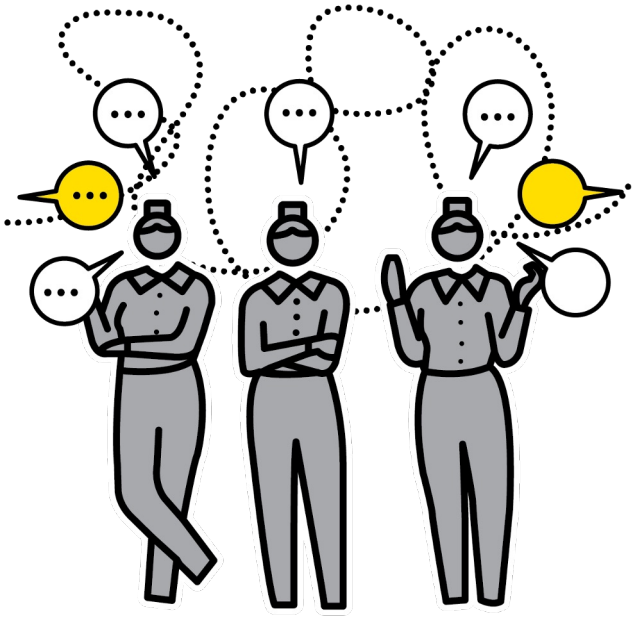
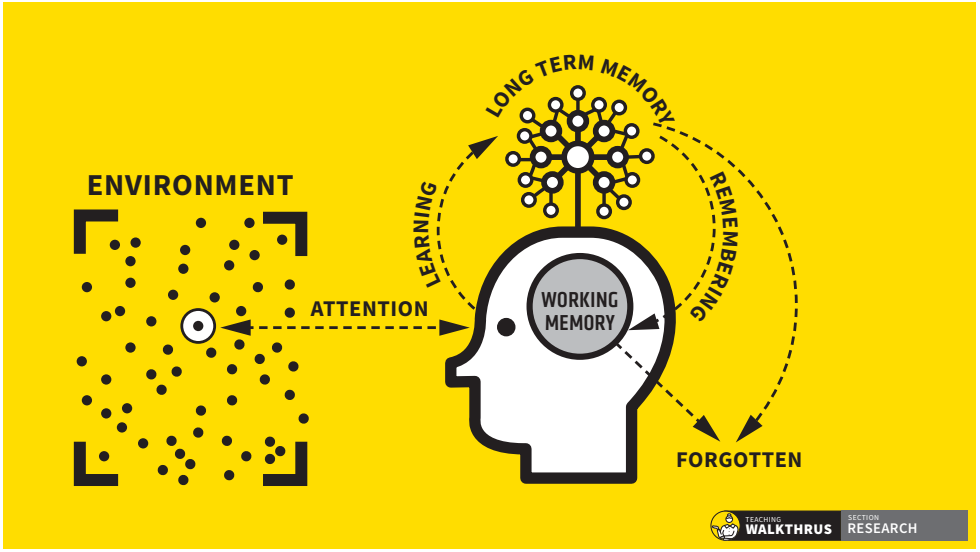
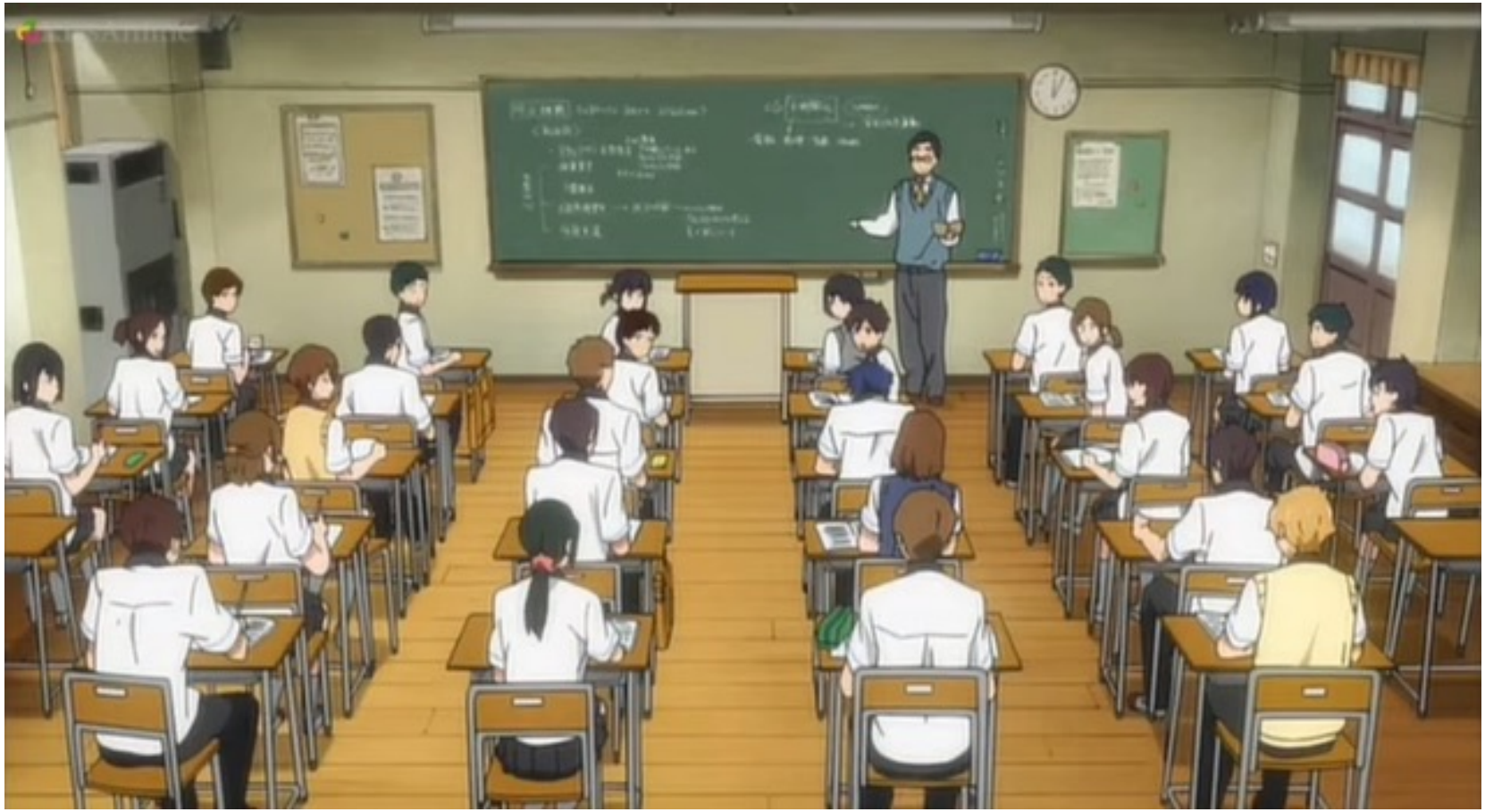
Evidence-Informed Teaching

