



Webinar 4. Assess for Mastery

Dr Tony Sherborne
Gemma Young



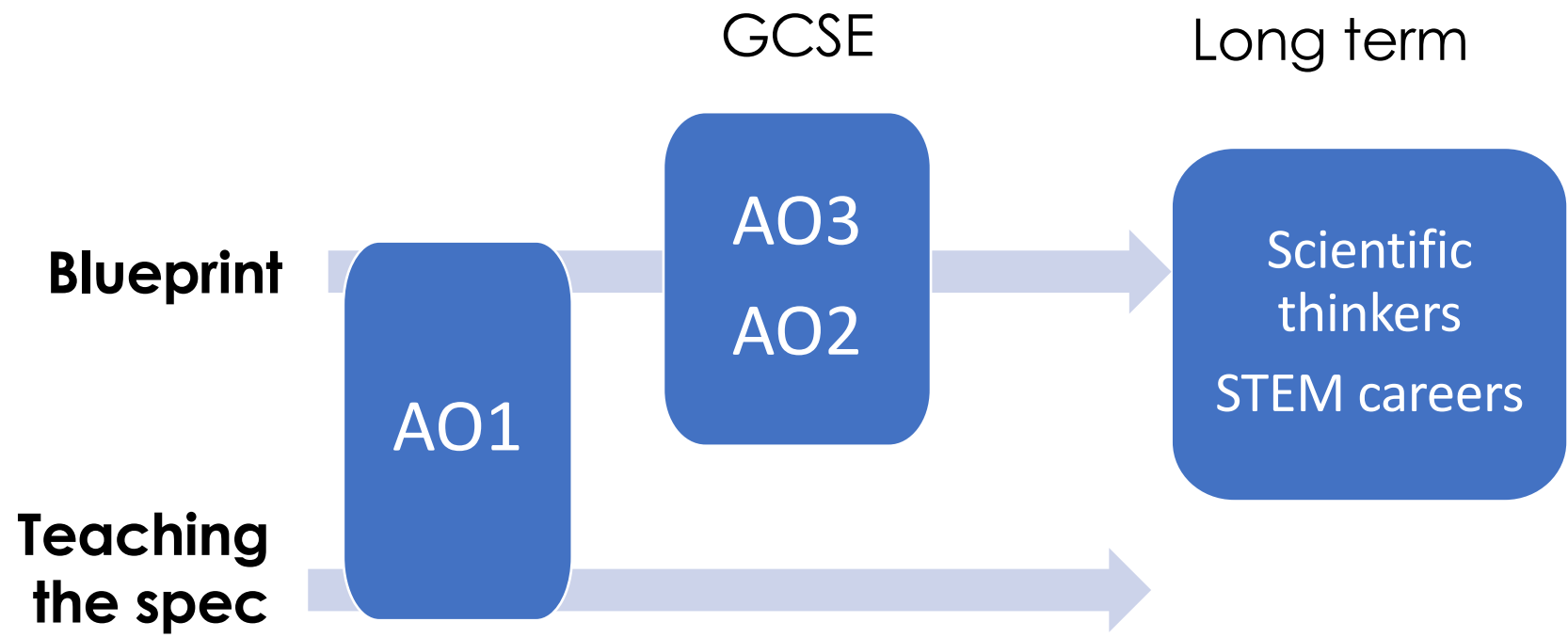
“Know thy impact” John Hattie

1. *My fundamental task is to evaluate the effect of my teaching on students' learning and achievement.*
2. *The success and failure of my students' learning is about what I do or don't do. I am a change agent.*
3. *I want to talk more about learning than teaching.*
4. *Assessment is about my impact.*

3 takeaways

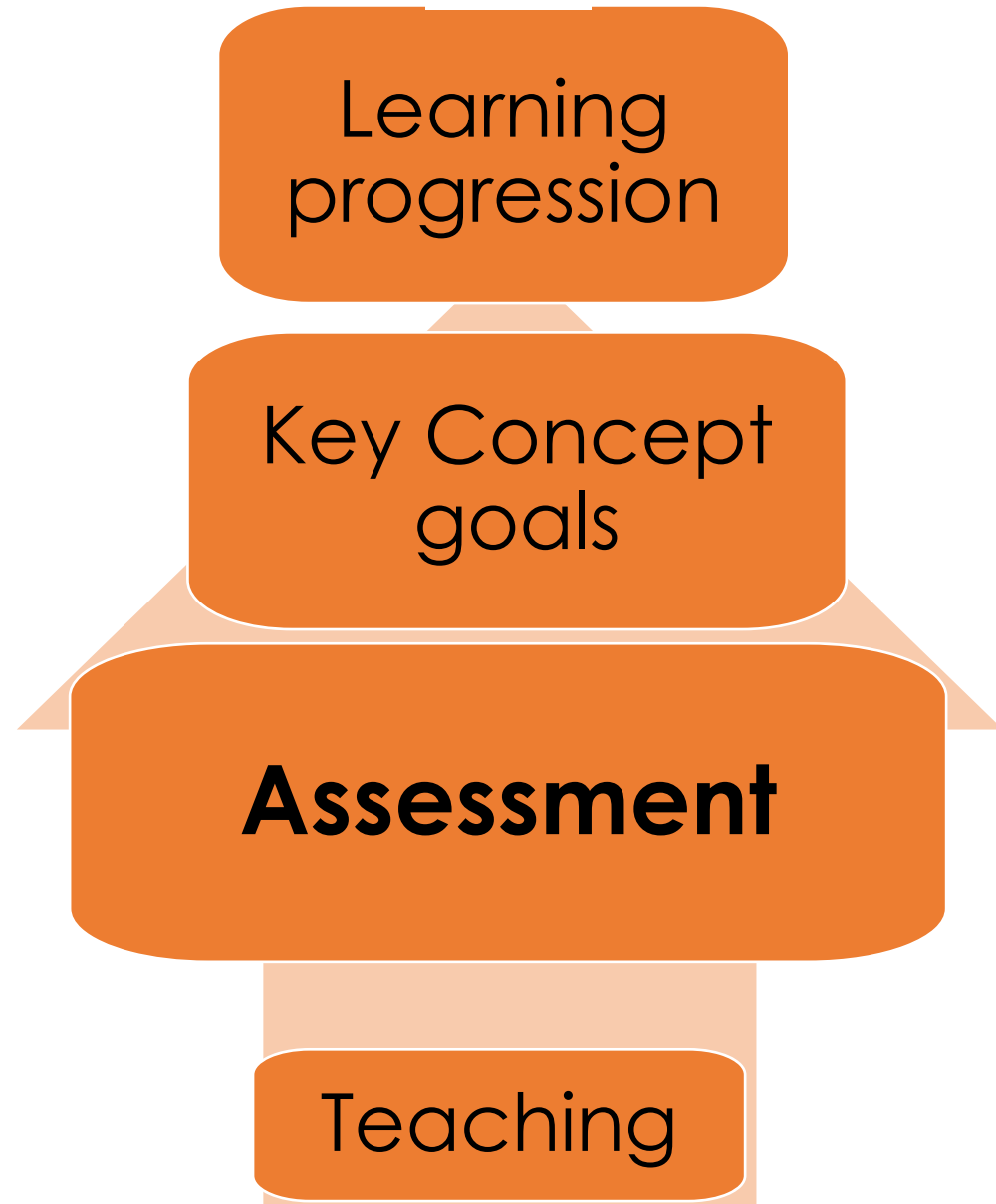
1. Measure type and depth of knowledge with Tests
2. Diagnose understanding of Key Concepts in Assess
3. Measure abilities with Performance Assessment

Aligned assessment





Alignment





All decisions about goals, assessment and teaching are consistent with the purposes of the curriculum.

