There is something called the ‘Goldilocks zone’ around a star.

Can you think what this means?

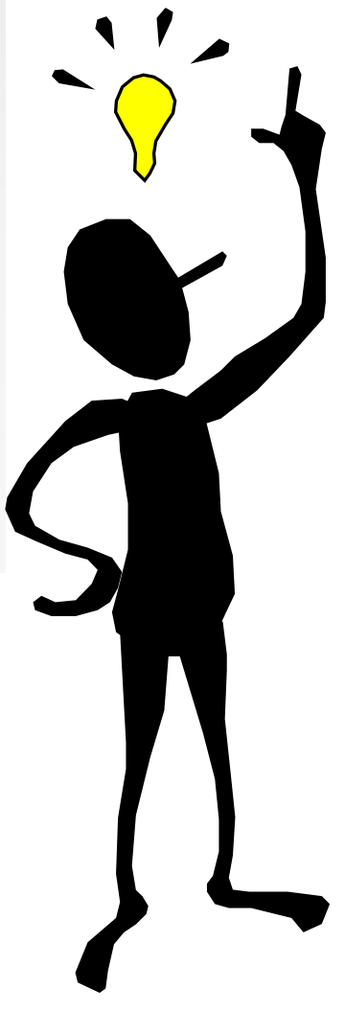
Clue: look at the fact cards & think what will happen to water on each planet

https://exoplanets.nasa.gov/faq/15/what-is-the-habitable-zone-or-goldilocks-zone/

Key question

- Is the aim of the lesson to develop children's skills; knowledge and understanding; or both?
- What will be the focused learning objective(s)?
- What will the children record?
- What and how will you asses?

The Bright Ideas Time: the PMI



Include a Bright Ideas Time in every lesson

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

PMI

Living on the Moon

P = Positive

M = Minus

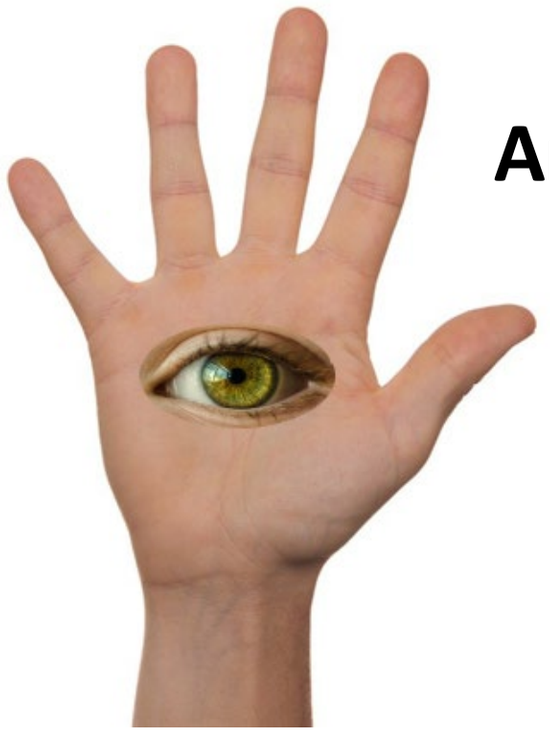
I = Interesting

The PMI: a different area of the curriculum

All door handles are made of chocolate

What is **P**ositive, **M**inus and **I**nteresting?

The chocolate teapot



An eye in the middle of your hand

Plants can walk

More PMIs

A world without friction

There are more examples of the **PMI** in the **General Resources** folder.

Go to: **More examples of Bright Ideas Time** (file)

These are organised by age group (KS1 and/or 2) and subject area, with background subject knowledge notes.

What if?

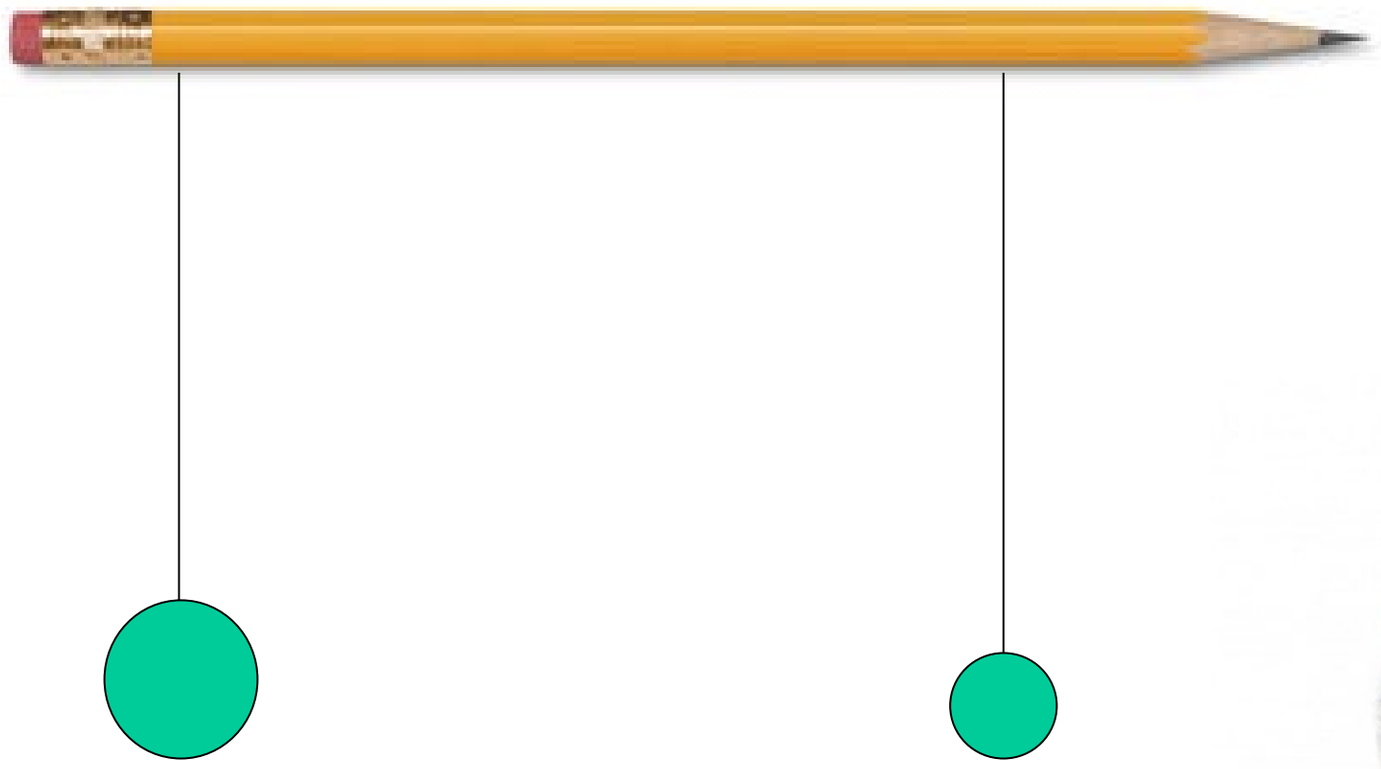
https://explorify.uk/en/activities/what-if/humans-lived-on-mars

https://explorify.uk/en/activities/what-if/the-earth-was-as-far-away-from-the-sun-as-mars

https://explorify.uk/en/activities/what-if/there-were-two-suns

Practical Prompt for Thinking

The scale of the Solar System:

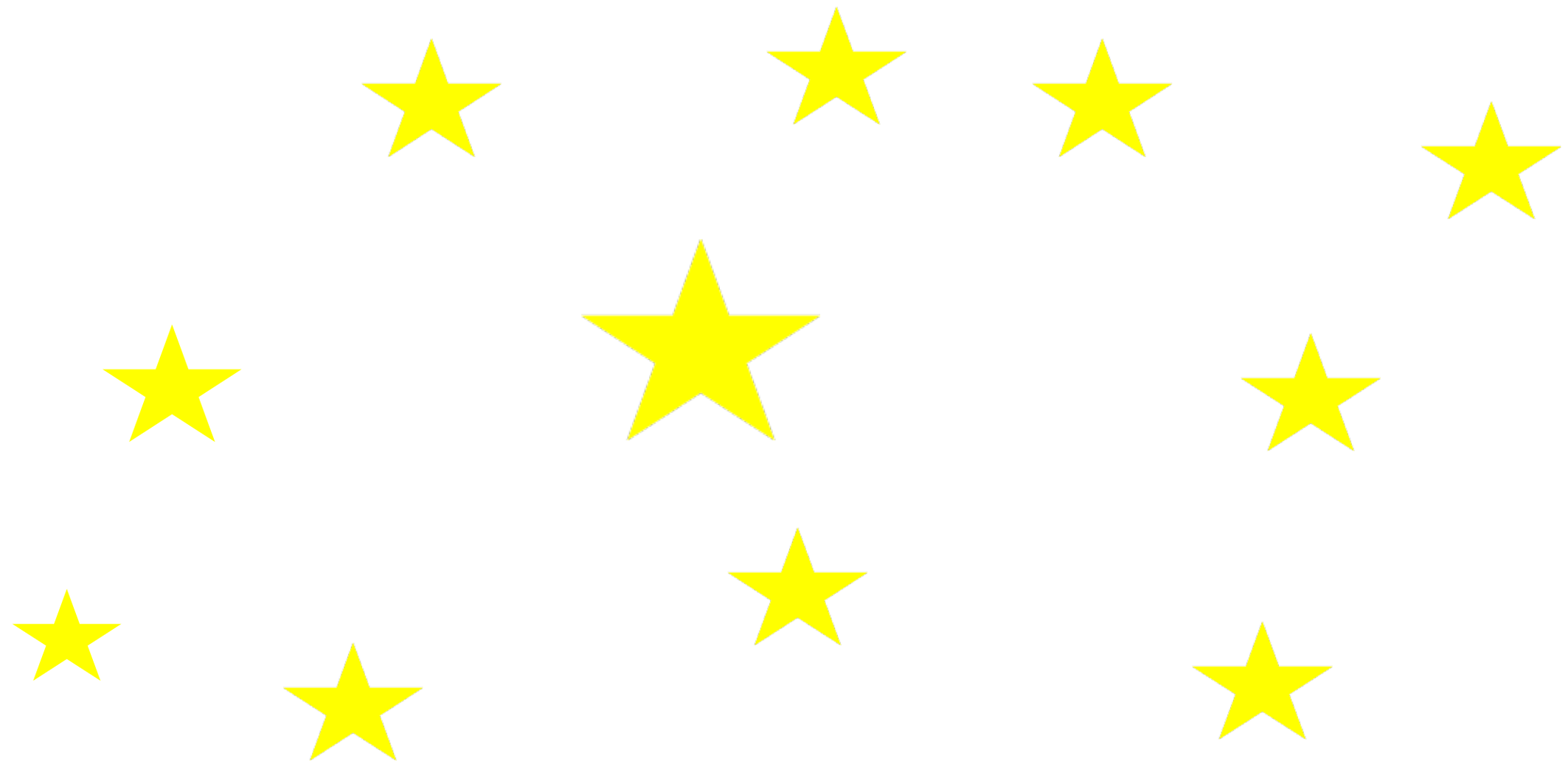


And…

Full details of each of these Practical Prompts in the **General Resources** folder