1. Literacy
2. Making everyone think

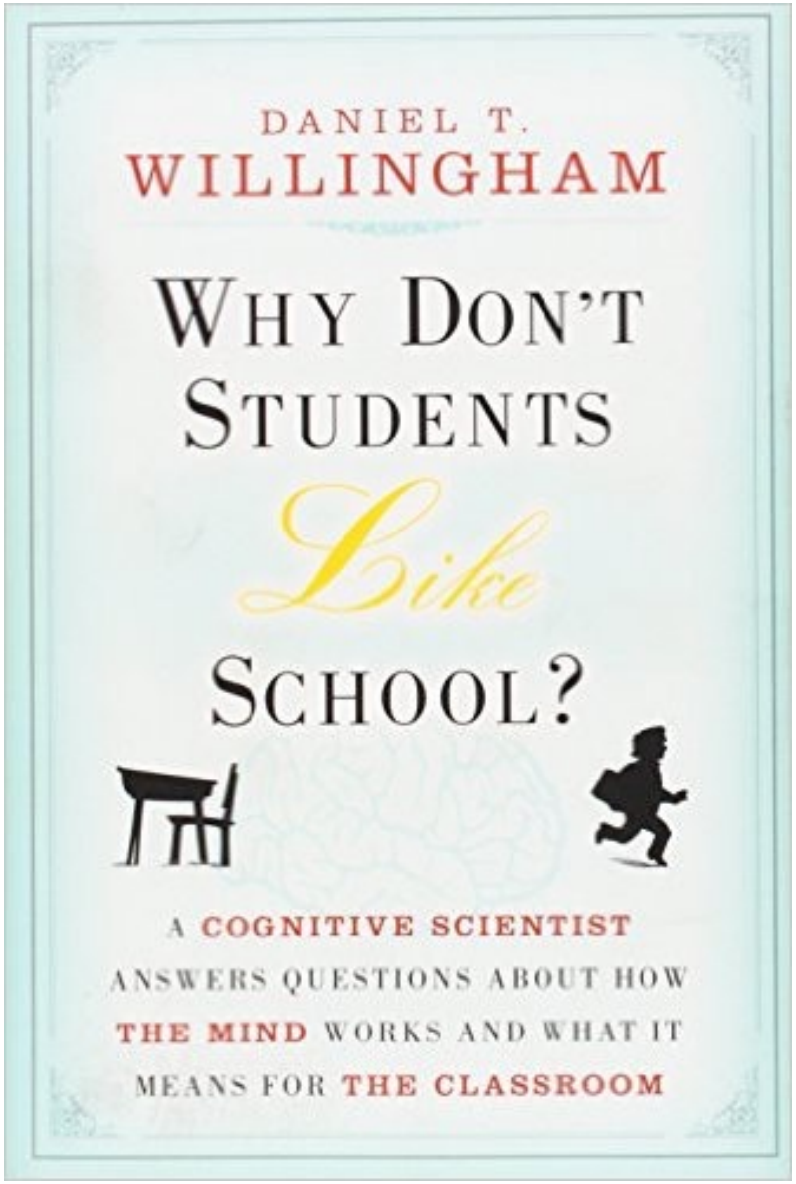


Tom Sherrington
April 2023





What's going on?


DANIEL T.
WILLINGHAM
WHY DON'T STUDENTS Like SCHOOL?
A COGNITIVE SCIENTIST ANSWERS QUESTIONS ABOUT HOW THE MIND WORKS AND WHAT IT MEANS FOR THE CLASSROOM

Daniel Willingham:

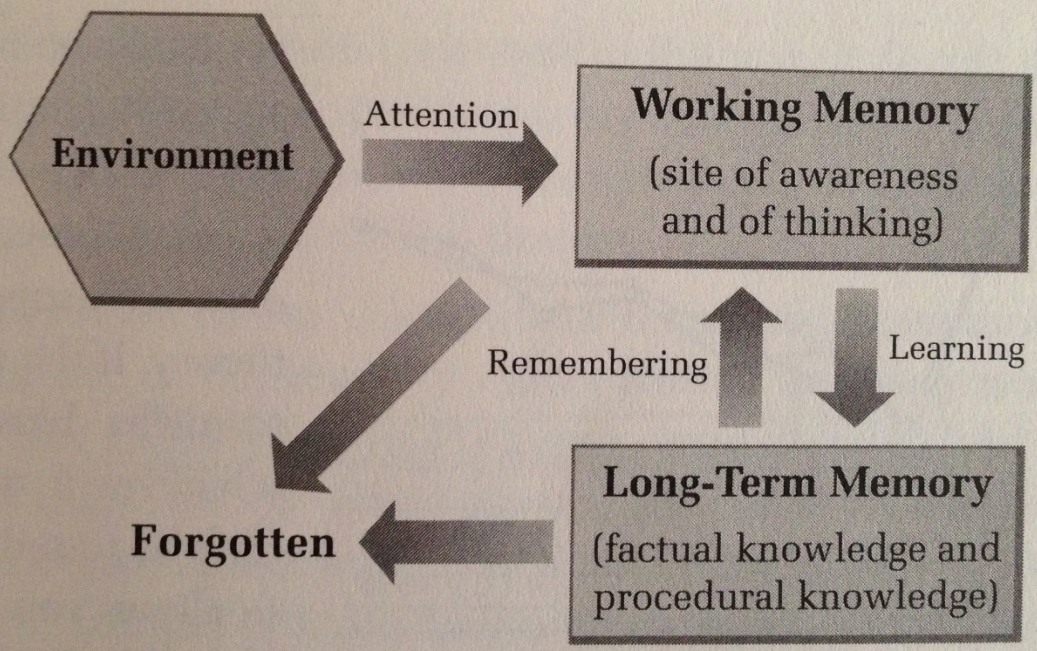
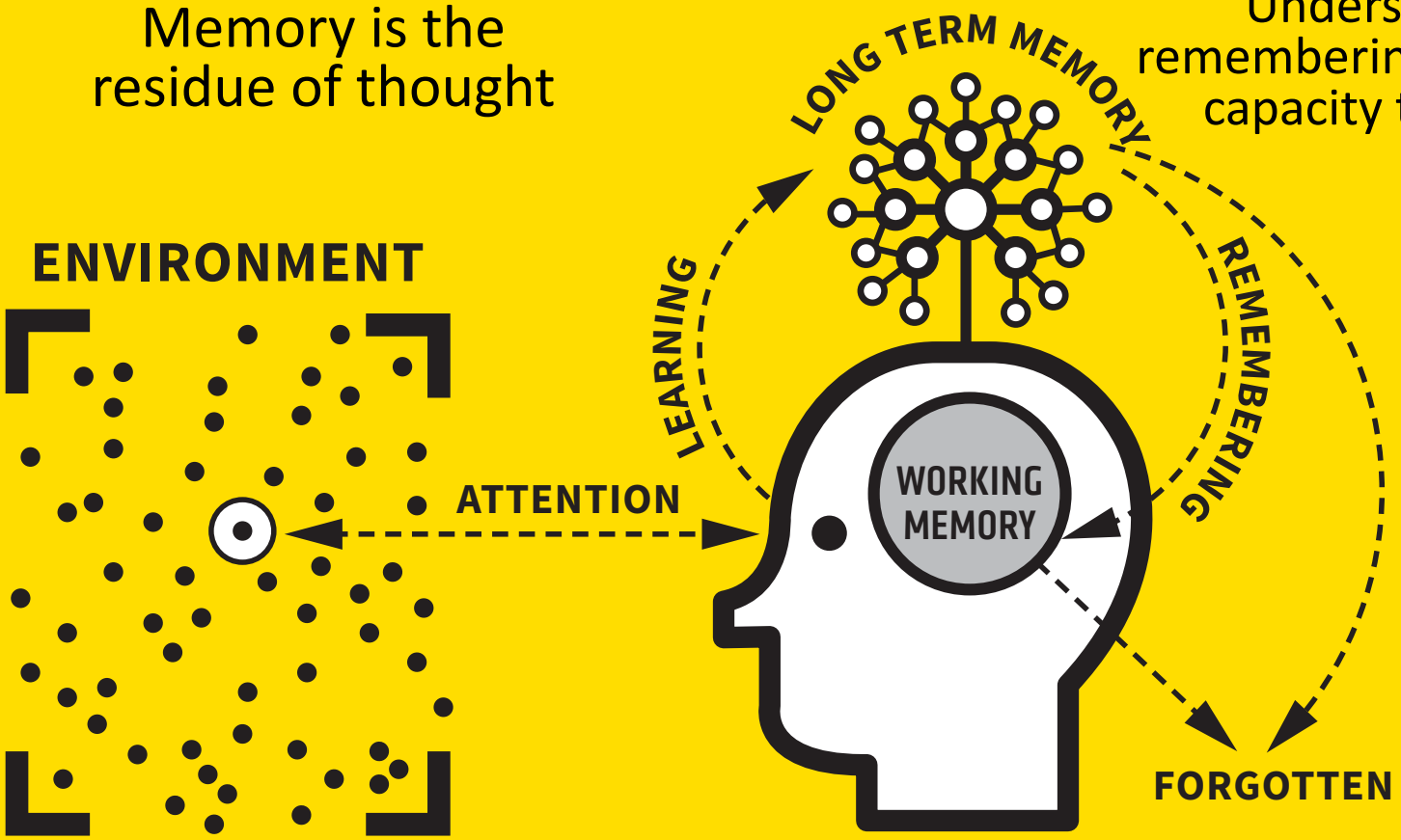