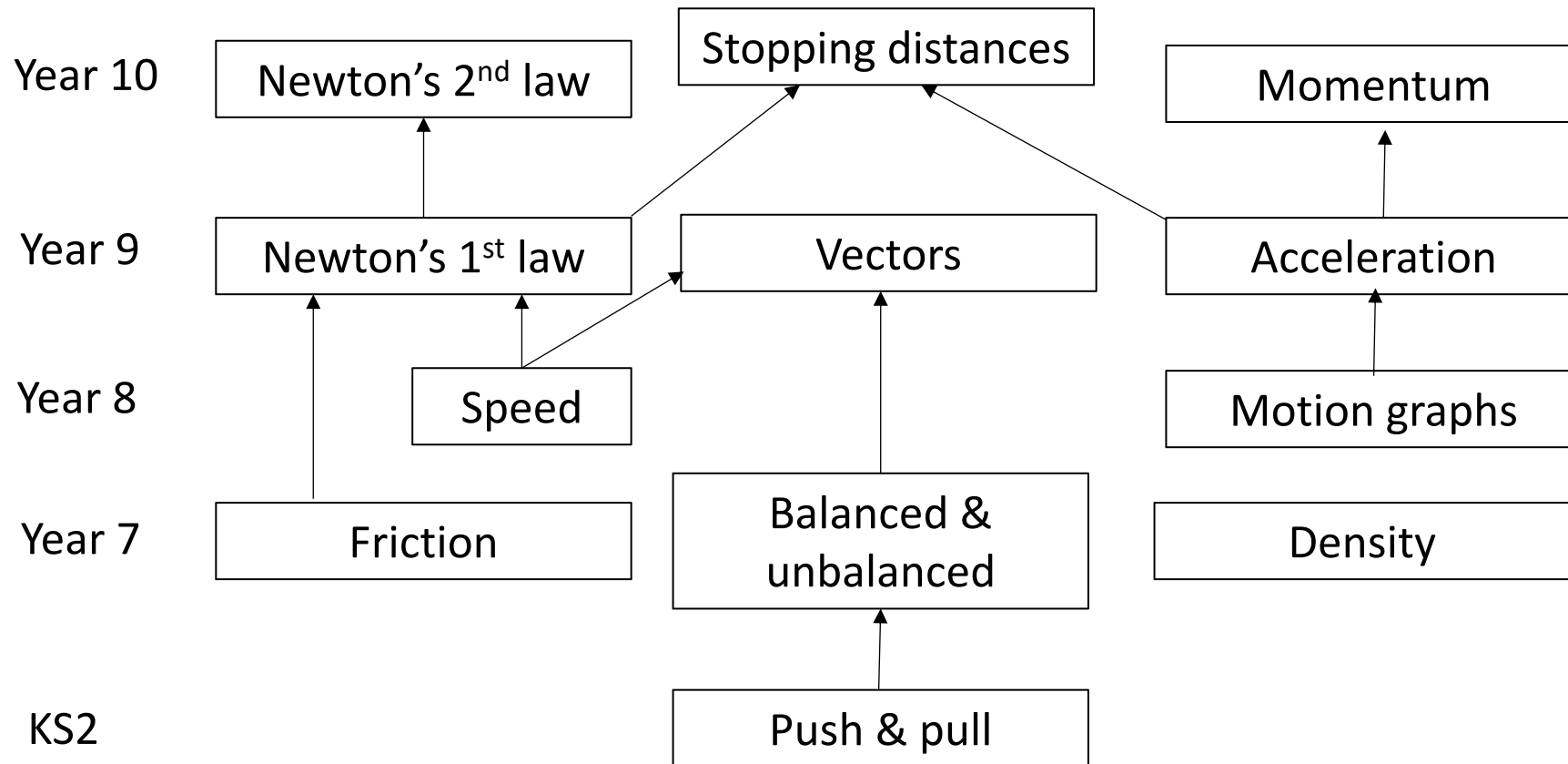
Progression over 5-years

5-year curriculum map: Physics


blueprint
secondary science V3.3 May 2020

Area	Big Idea	Year 7	Year 8	Year 9	Year 10	Year 11
 Forces	BI-Forces Predict Motion	7U-Forces on materials 7KC-Balanced & unbalanced 7KC-Friction 7KC-Density	8U-Movement 8KC-Speed 8KC-Motion Graphs	9U-Force & direction 9KC-Force Vectors 9KC-Force equilibrium	10U-Newton's laws 10KC-Acceleration 10KC-Newton's 2 nd Law 10HKC-Momentum	
	BI-Fields Produce Forces		8U-Gravity 8KC-Weight 8KC-Gravitational Force 8KC-Solar system		10U-Magnetism 10KC-Electromagnetism 10KC-Motor Effect	
 Energy	BI-Energy is conserved	7U-Energy transfers 7KC-Heat & Temperature 7KC-Energy 7KC-Wasted Energy			10U-Heating 10KC-Thermal Transfer 10KC-Specific & Latent 10KC-Pressure	11U-Energy & work 11KC-Kinetic & Potential 11KC-Work Done
	BI-Electricity transfers energy	7U-Electric circuits 7KC-Electric Current 7KC-Resistance	8U-Electrical energy 8KC-Electric charge 8KC-Voltage	9U-Home electricity 9KC-Ohm's Law 9KC-Electrical Power 9KC-Energy Resources		
	BI-Radiation transfers energy		8U-Light 8KC-Reflection 8KC-Refraction	9U-Sound & waves 9KC-Longitudinal & Transverse 9KC-Wave Model	10U-E.m. radiation 10KC-Electromagnetic Spectrum 10KC-Wave energy	11U-Radioactivity 11KC-Radioactive Decay 11KC-Half Life

Big idea: forces predict motion




Progression within a Key Concept



Novice

7KC-Cell structure

Mastery planner 7U-Cells unit



Activate

Prior PS-Life processes: There are differences between things that are living, dead, and things that have never been alive.

Goal To show understanding of prior ideas that are prerequisite for new learning.

Acquire

Building blocks

Level 3 Building blocks: Studying living organisms with microscopes revealed that they are made of one or more cells - the smallest living units.

Level 2 N/A

Level 1 Multicellular, Microscope, Single-celled organism, Scale of cells, Calculate total magnification

Skill Argue for a claim by explaining how each piece of evidence supports it or not.

Technique Use a microscope

Goal To check a claim that an unknown specimen is alive by using a microscope to examine plant and animal cells and identifying common structures.

Life functions

Level 3 Life functions: Cells use energy to carry out life processes like growth and reproduction and have specific parts for these jobs.

Level 2 Plant cell, Bacterial cells

Level 1 Ribosome, Cell membrane, Nucleus, Cytoplasm, Mitochondrion, Chloroplast, Cell wall, Permanent vacuole, Flagella

Skill Represent a real world event, process or system using a model.

Technique ...

Goal To examine diagrams of real animal, plant and bacteria cells, identify similarities and differences, and explain how those parts keep the cells alive.

Level 3 N/A

Level 2 N/A

Level 1 N/A

Skill N/A

Technique N/A

Goal ...

Assess

Goal To show accurate understanding of the ideas and rectify gaps and misconceptions before problem-solving.

Apply

Goal To identify what type an unfamiliar cell is with reasons, by comparing its structures to those of plant and animals, To work out an

Myth

“Unit tests scores are the most useful assessments.”

Do tests tell you about progress?

8B

End of Unit Test

Name _____ Class _____

1 Which sentence describes respiration? Circle the correct letter.

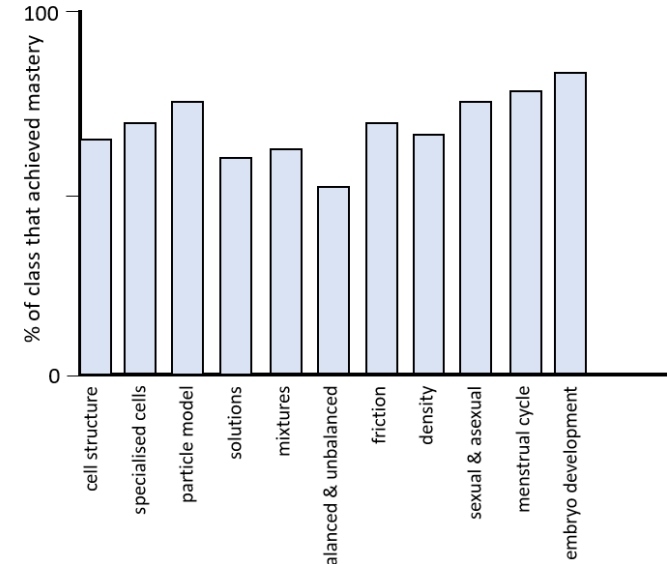
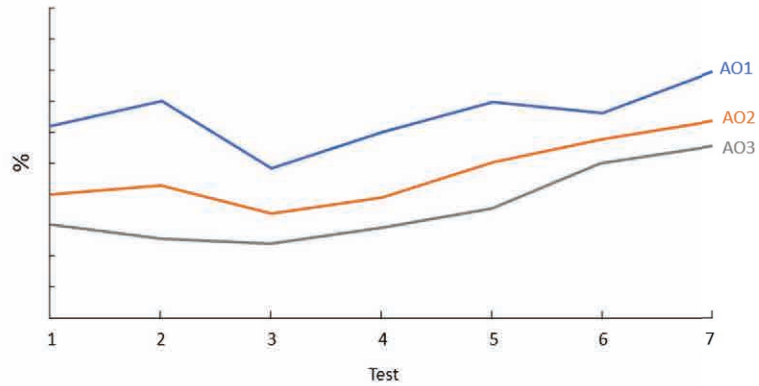
- A Lungs take in air and then blow it out.
- B Cells release energy through a chemical reaction.
- C Blood is pumped around the body.
- D Lungs expand during breathing in.

8
B

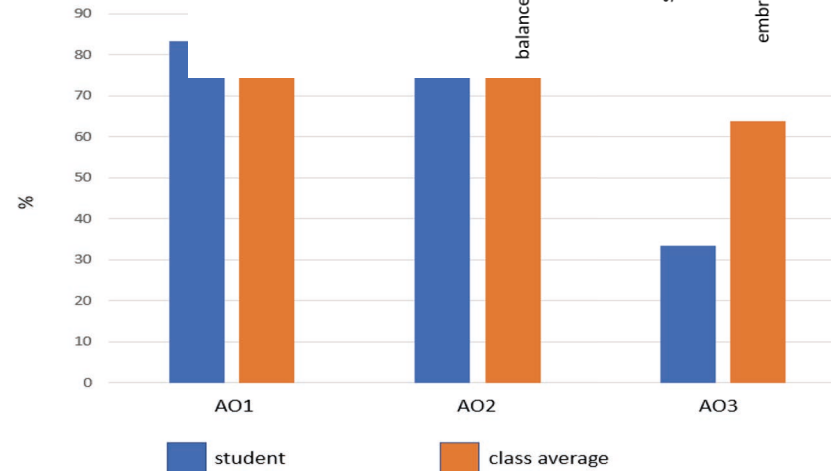
Test 1	Test 2
20	29
49	80
16	23
34	83
37	74
23	34
40	71
50	37
30	60
30	66
21	46
32	71
15	17
30	77
19	63
39	77