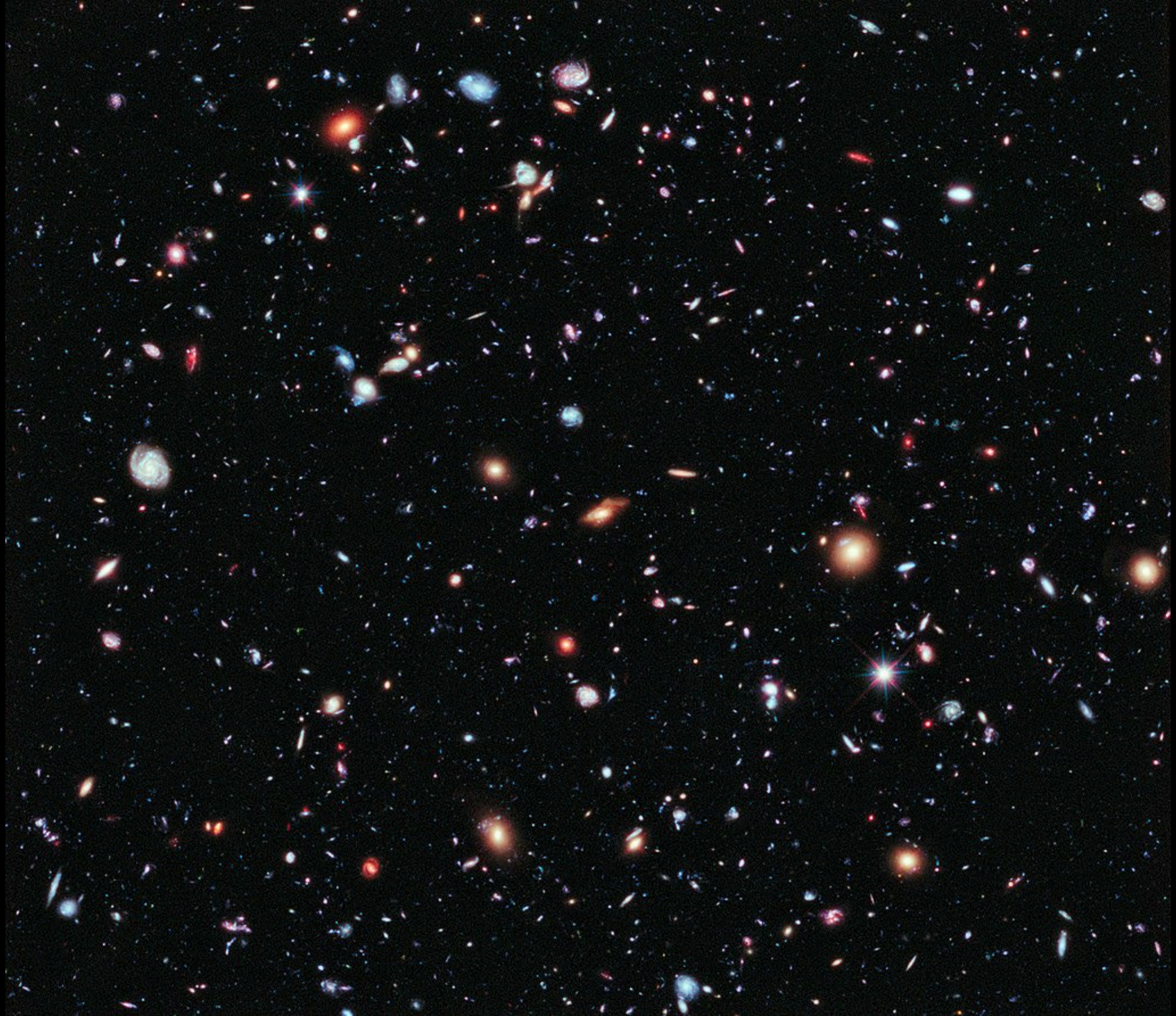
A galaxy is

a **huge** collection of stars




© Ivan Bok

We see history



Theme: Living Things

The strategies are generic and for all curriculum areas – we are exemplifying them through living things

Focused recording

Thinking Doing Talking Science

Creativity

Practical Prompts for Thinking

Questions - pupil & teacher

Practical Investigations

talking

Higher order thinking

doing

Bright Ideas Time

Practical Problem solving

Animals, including humans

- notice that animals … have offspring which grow into adults
- construct and interpret a variety of food chains …
- describe the changes as humans develop to old age

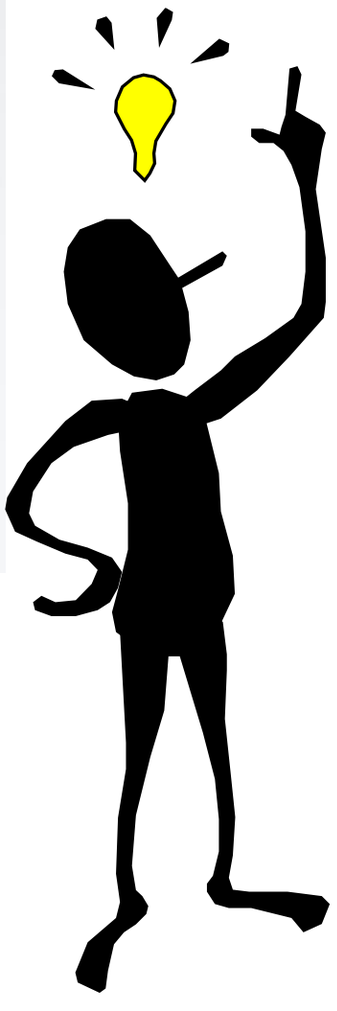
Living things and their habitats

- identify that most living things live in habitats to which they are suited …
- 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
- identify … that adaptation may lead to evolution

Plants

- explore the part that flowers play in the life cycle of flowering plants

The Bright Ideas Time: recap



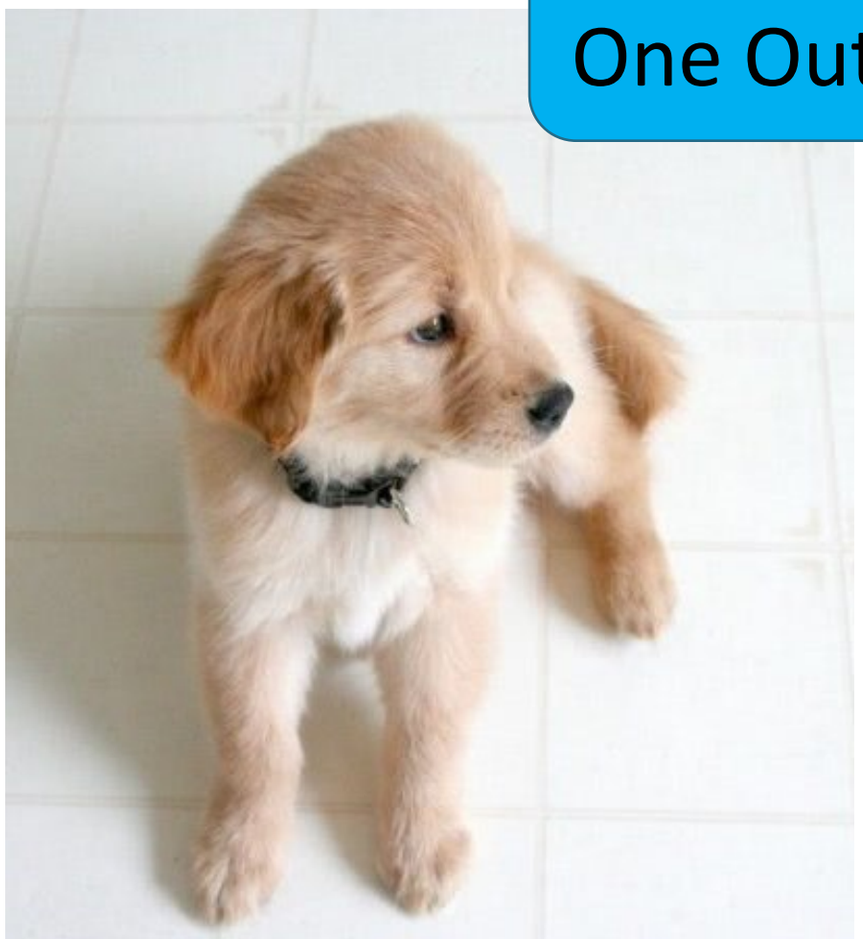
Include a Bright Ideas Time in every lesson