FIGURE 1: A slightly modified version of our simple diagram of the mind.

Daniel Willingham:

Memory is the residue of thought

Understanding: remembering in disguise; capacity to explain.



Drills for fluency

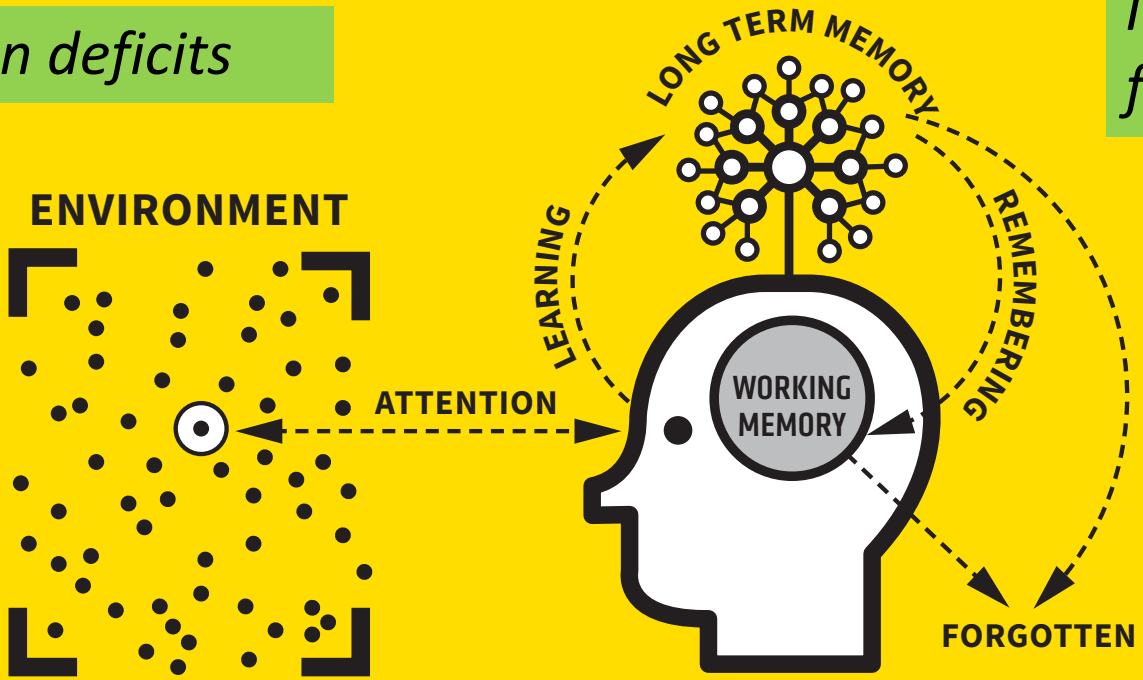
Power of stories

TEACHING WALKTHRUS SECTION RESEARCH

Lack of prior knowledge

Attention deficits

Insufficient fluency of recall



Task completion poor proxy for learning:

Memory overload:

Daniel Willingham 🦢 @DTWillingham · Apr 7

Very proud to have played a small role in this study, now reported in a working paper. Still much to be done, but v encouraging results in reading from a knowledge curriculum, cumulative (K-6) long-term effect for all students approx 16 percentile points. edworkingpapers.com/ai23-755

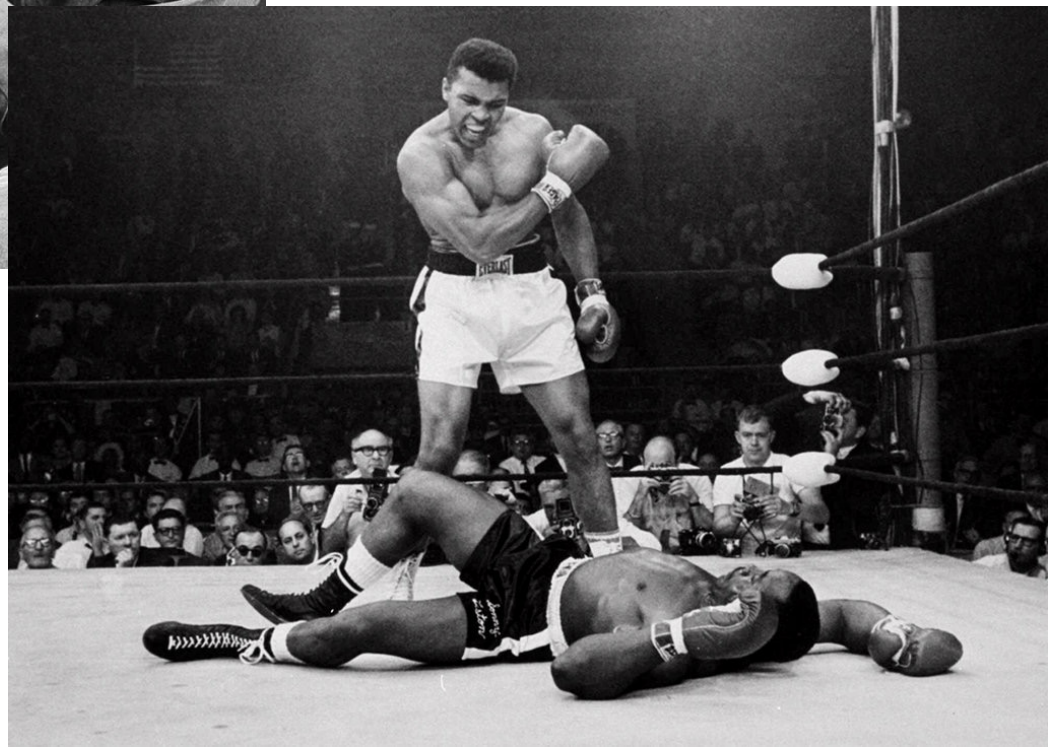
The Core Knowledge curriculum is a K-8 curriculum focused on building students General Knowledge about the world they live in that is hypothesized to increase reading comprehension and Reading/English-LA achievement. This is the first study to utilize an experimental design to evaluate the long term effects of using the K-8 Core Knowledge curriculum. Fourteen oversubscribed kindergarten lotteries for enrollment in nine Core Knowledge Charter schools (CK-Charter) using the curriculum had 2310 students applying from parents in predominately middle/high income school districts. State achievement data was collected at 3rd- 6th grade in Reading/English-LA and Mathematics and at 5th Grade in Science. A new methodology addresses two previously undiscovered sources of bias inherent in kindergarten lotteries that include middle/high income families. The unbiased confirmatory Reading-English-LA results show statistically significant ITT (0.241***) and TOT (0.473***) effects for 3rd-6th grade achievement with statistically significant ITT and TOT effects at each grade. Exploratory analyses also showed significant ITT (0.15*) and TOT (0.300*) unbiased effects at 5th grade in Science. A CK-Charter school in a low income school district also had statistically significant, moderate to large unbiased ITT and TOT effects in English Language Arts (ITT= 0.944**; TOT = 1.299**), Mathematics (ITT= 0.735*; TOT = 0.997*) and positive, but insignificant Science effects (ITT= 0.468; TOT = 0.622) that eliminated achievement gaps in all subjects.