Assessing progress

Performance dashboard: Class 7B

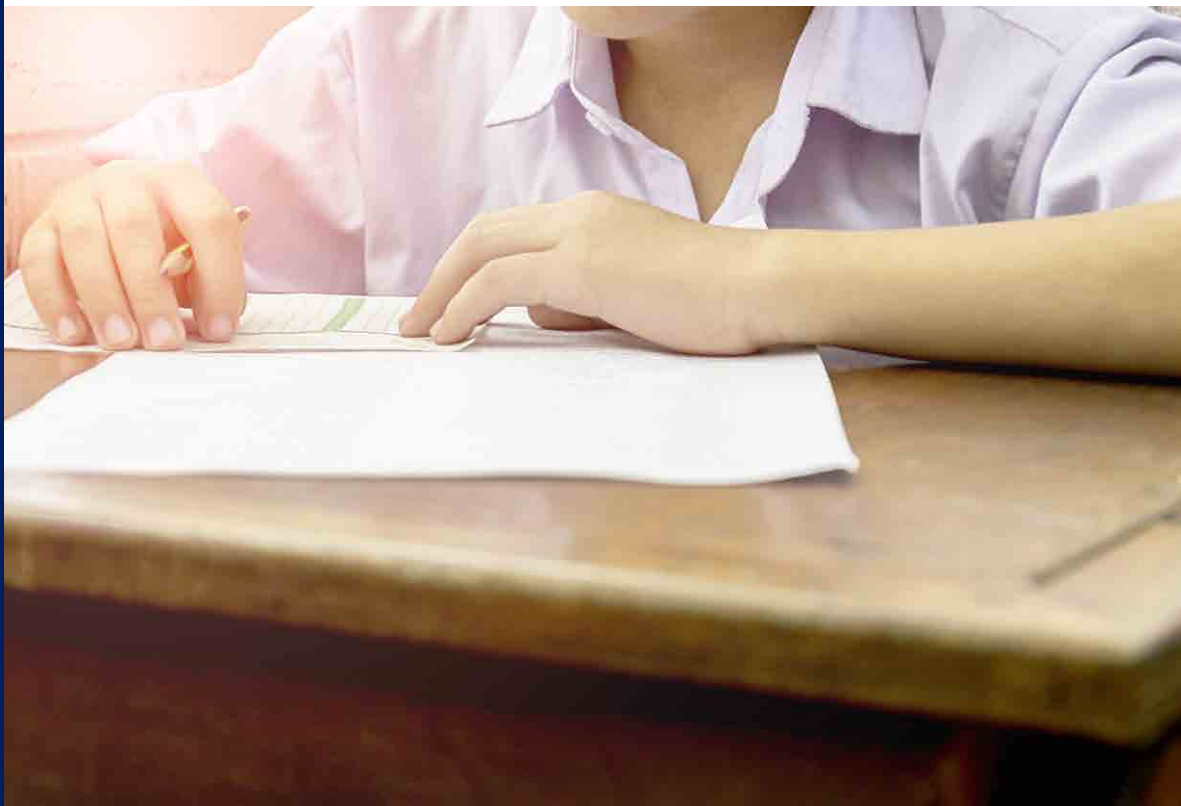


William T



Measure type and depth of knowledge

Aligned unit tests



Summative assessment for each key concept

Assess AO1, 2 and 3 (science ideas plus enquiry) in same proportion as GCSE

7KC-Cell structure

Mastery planner 7U-Cells unit

Level 1 Ribosome, Cell membrane, Nucleus, Cytoplasm, Mitochondrion, Chloroplast, Cell wall, Permanent vacuole, Flagella

Acquire (AO1) Knowledge in isolation. Low demand questions to build confidence.

Q1 What is the function of the cell nucleus?

Tick **one** box.

[1 mark]

It is the brain of the cell

It controls what enters and leaves the cell

It contains information to build proteins

Recall of science idea: cell function

7KC-Cell structure

Mastery planner 7U-Cells unit

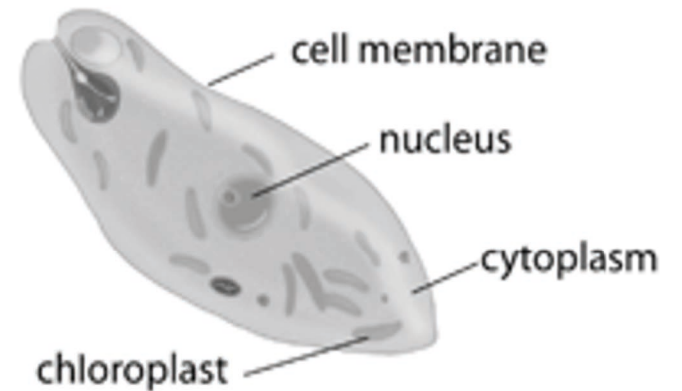
Level 3 Life functions: Cells use energy to carry out life processes like growth and reproduction, and they have specific parts for these jobs.

Also AO1 but demand increases. Questions assess understanding.

Q4 Shaquille found this picture of a cell in a text book.

Assessing understanding
He thinks it is a plant cell.

Give **one** reason why he is not correct.



[1 mark]

7KC-Cell structure

Mastery planner 7U-Cells unit

To work out an explanation for how a given change in a cell will affect the whole organism.

**AO2 criteria: Unfamiliar situation
Problem-solving thinking required (not just recall)**

Apply understanding (AO2)

Q8 Arsenic is a poison. It prevents mitochondria in the cells working properly.
Explain why arsenic poisoning can kill. [2 marks]

7KC-Cell structure

Mastery planner 7U-Cells unit

Technique Use a microscope

Apply understanding of technique

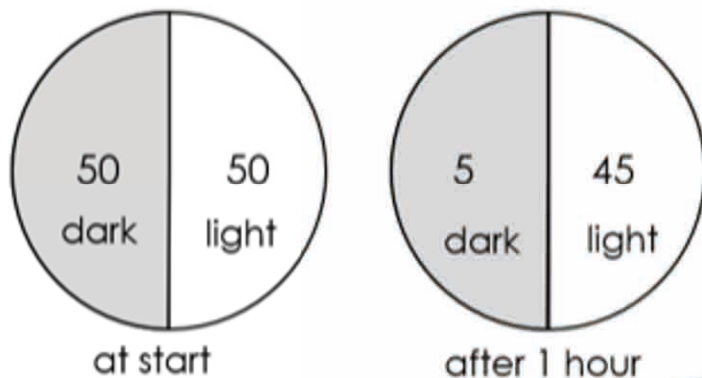
Q9 Esme wants to study carrot using a light microscope. She uses a sharp knife to shave a thin slice of carrot. She puts the slice onto a glass slide.
Explain why it is important to use a **thin** slice. [2 marks]

7KC-Cell structure

Mastery planner 7U-Cells unit

To use experimental evidence about cells to support the argument that cells carry out life processes.

Q10 A scientist puts algae cells into a dish of water. She covers half the dish in black paper and places it under a lamp. The diagram shows how many algae were in each half of the dish at the start and after 1 hour.



Assesses understanding of science idea (cell function) as well as skill (argue a claim)

Use this data to write an argument that algae make food using photosynthesis.

[3 marks]

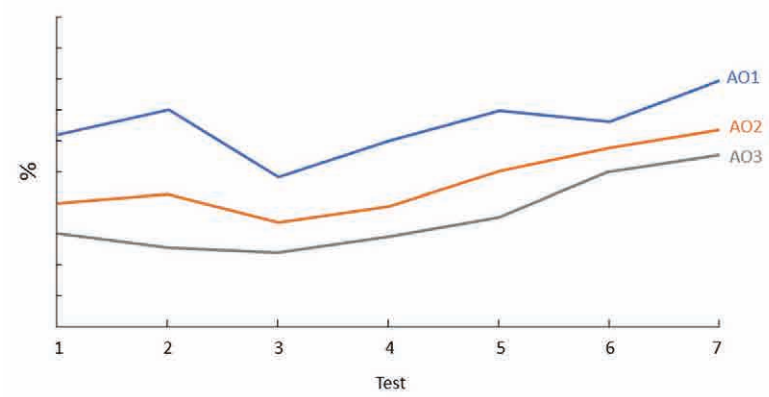
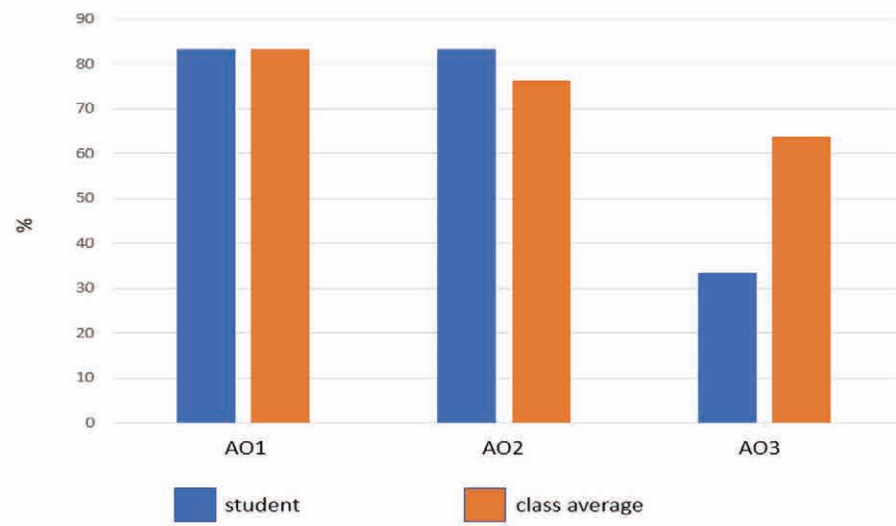
A03 criteria: Analyse information and ideas
Require a longer answer

Change course?

Is the way we're teaching enabling most students to reach mastery?

Are student's cognitive processes improving across time?

Who needs extra support or challenge?