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

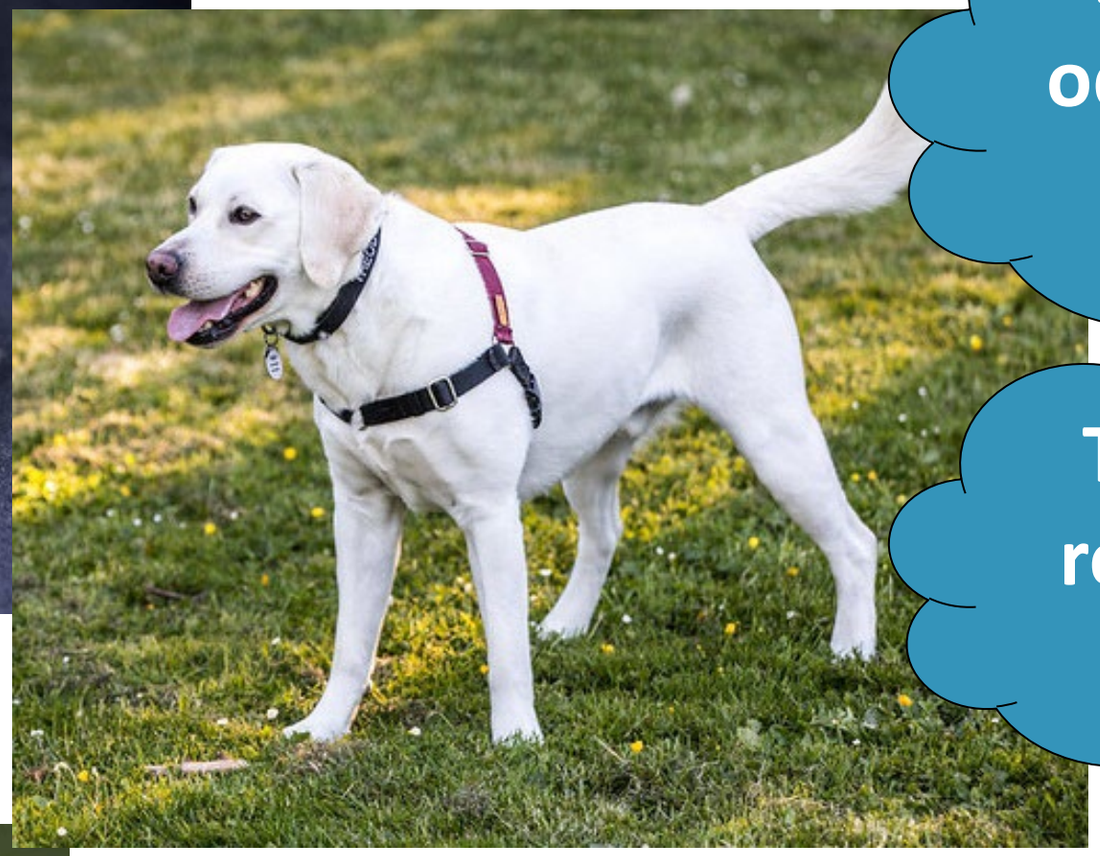
© Roger Culos

Thinking Doing Talking Science

Which is the Odd One Out and why?

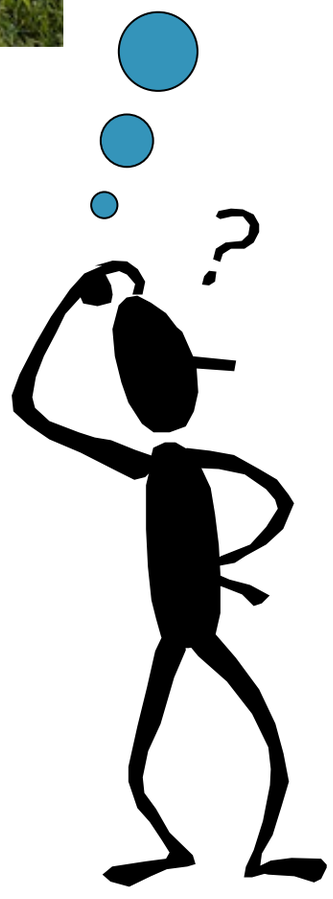


© Eric Bégin



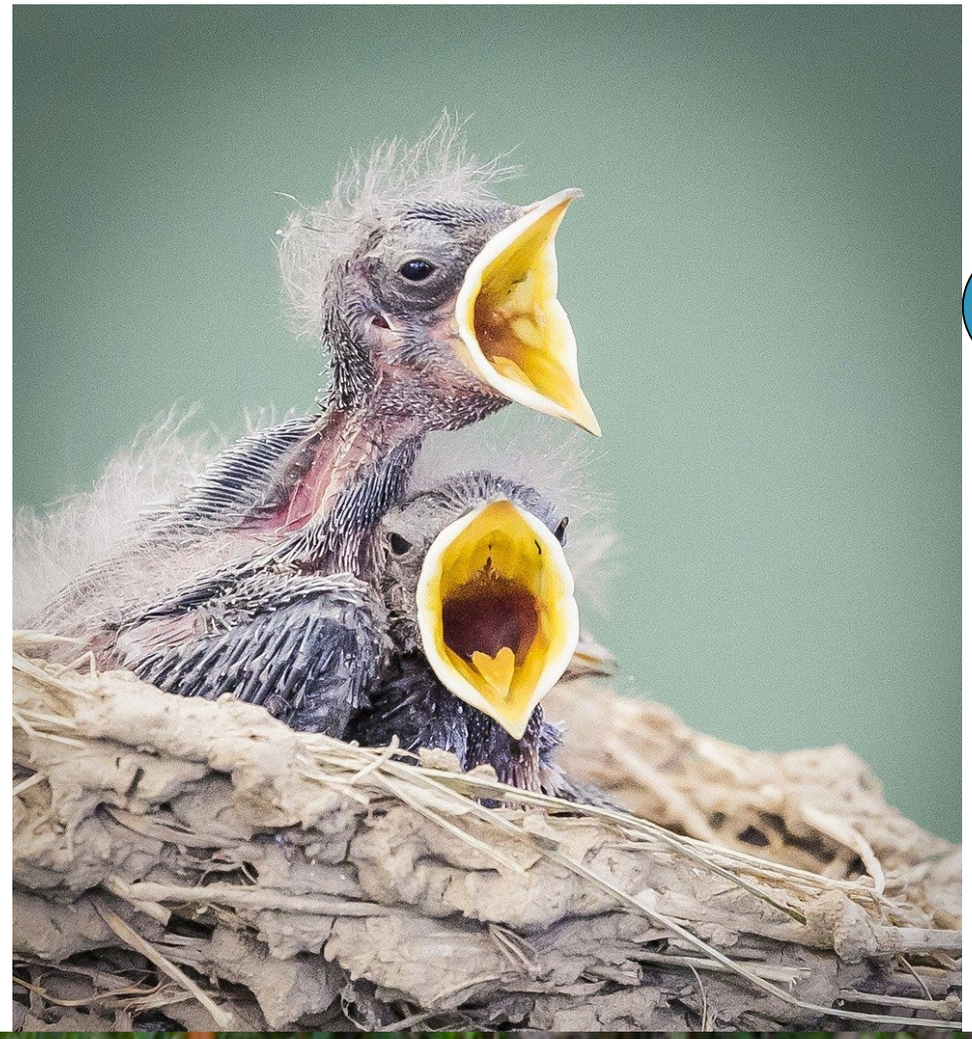
Which is the odd one out & why?