Muhammed Ali relinquished his World Champion title after refusing to serve in Vietnam.

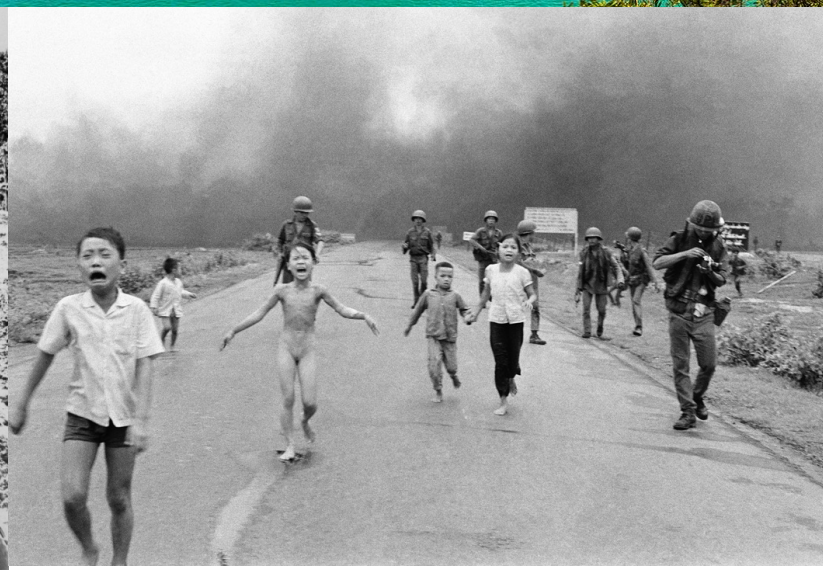
True or False

- Muhammed Ali did not give up his titles because of his beliefs?

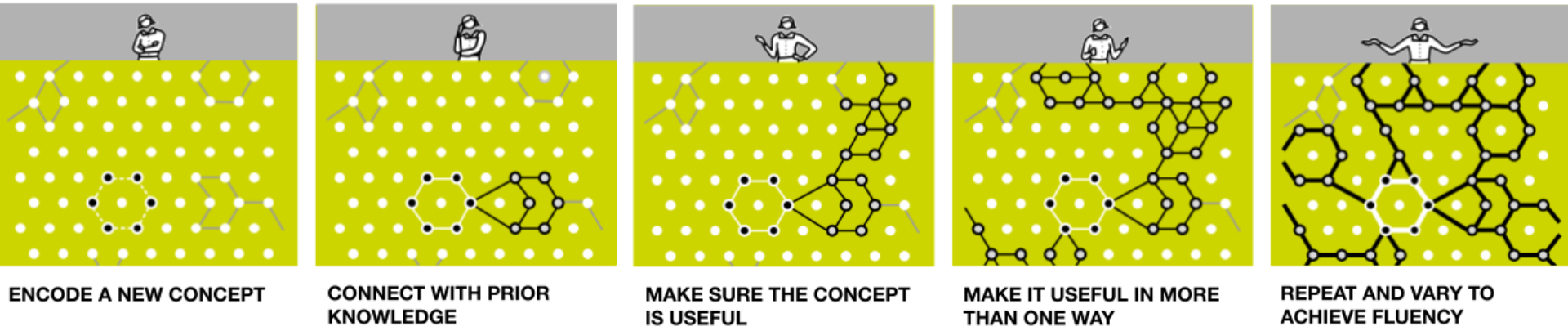
SUNDAY NEWS
30,000 MARCH
IN VIET PROTEST



95°
100°
Tropic of Cancer
105°
110°
CHINA
MYANMAR
LAOS
THAILAND
CAMBODIA
VIETNAM
20°
15°
10°
Nay Pyi Taw
Vientiane
Bangkok
Nakhon Ratchasima
Phnom Penh
Ha Giang
Cao Bang
Lao Cai
Bac Kan
Lai Chau
Tuyen Quang
Thai Nguyen
Son La
Viet Tri
Bac Ninh
Cam Pha
Hoa Binh
Hanoi
Haiphong
Nam Dinh
Thai Binh
Thanh Hoa
Qui Chau
Sam Son
Nghia Dan
Dien Chau
Vinh Vien
Ha Tinh
Tuyen Hoa
Dong Hoi
Ha Xa
Dong Ha
Quang Tri
Hue
Da Nang
Hoi An
Tam Ky
Quang Ngai
Mo Duc
Bong Son
Tam Quan
Kon Tum
Phu My
Pleiku
Phu Cat
Quy Nhon
Song Cau
Buon Me Thuot
Tuy Hoa
Da Lat
Nha Trang
Cam Ranh
Phan Rang–Thap Cham
Phu Rieng
Tay Ninh
Bao Loc
Phan Thiet
Bien Hoa
Ho Chi Minh City
Go Cong
Chau Doc
Long Xuyen
Rach Gia
Can Tho
Thoi Binh
Soc Trang
Ca Mau
Bac Lieu
Nam Can
Con Son
Gulf of Tonkin
Gulf of Thailand
ANDAMAN SEA
SOUTH CHINA SEA
0 100 200 mi
0 150 300 km



HOW MEMORIES ARE CONSTRUCTED: A MODEL



From Efrat Furst in Walkthrus Volume 3

Implications:

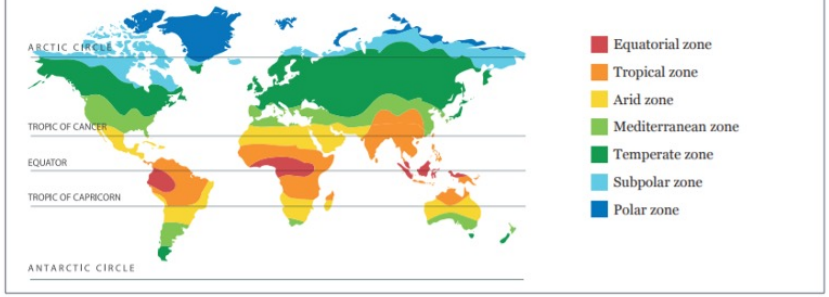
→ Rehearsal first; retrieval practice later

→ Making meaning means connecting new knowledge to prior knowledge.