Leading indicators

Progression within a unit

activate

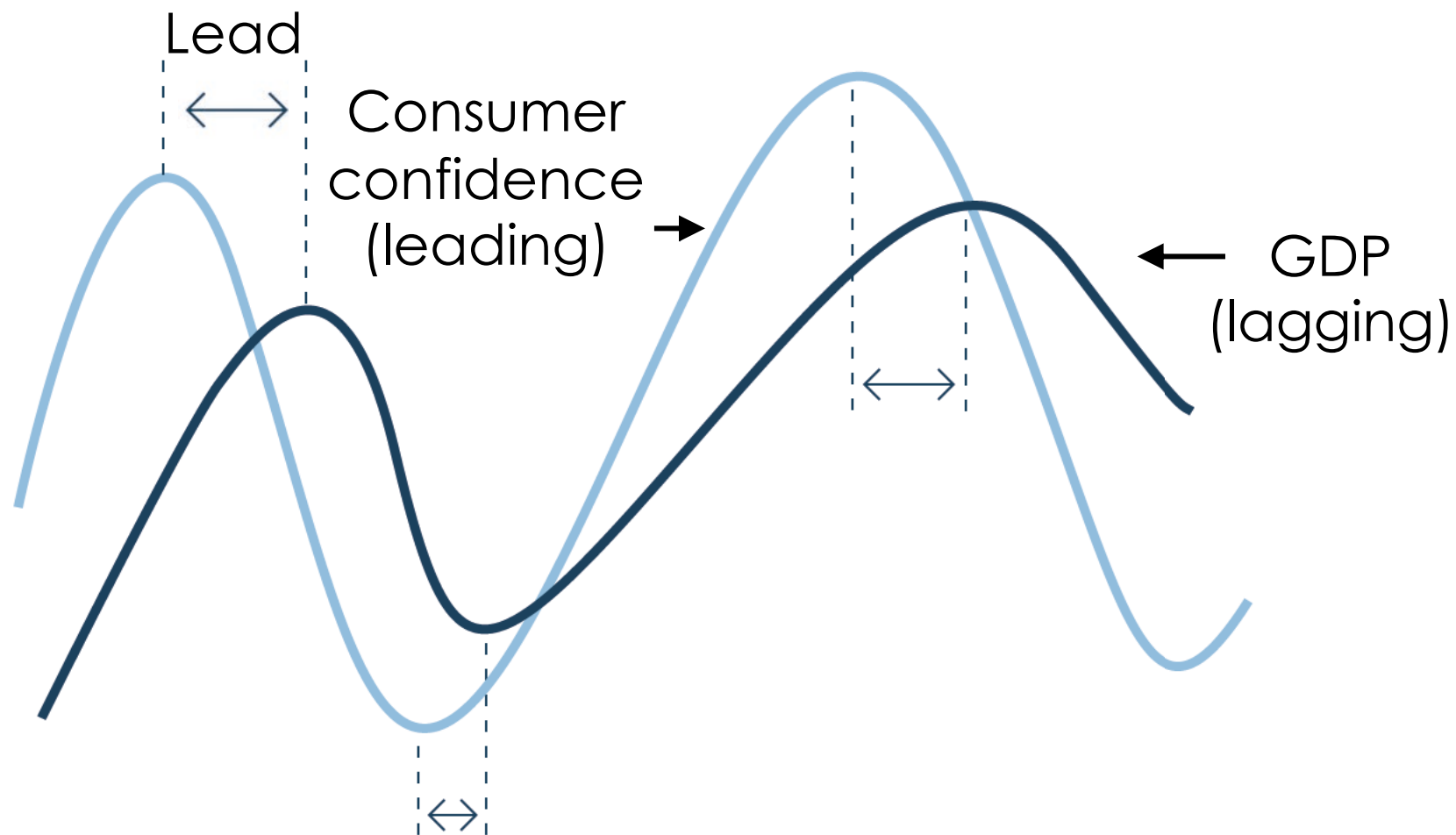
acquire

assess

apply

analyse

Leading and lagging indicators



Possible leading indicators

activate

% students missing prior ideas

acquire

% students correct on exit tickets

assess

Diagnostic quiz on main ideas

apply

analyse

% academic engaged time (lesson observation)

Diagnose understanding

Diagnostic instrument

For teachers

Shows understanding of main ideas

Highlights specific misconceptions

Outcomes guide next lessons

For students

Retrieval practice

Improves thinking skills

Feedback - opportunity for further learning

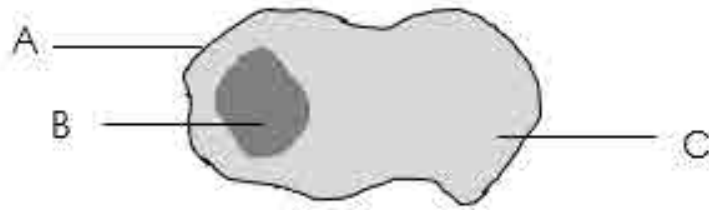
Example: cell structure

Life functions

Level 3	Life functions: Cells use energy to carry out life processes like growth and reproduction, and they have specific parts for these jobs.
Level 2	Plant cell, Bacterial cells, Animal cells
Level 1	Ribosome, Cell membrane, Nucleus, Cytoplasm, Mitochondrion, Chloroplast, Cell wall, Permanent vacuole, Flagella
Skill	Represent a real world event, process or system using a model.
Technique	N/A
Goal	To examine diagrams of real animal, plant and bacteria cells, identify similarities and differences, and explain how cell parts keep the cells alive.

This is not a diagnostic question

1. The diagram below shows a cell.



a) What is the name of the part labelled A? [1]

Tick (✓) **one** box.

Cell wall

Cytoplasm

Cell membrane

b) What is the function of the part labelled B? [1]

Tick (✓) **one** box.

Controls what enters and leaves the cell

Contains genetic material and controls activities in the cell

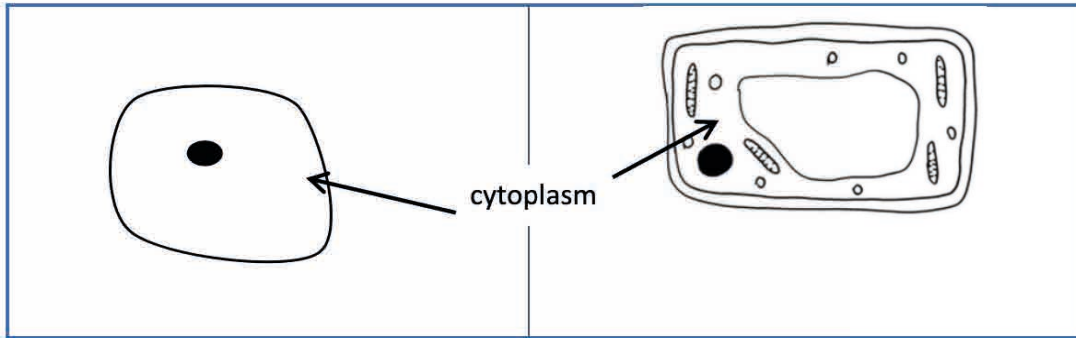
Makes food for the cell using light

How to design a diagnostic quiz

Question	Know												Apply					
	1			2			3			4			5			6		
	What is cytoplasm?			Shape of cells			Job of the nucleus			Single cells alive			Describe why an image is a plant, animal cell or neither and provide evidence			Suggest an explanation for how a change in a cell will affect the organism		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Concept																		
Cells are the smallest elements of life that are alive				✓							✓				✓			
Cells have parts that play different roles in life functions		✓						✓										✓
Misconceptions																		
Cells aren't alive																		
Cells like models					X	X	X			X			X		X			
Same size and shape					X	X												
Cells don't contain water	X																	

These are diagnostic questions

Q1 Plant and animal cells contain cytoplasm.



What is cytoplasm made of?

- A It is just empty space ← Cells don't contain water
- B A gel containing water
- C A solid jelly with no water ← Cells don't contain water

Q3 Which best describes the job of the nucleus in a cell?

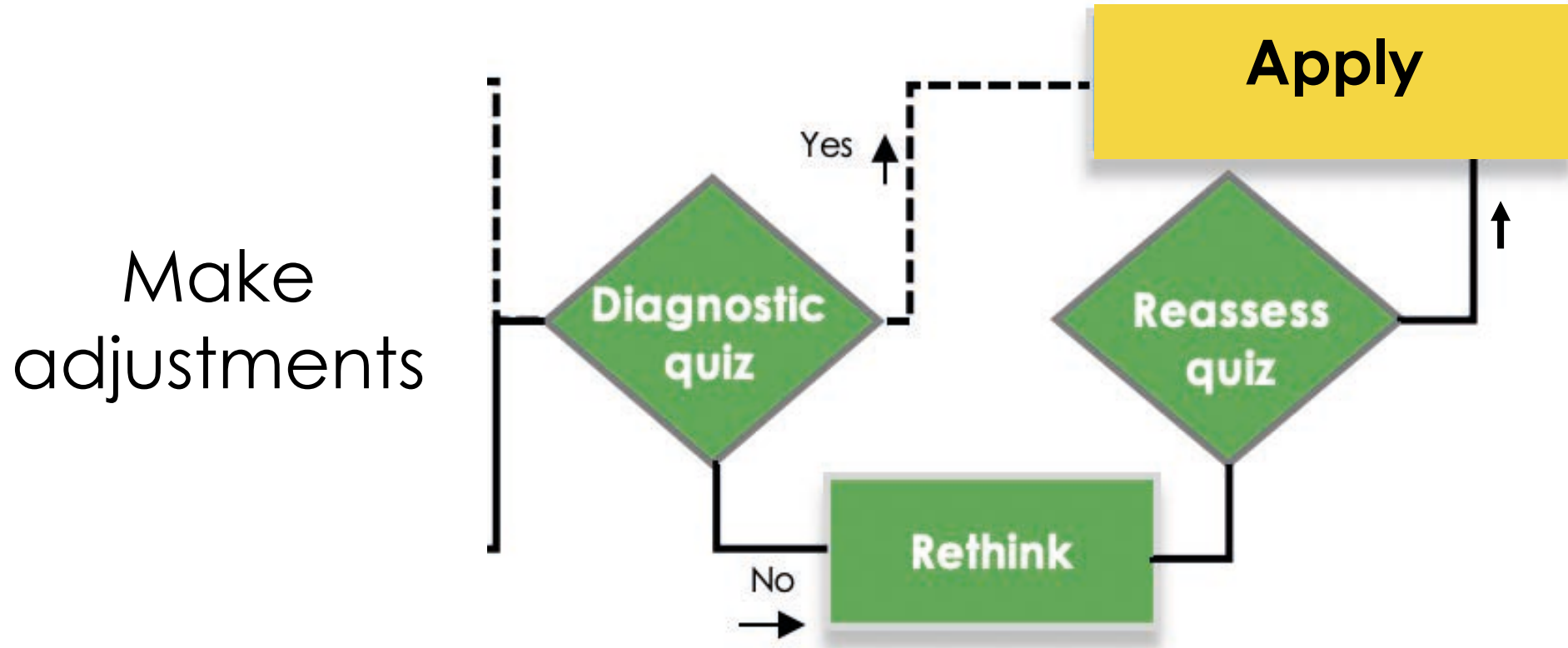
- A It acts as the brain of the cell ← Cells are like the model
- B It controls the activities of the cell
- C It controls what substances leave and enter