Think of 2 reasons for each



Thinking Doing Talking Science

What is similar and what is different?



Compare these young animals

Thinking Doing Talking Science

The HOT Question

How did this happen?

The HOT Question

Why do people get old?

PMI

People have their own plant-like green skin, so they can create their own food in sunlight

M: You might not be able to lie still to sunbathe – you'd get a sugar rush and have to run around!

P: Poor people wouldn't starve

I: Would you not need sleep?

I: Would diabetes be a problem or not?

Where is the HOT?

Examples of children's responses from St Andrew's Primary School, Oxford

PMI

Bees become extinct

PMI

The average human life span becomes 200 years

A drug that stops people getting old

Create an animal …

…adapted for a particular environment

Full details of this & all activities in your **Day 3 Teacher Supplements** folder

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

- Where does your creature live?
- How does it move?
- What does it eat? Is it a carnivore or herbivore?
- Why is its mouth shaped like that?
- Is it nocturnal or diurnal?
- Does it make a noise? If so when and why?
- Would I like to hold it?
- What does it feel like? Why?
- Does it have any natural enemies?
- How does it detect enemies?
- How does it protect itself?

What happens next?

- Children can build homes for their creatures.
- Children can create a whole habitat display from the homes.
- Interdependence
- Keys
- Food webs
- Use some of the creatures for an Odd One Out:

https://scienceoxford.com/resources/science-oxford-challenges/creature-creations/

Link to Life cycles

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

So what and how will the pupils record?

Possible learning objectives:

- To justify the classification of a creation by drawing on scientifically correct identifying characteristics
- To describe a life cycle that is appropriate to the classification

Focused recording suggestions…

Print a photo of your creation, use post-it notes to record the reasons for deciding whether it is a mammal, an amphibian, an insect or a bird

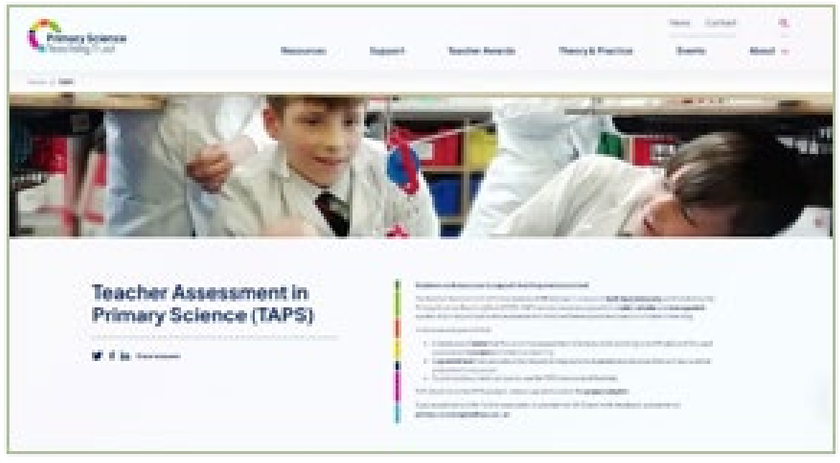
Take photos of the life cycle and label them to explain the process

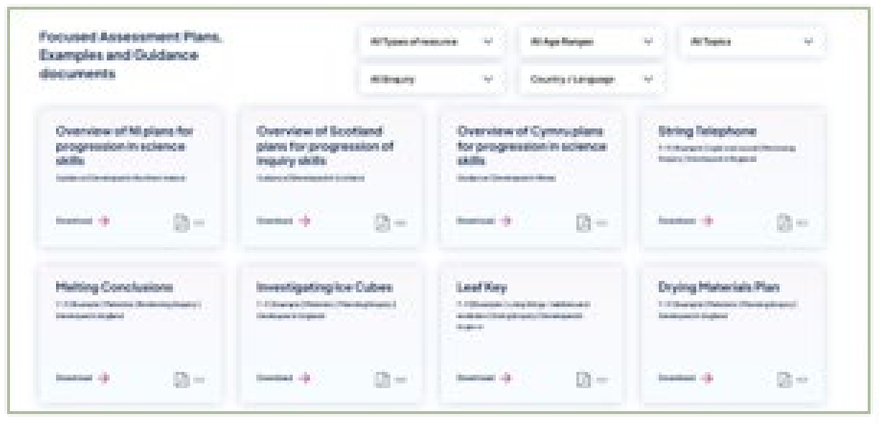
Teacher Assessment in Primary Science (TAPS)

- 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://pstt.org.uk/unique-resources/taps/

TAPS Focused Assessment Plans

Very good stuff!

Lesson plans that have built in focused assessment in each area of the curriculum and year group.

See Teacher Supplements folder

Year 5: Life cycles
Year 5: Growth survey

Higher Order Tasks/Questions

Revision questions (for retrieval) and those requiring only the representation of known material attract ***lower order*** answers; while questions that ask students to deduce, hypothesise, analyse, apply, synthesise, evaluate, compare, contrast or imagine attract ***higher order*** responses (Kerry & Kerry).

Encourage higher order thinking skills, not **just** lower order thinking

HOTS not just LOTS!