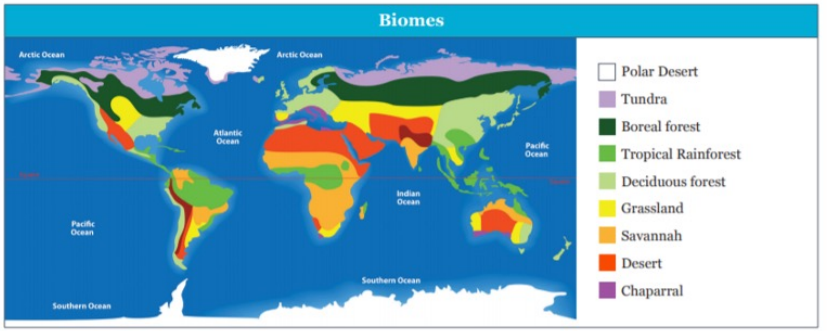
Geography Knowledge Organiser

Year 6 Biomes

Climate



Biomes



Key Vocabulary

Arid zone – Areas north and south of the tropics

Biome – An area with similar plants and animals

Boreal forest – A forest made up of coniferous plants in cold areas

Climate – The weather conditions in an area over time

Deciduous forest – A forest that has trees that lose their leaves each year

Desert – A waterless area with little or no vegetation

Equatorial and Tropical zones – Area in the centre of the globe with a hot temperature

Grassland – A large open area covered with grass

Polar and subpolar zone – Areas in the north and south of the globe

Rainforest – A thick forest that has lots of rain

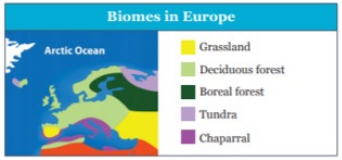
Savannah – A grassy plain in tropical and subtropical regions with definition

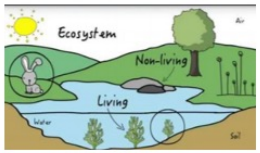
Temperate zone – Areas of mild temperature

Tundra – A flat, cold, treeless area

Vegetation belt – smaller regions indicating where vegetation grows

Biomes in Europe





What Should I Already Know?

- Understand what a biome is, e.g. a rainforest.
- Recognise some local, national and international rivers, including
- basic features. E.g. Rivers: Sheppey, Amazon and Ganges.
- Understand the water cycle.
- Recognise the human impact on different biomes.
- Understand food chains.

Overcoming the challenges of a biome

Deciduous forest
Lake District, United Kingdom

In many parts of the UK, including the Lake District, deciduous forest has been cut down and cleared (on flat ground). This makes space for the growing of crops and the grazing of animals.

Grassland
Southern Spain

In Southern Spain, in the summer months when droughts are common, water is transported from lakes and reservoirs to keep the soil fertile and allow crops to grow.

Challenges of a biome for humans

Rainforest:
- It can rain more than 250cm a year
- It is difficult to grow crops
- Diseases spread easily

Savannah:
- It rarely rains
- It is difficult to find water
- It is difficult to grow crops

Desert:
- It is often dangerously hot or cold
- It is difficult to find water
- There are limited food sources

Chapparal:
- Fires can easily start
- The winter is very wet
- The summer is very dry

Grassland:
- Fires can easily start
- Limited building materials
- Droughts common

Deciduous forest:
- Limited open spaces
- Weather limits when plants can grow
- Transport is difficult

Boreal forest:
- Limited open spaces
- Transport is difficult
- Cold in winter

Tundra:
- Dangerously cold in winter
- Poor nutrients in the soil
- It rarely rains

Challenges of a biome for humans

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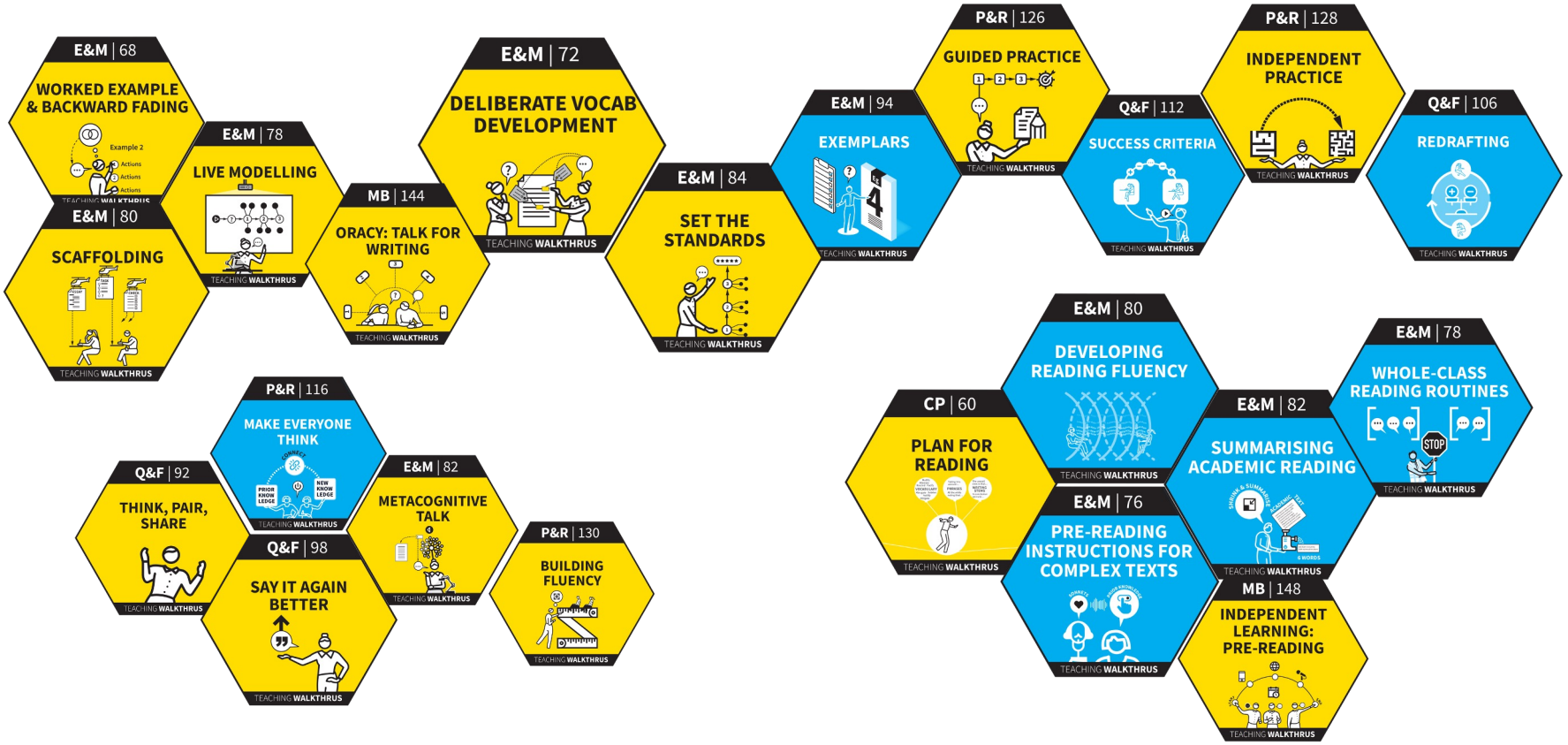
Deciduous Forest