Corrective feedback

Why the right answer is right and why the wrong answer is wrong

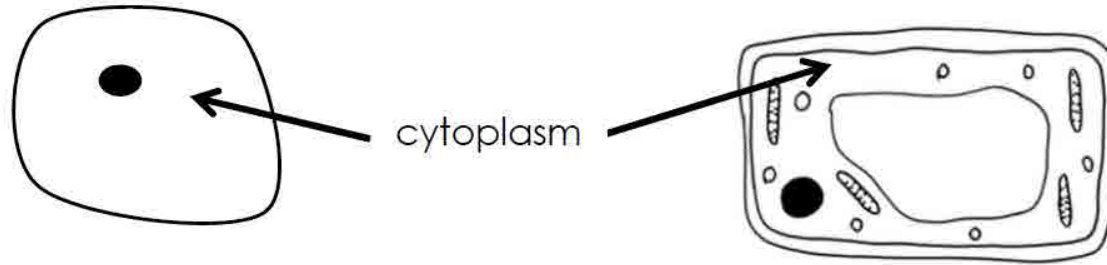
Q	A	Review: correct answer	Review: wrong answers
1	B	Cytoplasm is made of a gel which contains water. It is not empty space.	<p>A: This is not true. In drawings, the cytoplasm might look like empty space, but it is filled with a clear substance.</p> <p>C: It is true that the cell is filled with a jelly. But it is not solid and is mostly made of water.</p>
3	B	The nucleus contains genetic material. This is instructions on how to make proteins, which are vital to the activities of the cell.	<p>A: This is not true. In everyday language, people say the nucleus is the 'cell's brain'. But a cell does not have a brain. Only an organism with many cells has a brain.</p> <p>C: The cell membrane controls which substances enter and leave, not the nucleus.</p>

After the diagnostic quiz



Reassess

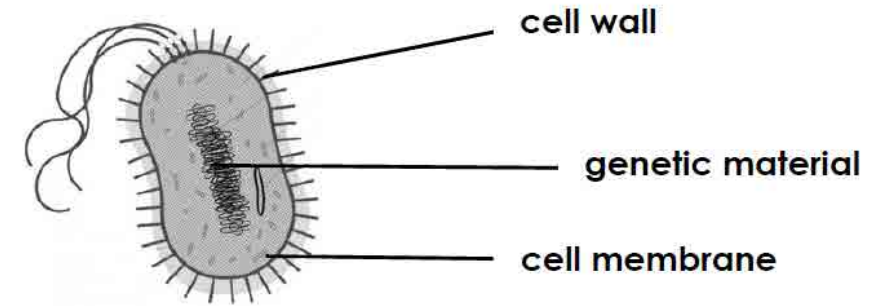
Q1 Plant and animal cells contain cytoplasm.



Which of these statements best describes the cytoplasm?

- A** The cytoplasm gives the cell its shape
- B** The cytoplasm is made of air and water
- C** The cytoplasm is where chemical reactions happen

Q3 This a bacteria cell.



Which is the function of the cell membrane?

- A** It lets substances in and out of the cell
- B** It supports the cell and gives it shape
- C** It controls the activities of the cell

Assess abilities

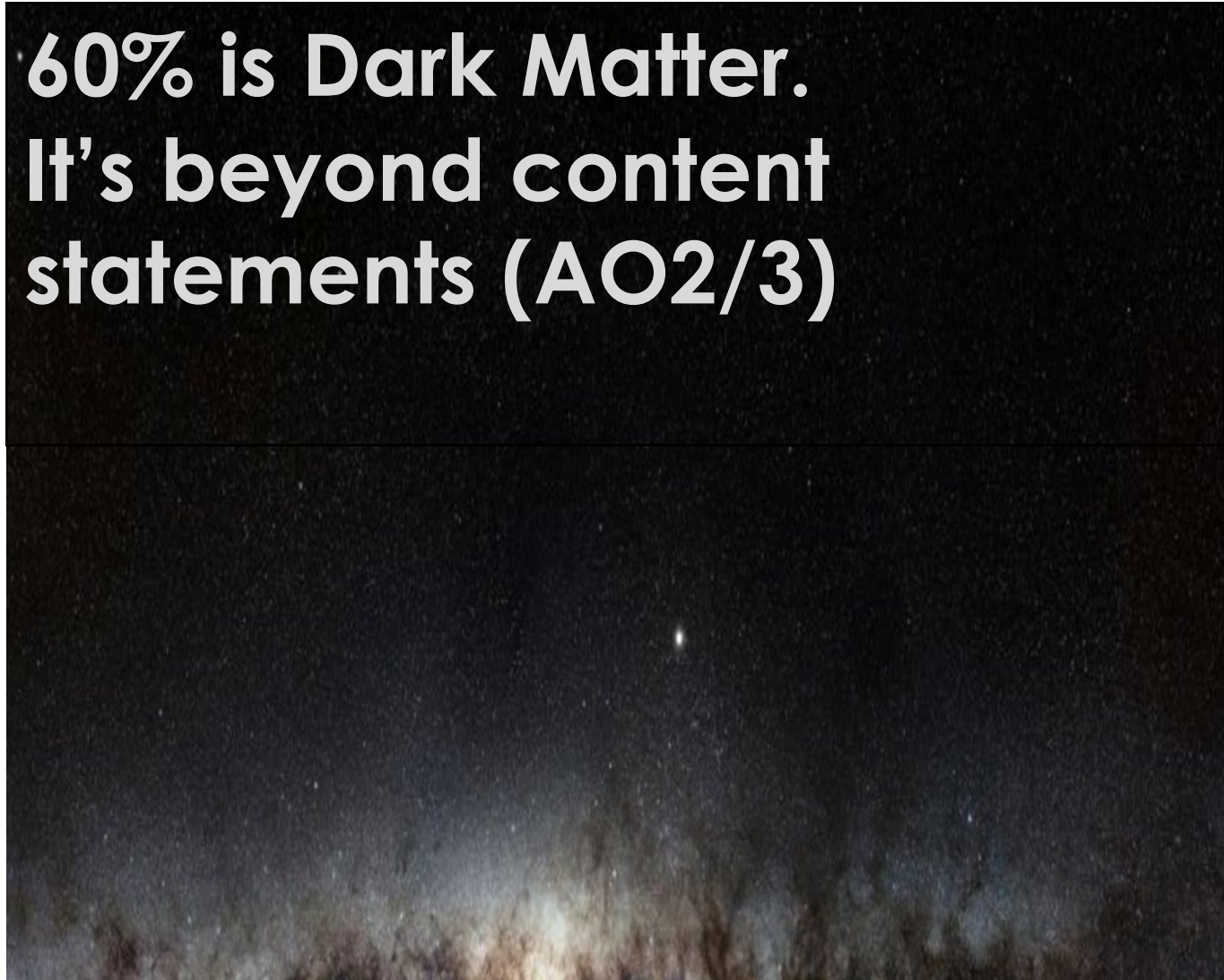
Myth

“It’s enough to assess knowledge”

GCSE is a Universe of marks

**40% is Visible matter.
It's the content
statements (AO1)**

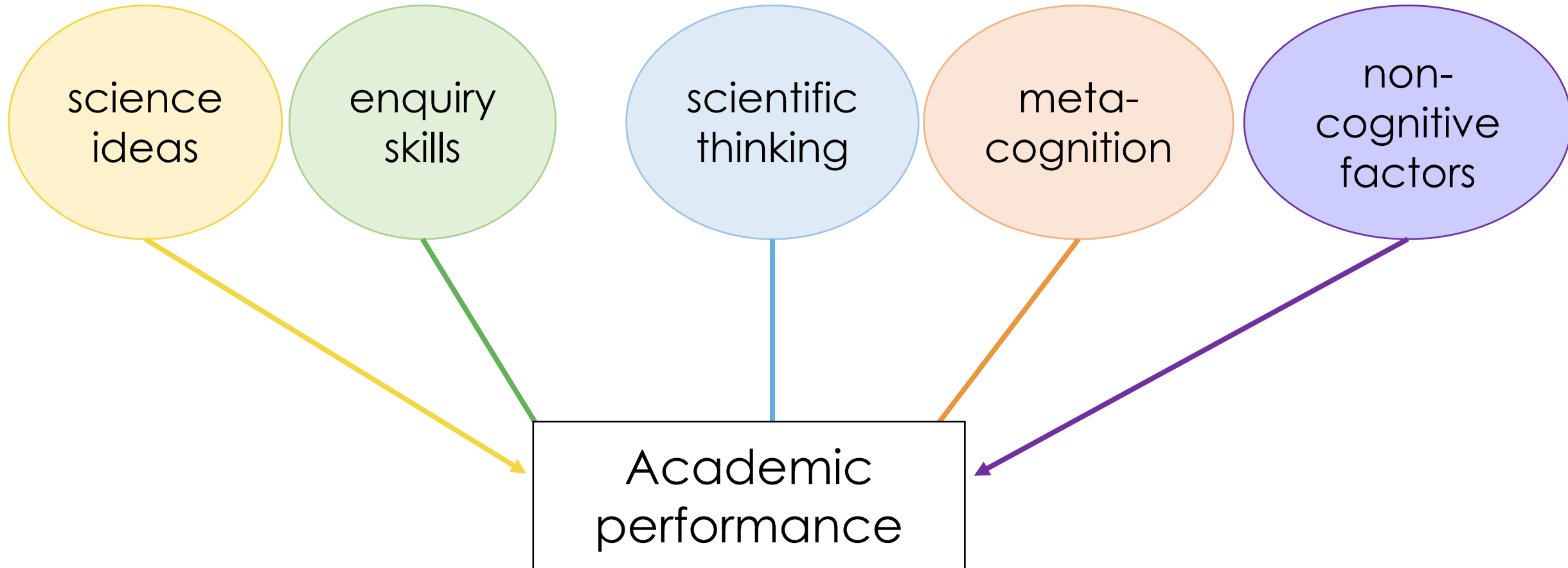
**60% is Dark Matter.
It's beyond content
statements (AO2/3)**