HOTS not just LOTS

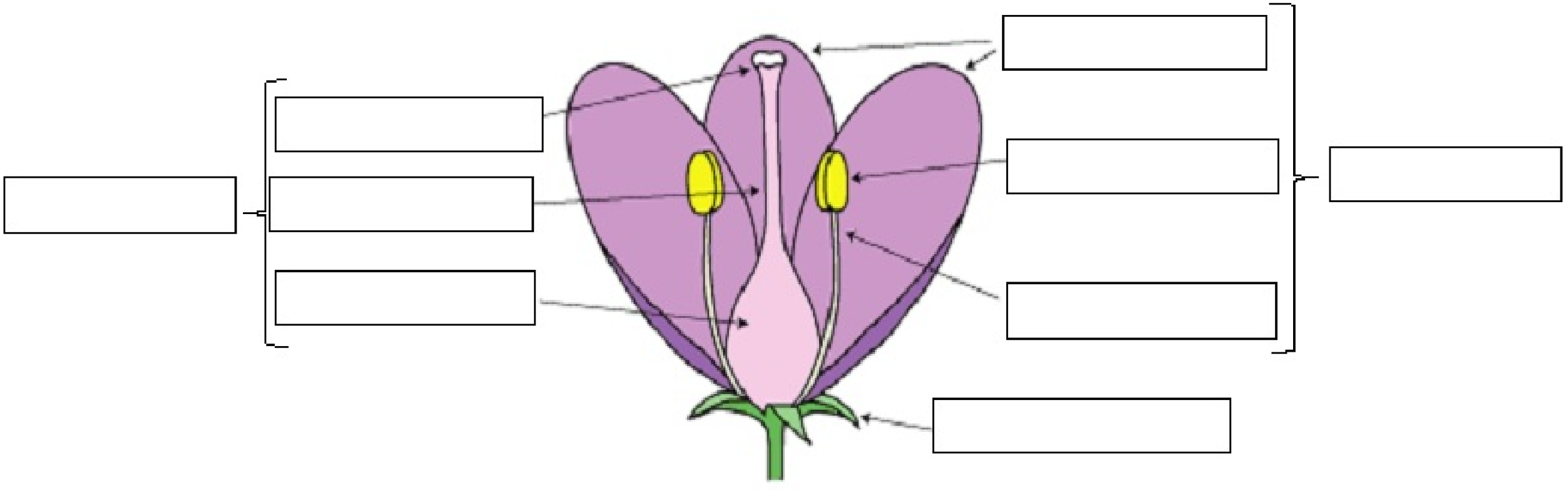
So, encouraging HOT requires thoughtful task setting - not just ‘find out about’, e.g.

- I want you to explain **why** you think the seeds you have collected are shaped so differently
- What are the **advantages and disadvantages** of the frog’s life cycle?

Label the parts of the flower
Where is pollen found?

Thinking Doing Talking Science

Can you think of an approach that encourages HOT?



© Avion Thomas

- Cut up a flower and see if you can find the parts below.
- Do some research and find out what is the yellow stuff on the anthers.

Life cycles: Card Sort

Amphibian, bird, mammal, insect (butterfly):

Sets of photos of life cycle stages - one set for each of above:

In groups of 4:

- Organise the photos into their correct sets & sequence them

Card sort for HOT

In your group, using the photos you have now put into sets and sequenced, do one of the following – in each case use post-it notes to record your thoughts:

1. Choose two of the life cycle sets and note differences
2. Use all of life cycle sets and note commonalities
3. Use all of life cycle sets and note advantages & disadvantages

Did any questions arise as you were doing this activity?

Each group appoint someone to share how this went

Sequencing

Look at these photos carefully and sequence them according to age – note the numbers once you have put them in age order

What observations helped you sequence them?

Newborn: wrinkly, unfocussed eyes

2 mths: smiling, focussed, supported

Here is the answer!

3 mths: holding own head up

4-5 mths: weaning (baby rice)

6 mths: teething (red cheeks, dribble, bib, can see tooth)

12 mths: sitting up, longer hair

Another example of sequencing

You are welcome to use all our sequencing examples in your schools

Mammal Gestation Card Sort

There is an accompanying document with a wealth of suggestions for classroom use

This is another resource in today's section of the file

In science, posing **closed questions** is a necessary skill too! Used in making keys, classifying, etc.

I will show you a picture

What is it?

You can ask me questions, but I will only answer yes or no

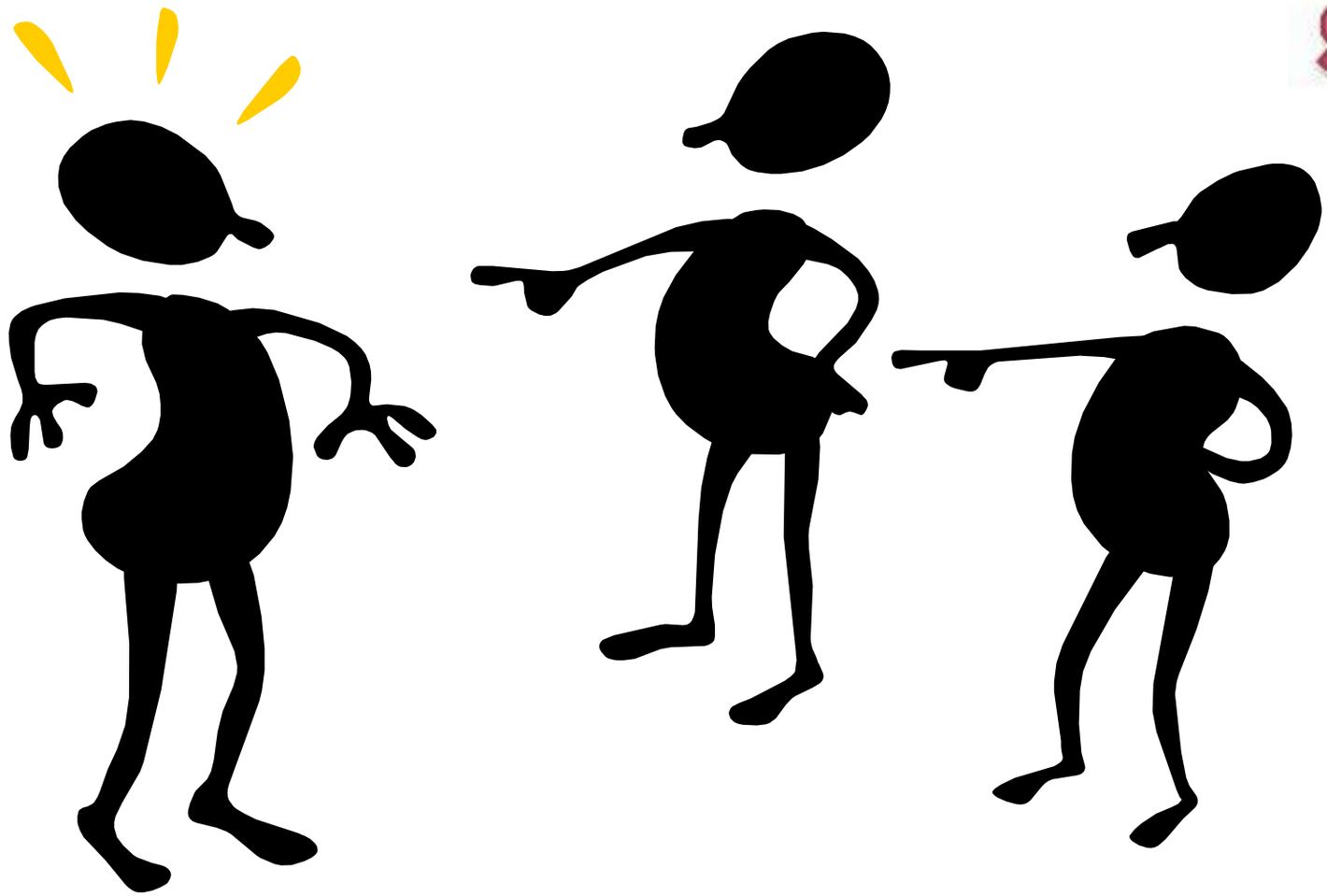
If you guess the wrong answer, I win!