Boreal Forest

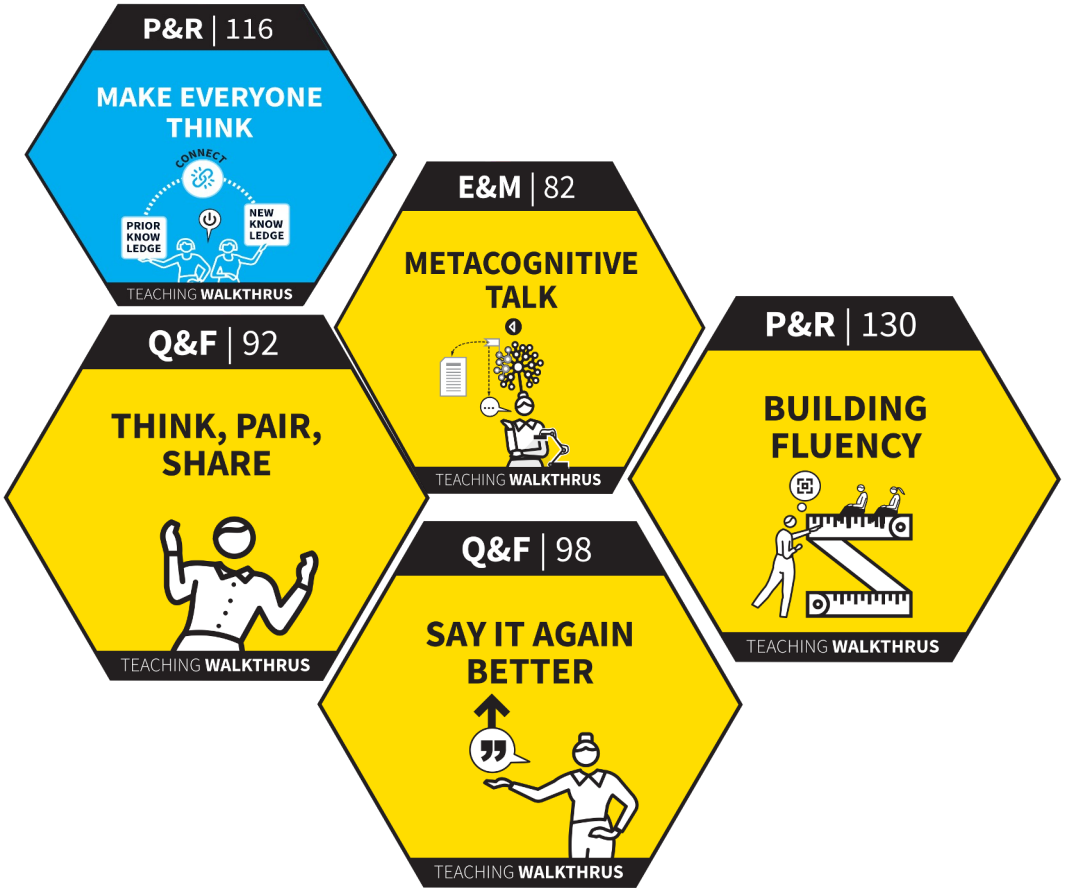
WALKTHRUs CLUSTERS

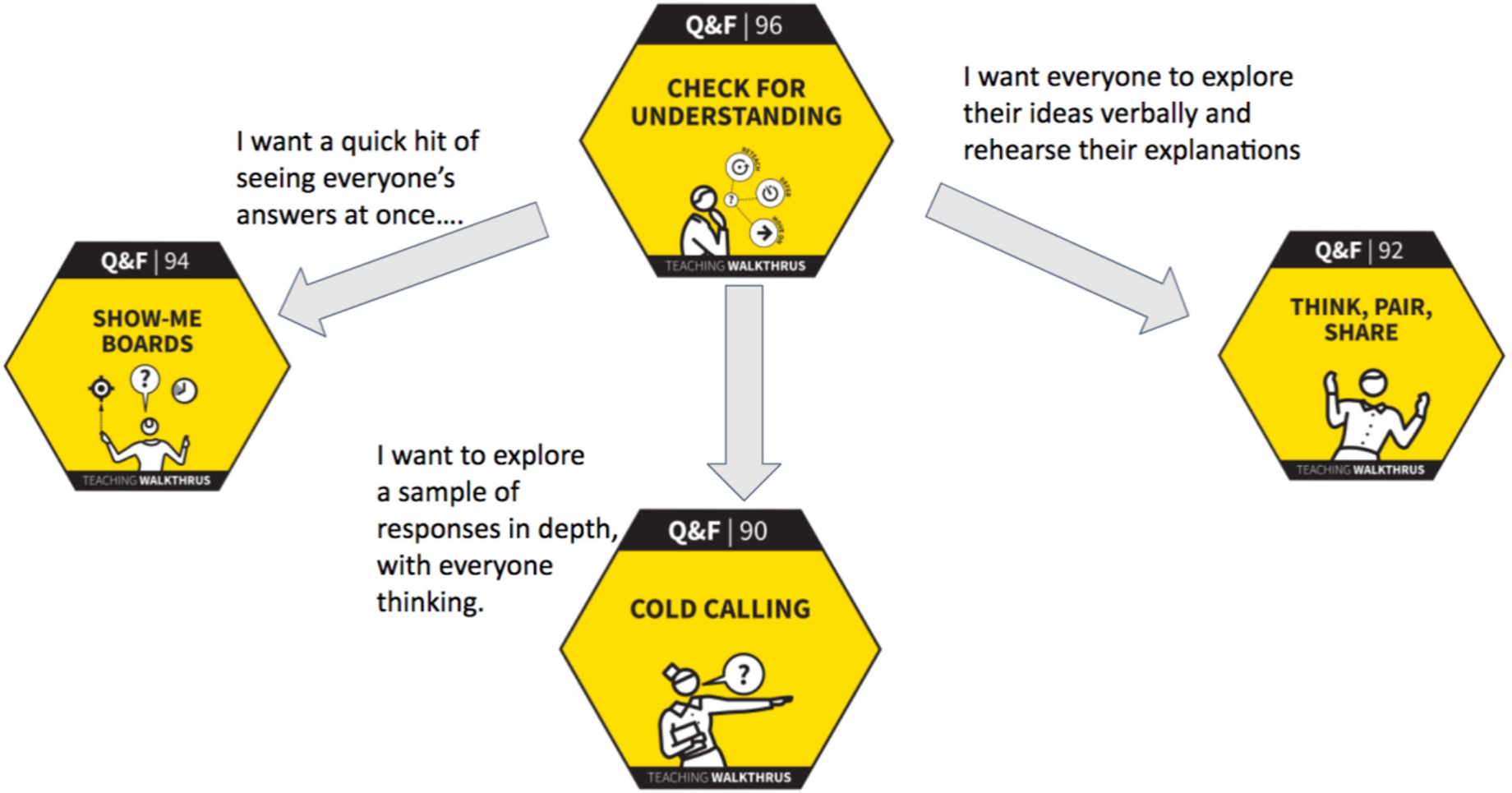
Literacy: Writing; Speaking; Reading



WALKTHRUs CLUSTERS

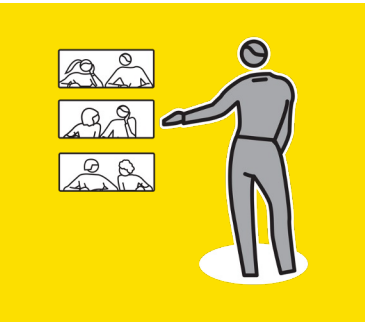
Literacy: Writing; Speaking; Reading




Q&F | 96
CHECK FOR UNDERSTANDING
TEACHING WALKTHRUS
I want a quick hit of seeing everyone's answers at once....
Q&F | 94
SHOW-ME BOARDS
TEACHING WALKTHRUS
I want everyone to explore their ideas verbally and rehearse their explanations
Q&F | 92
THINK, PAIR, SHARE
TEACHING WALKTHRUS
I want to explore a sample of responses in depth, with everyone thinking.
Q&F | 90
COLD CALLING
TEACHING WALKTHRUS

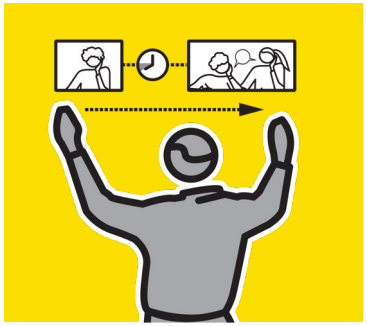
THINK, PAIR, SHARE

1 2 3 4 5



ESTABLISH TALK PARTNERS FOR EVERY STUDENT

SET THE QUESTION WITH A GOAL AND A TIMEFRAME