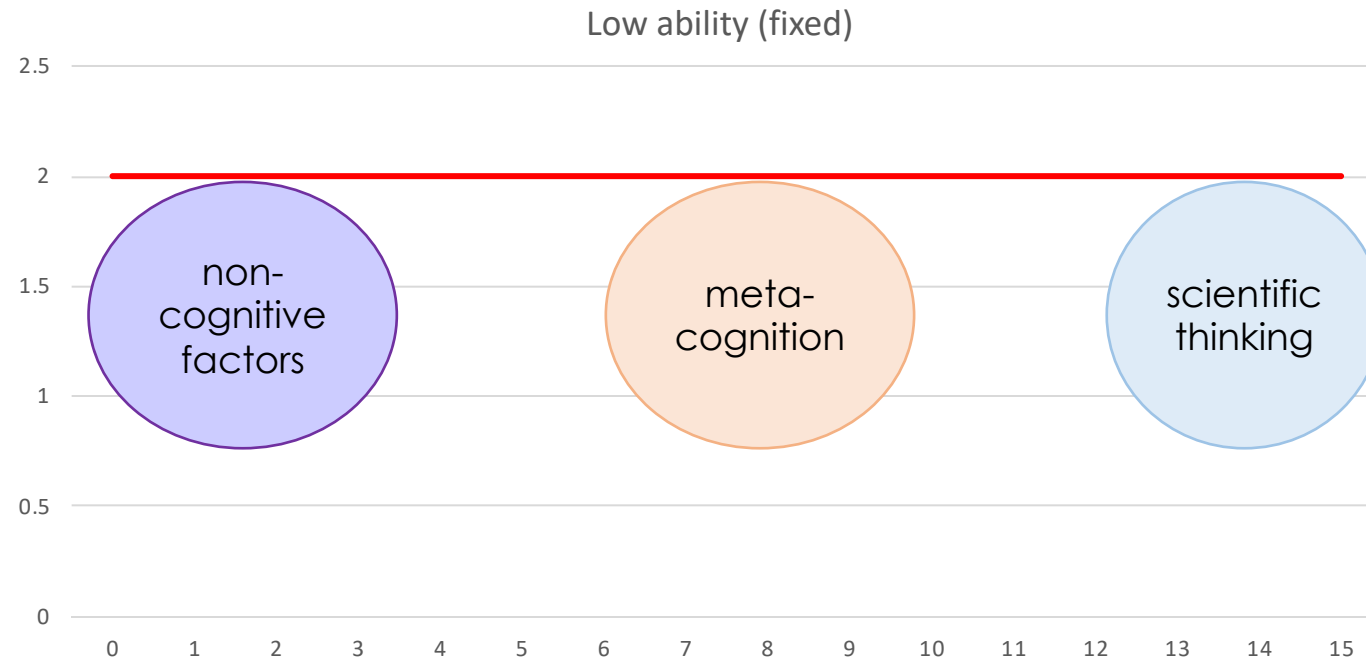
Achievement = knowledge x ability

Knowledge

Abilities



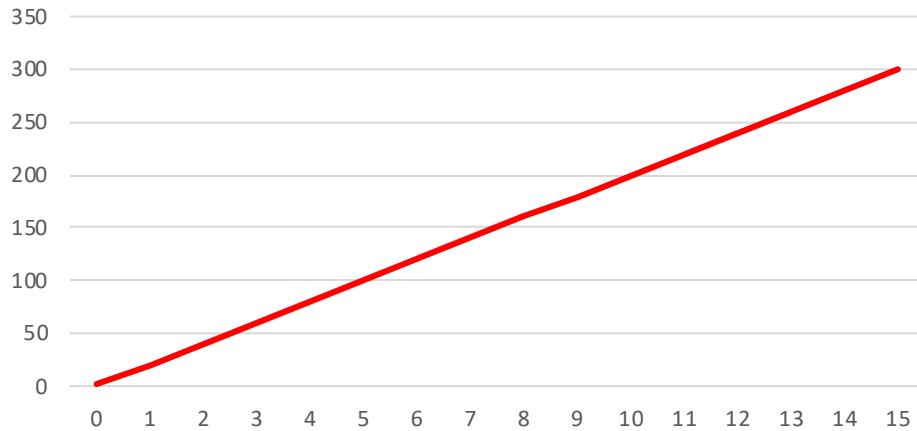
'Fixed ability' thinking



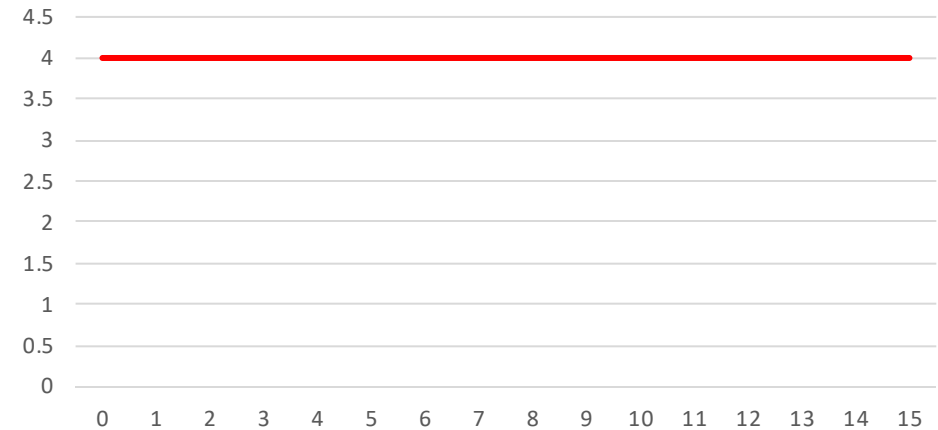
Low achievers

'Fixed ability' = meet expectations

Knowledge x ability



Predicted grade



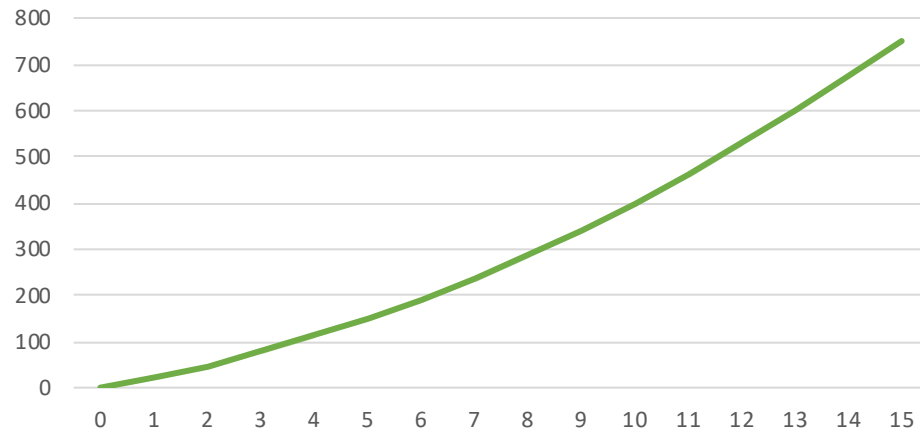
Low achievers

'Incremental ability'

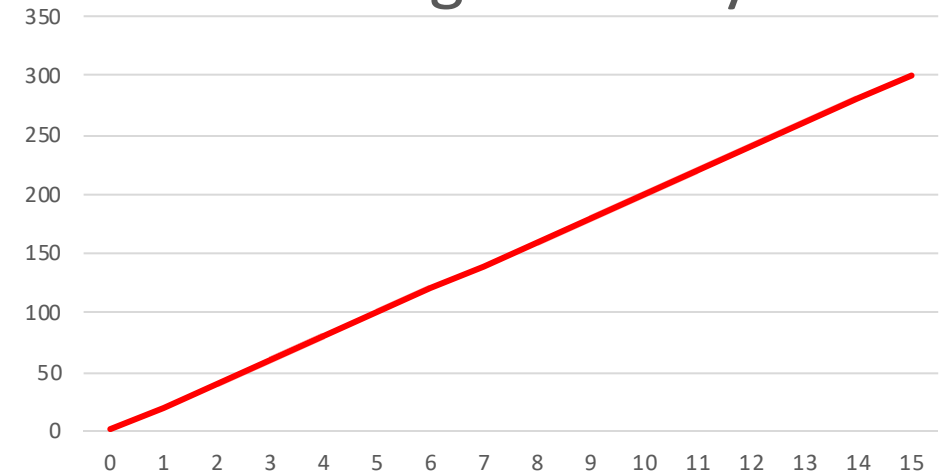
vs.