Zoom in, Zoom out

https://explorify.uk/en/activities/zoom-in-zoom-out/creature-comforts

https://explorify.uk/en/activities/zoom-in-zoom-out/feathery-friend

Guess who?



Make your own ‘Guess who?’ game:

https://scienceoxford.com/resources/science-oxford-challenges/make-your-own-garden-version-of-the-game-guess-who/

Guess What? Household Objects

Work out what object your partner has chosen using the smallest number of yes/no questions.

Guess What?

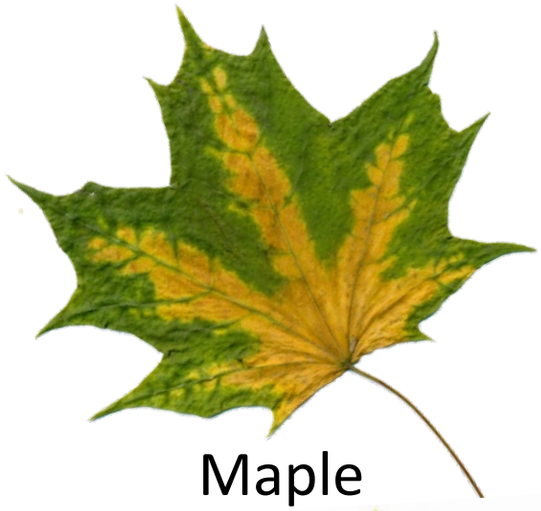
Leaves

Alder

Ash

Beech

Sycamore



Maple

Oak

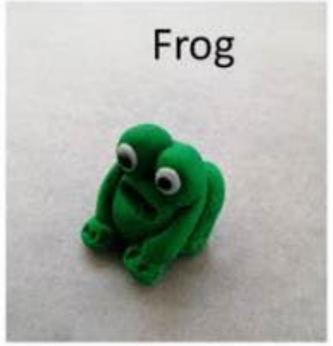
Birch

Chestnut

Rowan

Guess What?

Creatures made by children during lockdown



Guess What?

Another way to play …

Pairs of children collect two matching sets of objects (~8-20), arranged on trays or plates. Each child chooses an object from the selection on their tray without revealing what they have chosen.

Each child takes it in turns to ask yes/no questions. As objects are ruled out, children can cover them up or remove them from their tray. The first child to correctly identify which object their partner has chosen is the winner!

Crafting a TDTScience Lesson

- Our aim is to equip you to teach the TDTScience way, whichever area of the science curriculum you are teaching.
- TDTScience builds on your existing good practice.

We have given you a wealth of resources to draw upon

Tweaking lessons for HOTS

Crafting a lesson

Which BI time?

Bright Ideas Time

Which practical?

Practical

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

HOT

Skills *and* understanding

What are the learning objectives?