BUILD IN THINKING TIME

CIRCULATE TO LISTEN AS PAIRS ARE TALKING

USE COLD CALL TO SAMPLE PAIRS' RESPONSES

TEACHING WALKTHRUS
SERIES
QUESTIONING & FEEDBACK
A|D|A|P|T

PAGE 98

WALKTHRU
THE A|D|A|P|T PROCESS

SERIES
QUESTIONING & FEEDBACK

TEACHING
WALKTHRUS

SAY IT AGAIN BETTER

1 2 3 4 5

ASK A STUDENT A QUESTION

ACKNOWLEDGE THE FIRST RESPONSE

GIVE SUPPORTIVE FORMATIVE FEEDBACK

INVITE STUDENT TO “SAY IT AGAIN BETTER”

RESPOND TO THE IMPROVED RESPONSE

Scaffolds for dialogue

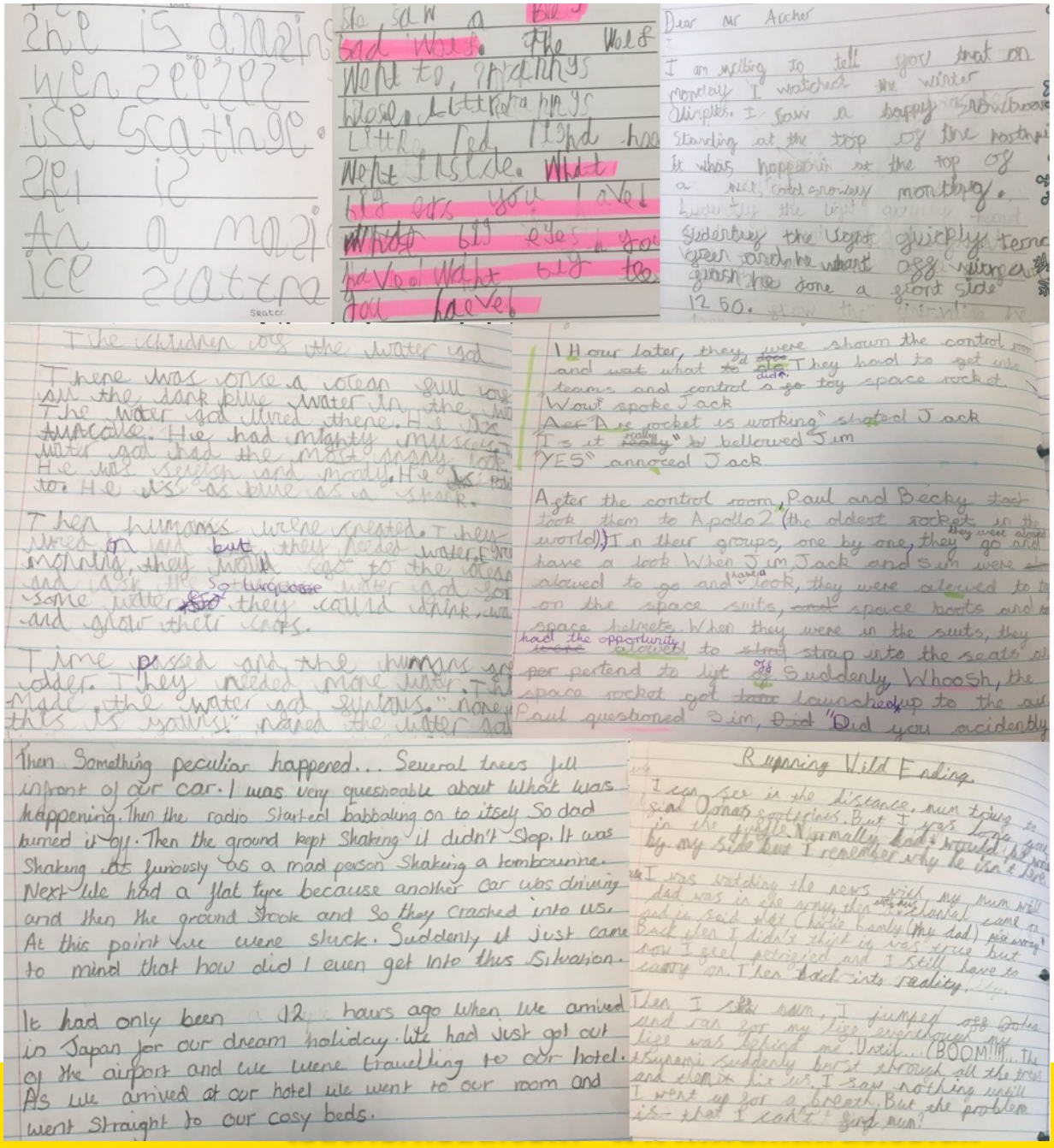
- Full sentences. *An example of a non-metal is…*
- At first….. Then
- In my opinion…
- Firstly…. Secondly…. And finally..
- On one hand…. On the other hand.
- An advantage of …. whereas a disadvantage..
- X happens because...
- If X happens… this in turn causes…

Is Harry Windsor ‘a sympathetic character’?