'fixed ability'

Knowledge x ability



Knowledge x ability



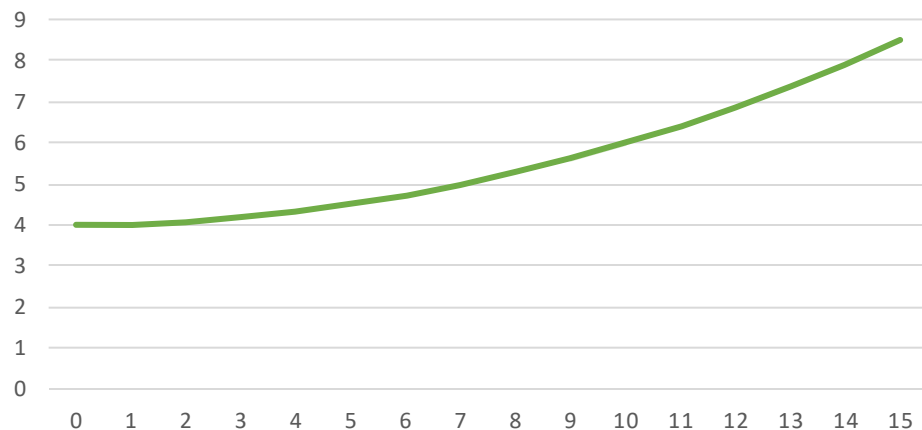
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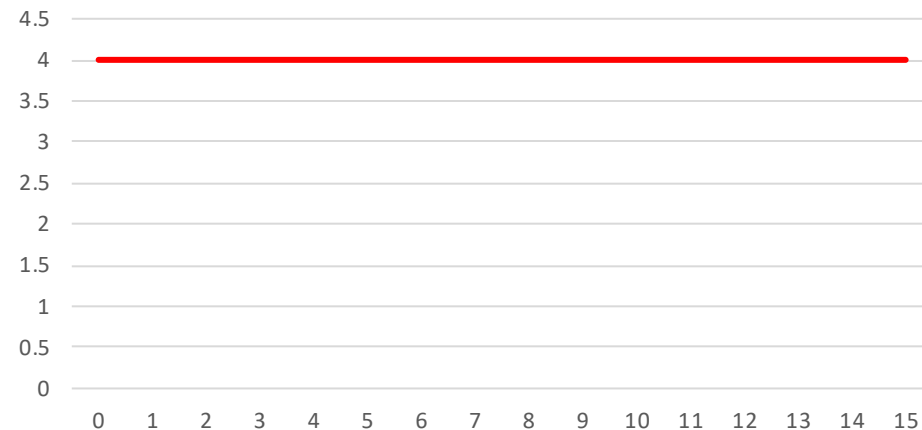
vs.

'fixed ability'

Predicted grade



Predicted grade



Standard tests are not enough

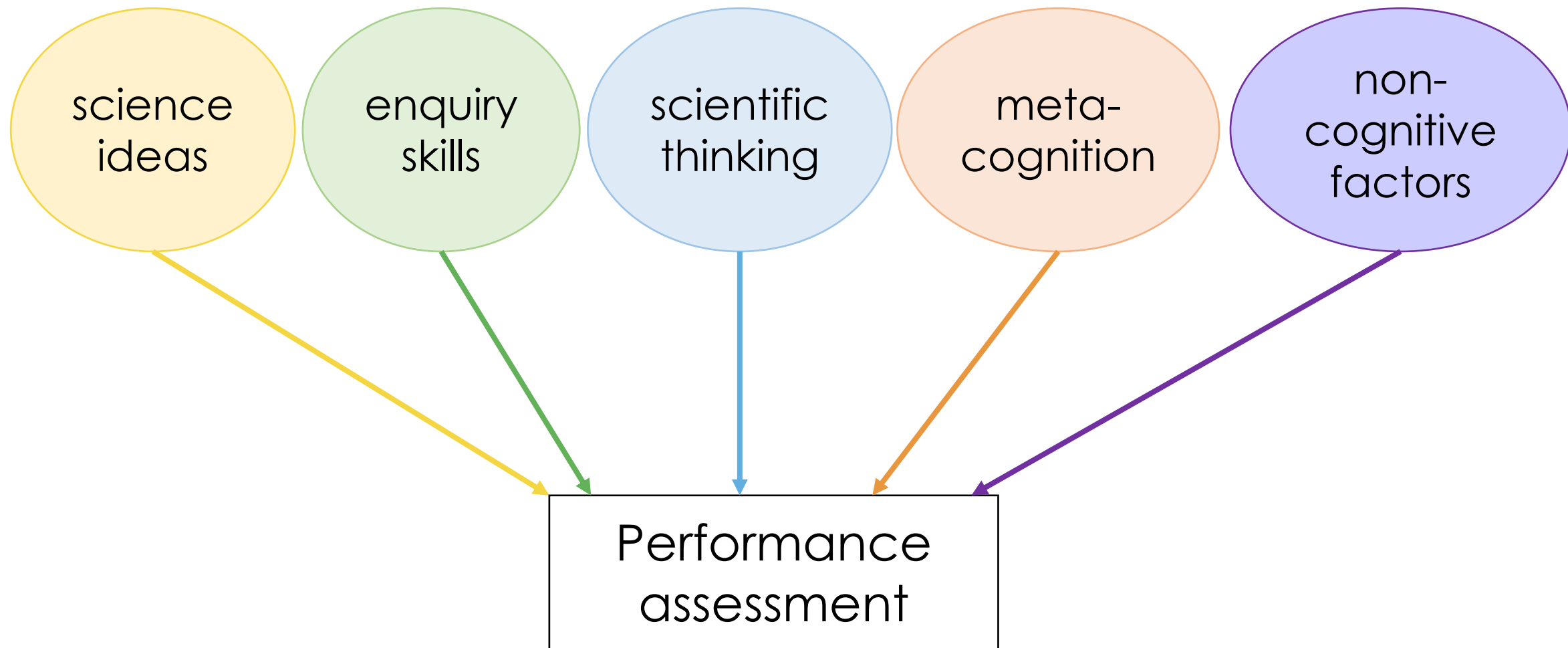
Assessment type	Scientific idea knowledge	Enquiry skills	Scientific thinking ability	Metacognitive ability
Quiz	Yes	Partly		
Long answer	Yes	Partly	Partly	Partly
Performance task	Yes	Yes	Yes	Yes

Measure abilities

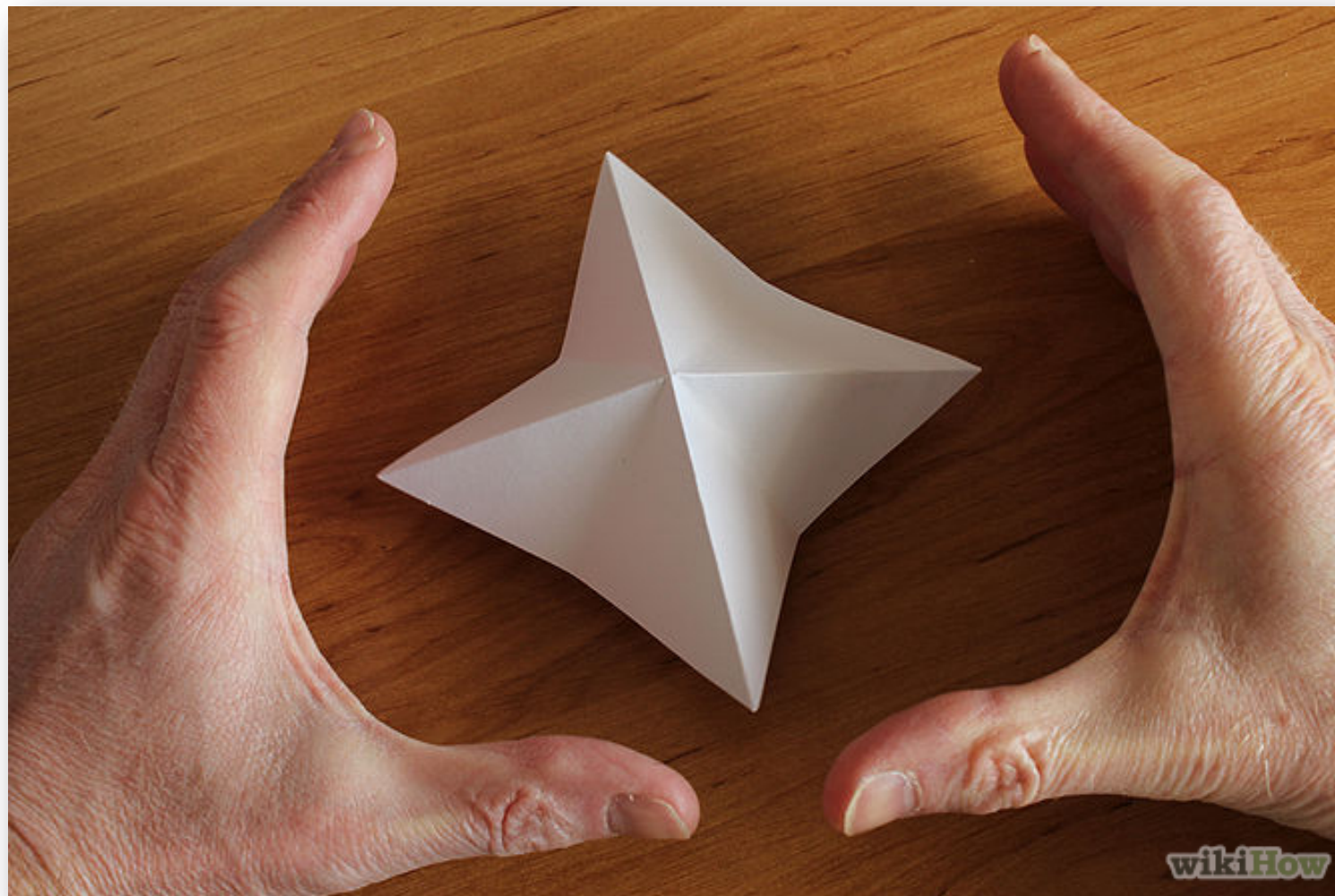
Performance assessment

- Students show integration knowledge, thinking and abilities
- Authentic situation: Real-life version of AO1-3
- Can be used to motivate the learning of Key Concept
- Decision making, investigation or design
- 1-2 lesson task

Assessment evidence



Example: The Chi wheel



What it assesses

- ✓ Science ideas: Particle model & density
- ✓ Enquiry ideas: Hypothesising
 - Invent a scientific hypothesis
 - Think up an experiment
 - Review hypothesis against evidence
- ✓ Scientific thinking ability: Experimental

Engage

Enable

Explore

Explain

Epilogue

Extend

Evaluate

Differentiating the task



What's the problem?

What do I know already that can help?

What do I need to know?

What science will solve the problem?