The TDTScience Way

Learning Objectives

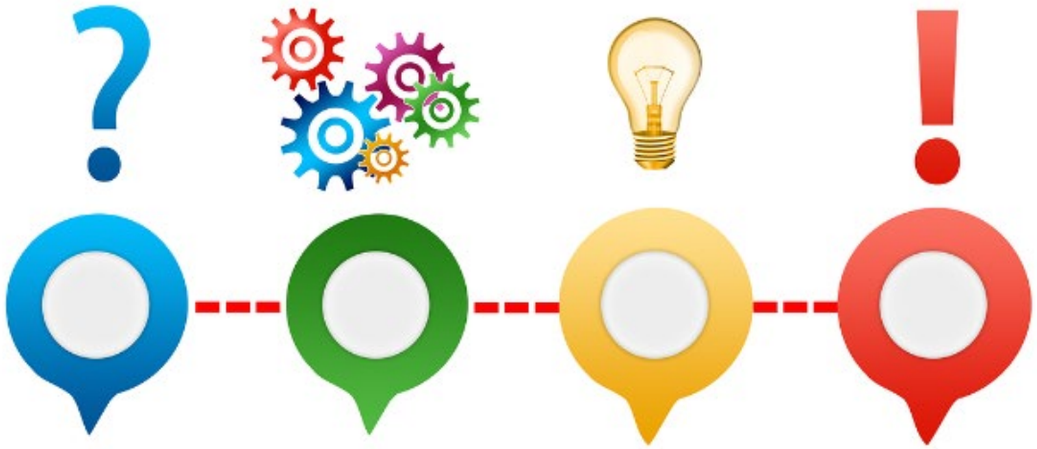
Bright Ideas Time

Practical

Focused Recording

Higher Order Thinking

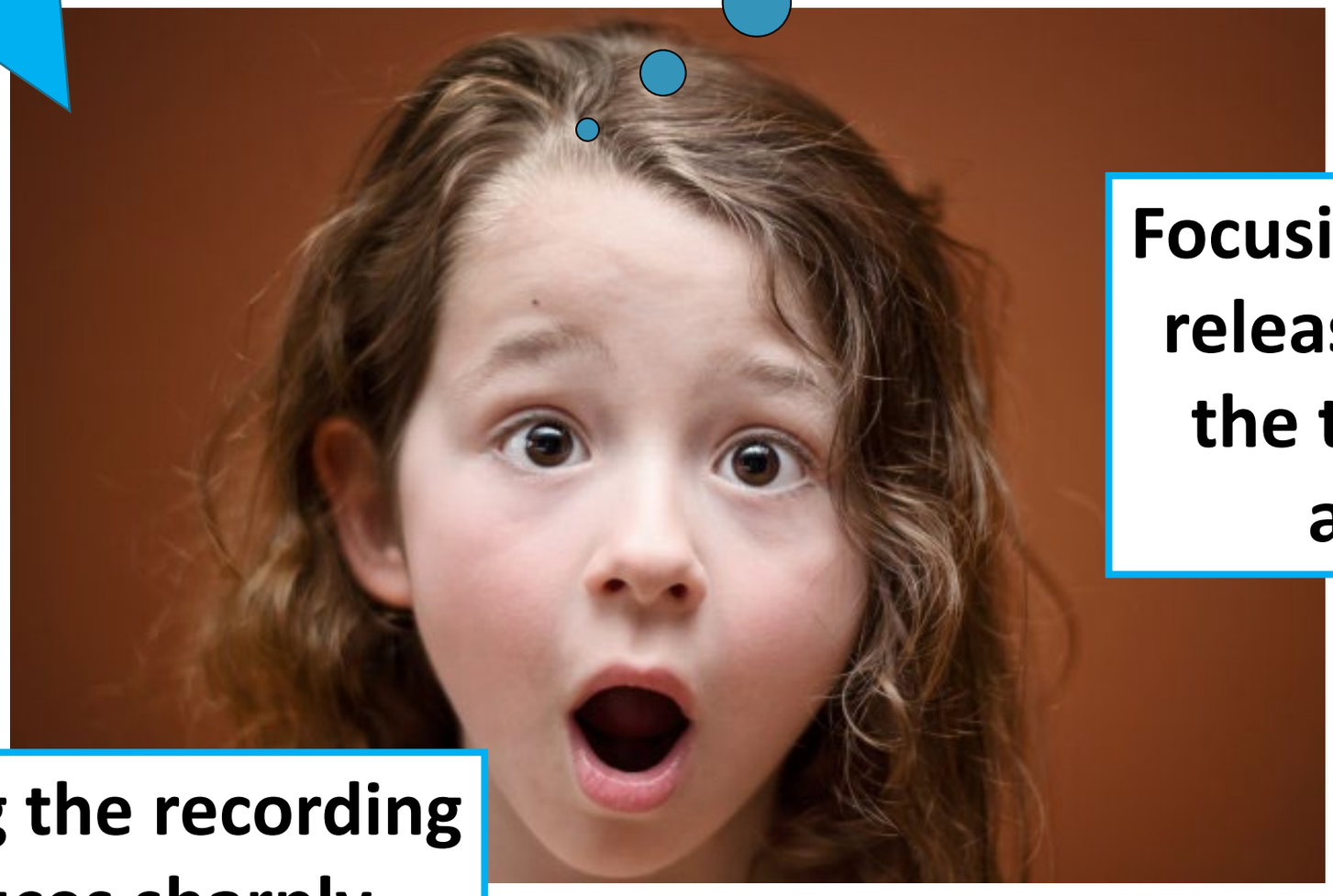
Key questions



- Is the aim of the lesson to develop the children's skills; knowledge and understanding; or both?
- What will be the focused learning objective(s)?
- Which Bright Ideas Time?
- Which practical?
- Where and how to encourage children's HOTS?
- What will the children record?
- What and how will you assess?

Focus the recording on the learning objectives

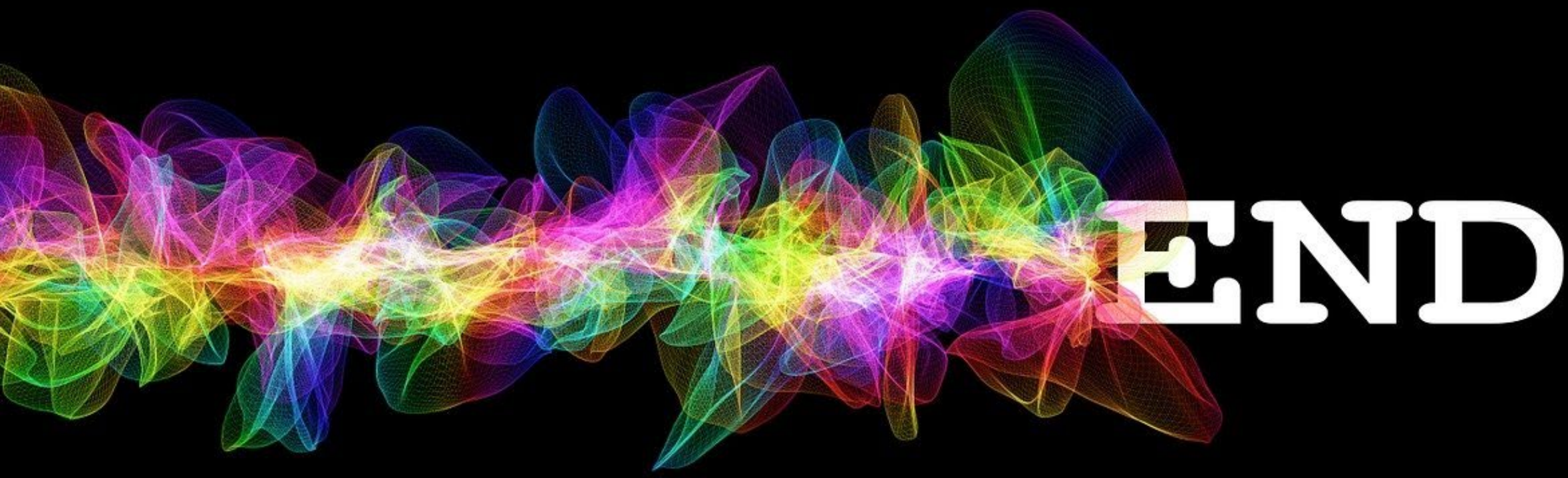
What and how do I record?



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

Focusing the recording produces sharply assessable work

THE PLENARY



The Gap Task

Before next time be ready to:

- Give feedback on any one science practical and the use of focused recording within it
- note some children's responses and bring some examples of their recording with you if possible
- reflect on how you thought it went

*There is a template for you record this in the **Day 3 Teacher Supplements** folder*