Scaffolding the stages

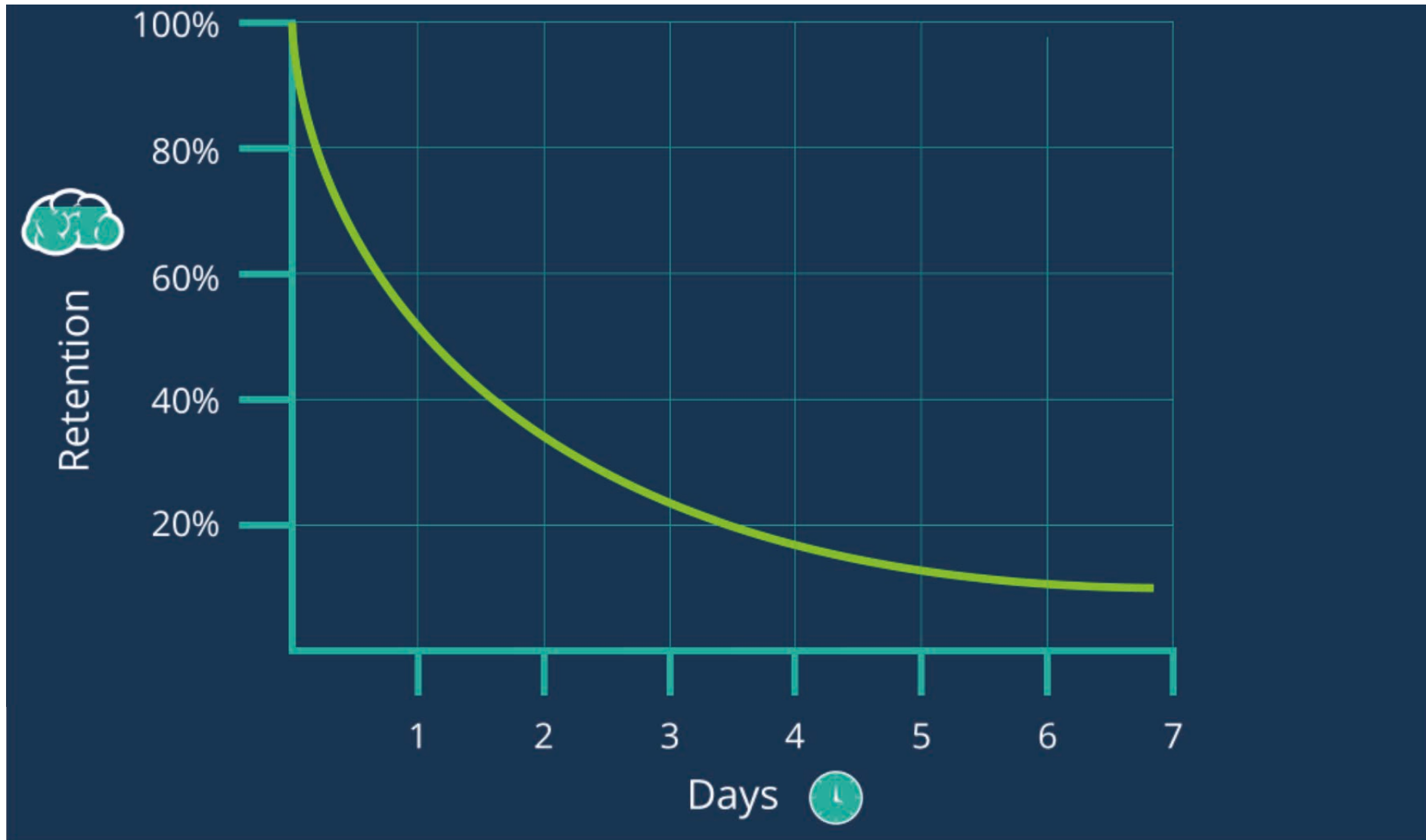
Outcomes

The outcomes from the performance assessment can show:

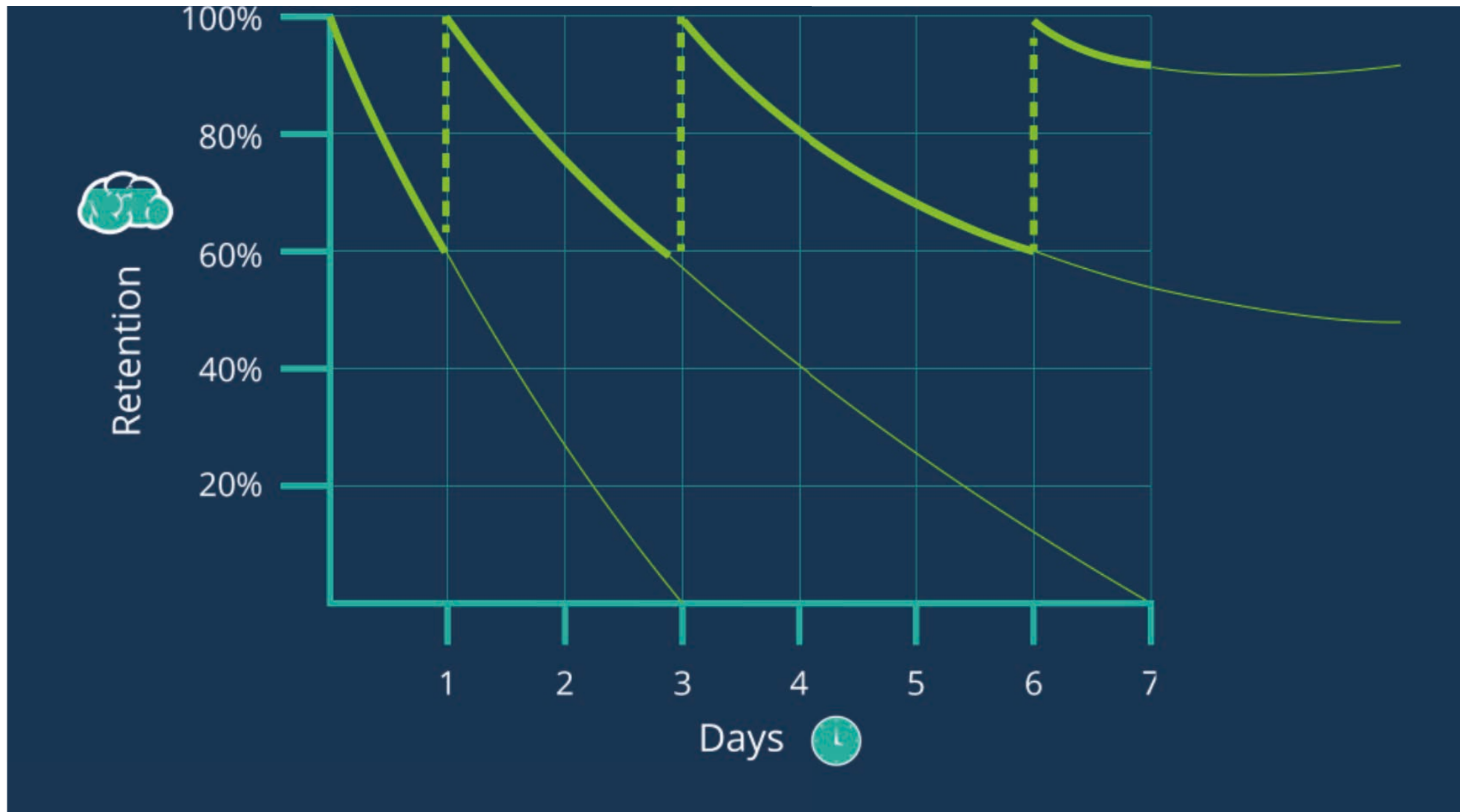
- Improvement in problem solving skills and metacognition
- What skills you need to focus on teaching in more depth

Spaced testing

Forgetting curve




Spaced testing




Unit tests

Solutions Quiz

1



copper sulfate




water

Letisha made a saturated solution by dissolving dissolved 35 g of copper sulfate in 100 cm³ of water.

How could she dissolve more? [1 mark]

2



A maximum mass of 38 g of sodium chloride dissolves in 100 cm³ of water at 50°C.

A maximum mass of 21g of potassium chloride dissolves in 50 cm³ of water at 50°C.

Which substance is more soluble? Show the calculation you used. [1 mark]

Plus retest questions

2



Carys and Oscar are on a high speed train moving at constant speed on a straight track.

Who is correct?
Explain why you think so. [1 mark]

There must be an unbalanced force acting on us to make us go this fast

The forces on us are balanced, because we are not getting any faster

Retest schedule

Key Concepts	1st repetition In 'Forces on Materials' test	2nd repetition In 'Substances & Particles test	3rd repetition In 'Electric Circuits' test
Balanced & unbalanced	21 days	56 days	133 days
Friction	14 days	49 days	126 days
Density	7 days	42 days	119 days

Next steps


Unit planners

Year 7/8 now

Year 9-11 coming soon


Next week's webinar

Teach thinking for AO2-3



7KC-Cell structure


Mastery planner 7U-Cells unit



Activate

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Acquire

Building blocks:

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Skill Argue for a claim by explaining how each piece of evidence supports it or not.

Technique Use a microscope

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Skill Represent a real world event, process or system using a model.

Technique ...

Goal To examine diagrams of real animal, plant and bacteria cells, identify similarities and differences, and explain how those parts keep the cells alive.


Level 3 N/A

Level 2 N/A

Level 1 N/A


Skill N/A

Technique N/A




Assess

Goal To show accurate understanding of the ideas and rectify gaps and misconceptions before problem-solving.




Apply

Goal To identify what type an unfamiliar cell is with reasons, by comparing its structures to those of plant and animals, To work out an explanation for how a given change in a cell will affect the whole organism.



Analyse

Goal To interpret experimental results about cells and make an argument that cells carry out life processes.



U = unit, KC = Key Concept, PS=Primary Science, Level 3 = main idea, Level 2 = other ideas, Level 1 = terms/facts

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