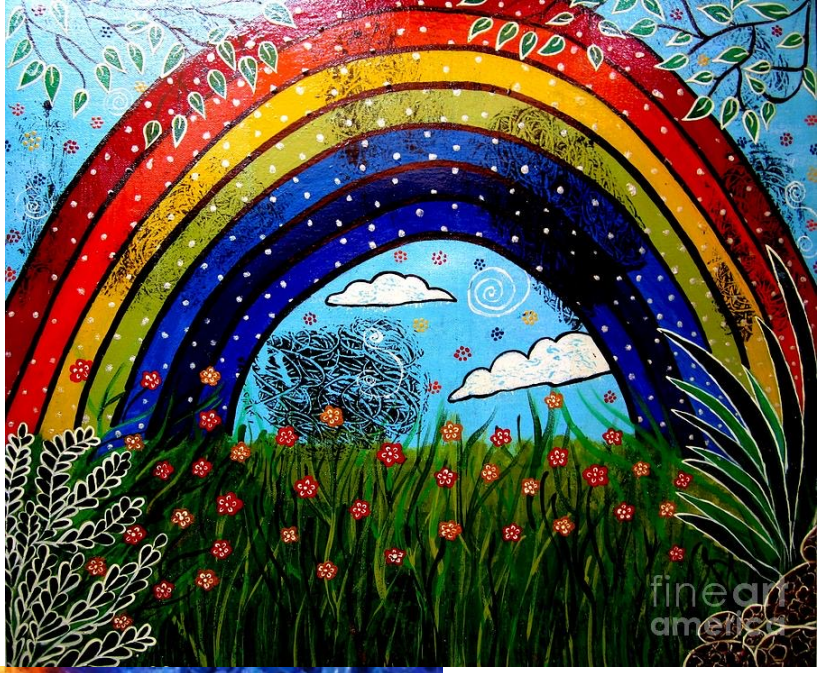
On one hand…

But on the other hand…

How do we build writing?



Which is better?

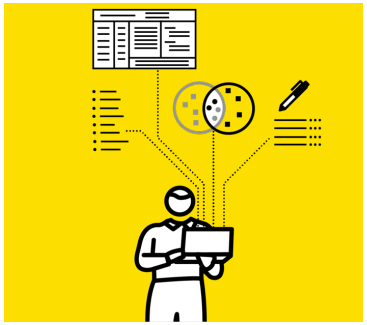


Quality Model

SCAFFOLDING

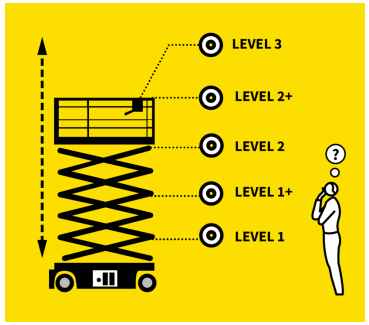
1 2 3 4 5

MAP OUT THE COMPONENTS OF A TASK

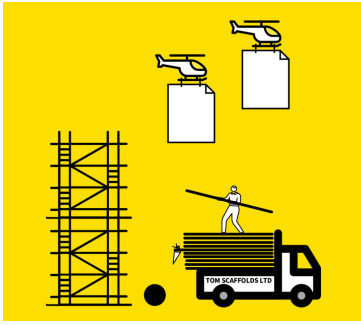


PROVIDE SUPPORTS AT A DETAILED LEVEL

PROVIDE SUPPORTS AT OVERVIEW LEVEL



PREPARE SCAFFOLDING SETS OFFERING VARYING LEVELS OF SUPPORT



TAKE THE SCAFFOLDING DOWN

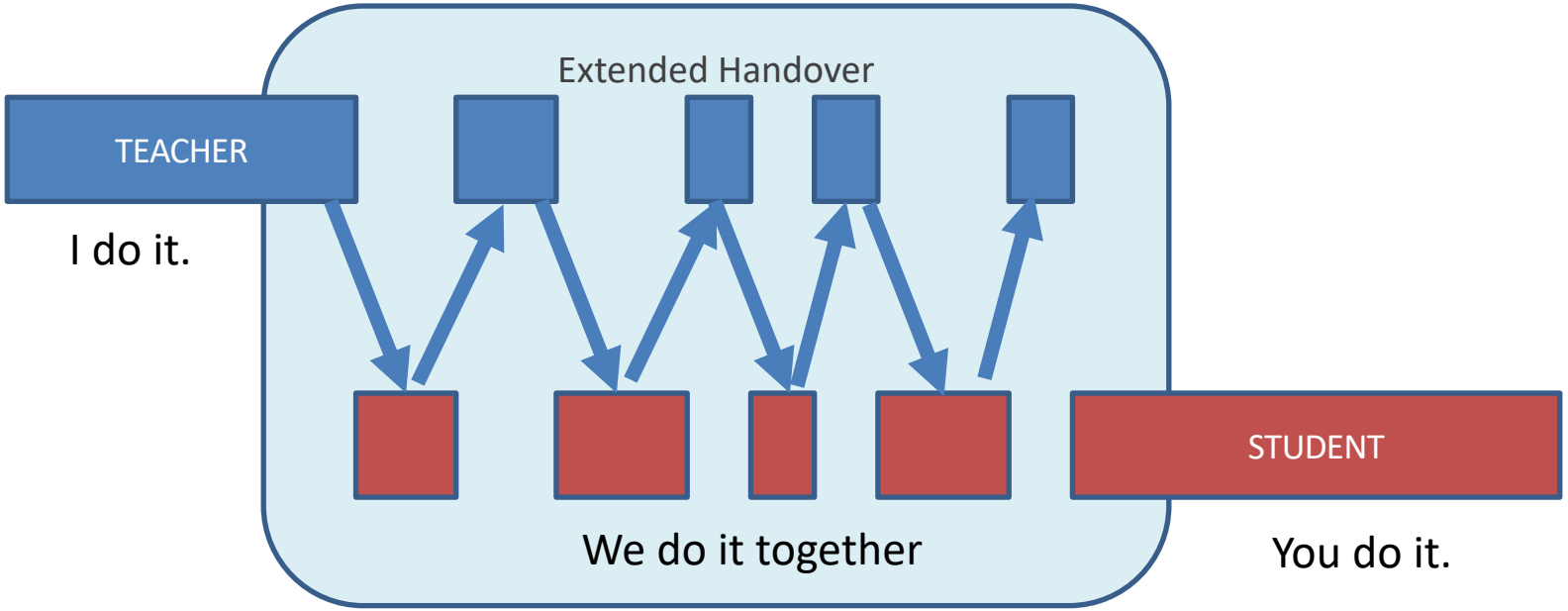
TEACHING WALKTHRUS

SERIES EXPLAINING & MODELLING

A|D|A|P|T

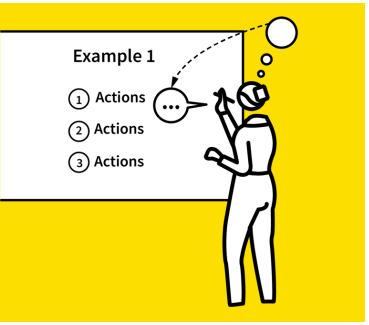
- Rosenshine suggests that more effective teachers successfully provide scaffolds for difficult tasks.
- Rather than setting lower expectations for students, they support them to reach ambitious goals using a range of scaffolding processes that guide them forward.
- Crucially, the metaphor embeds the idea that, when ready, scaffolding always comes down.

Passing the baton….

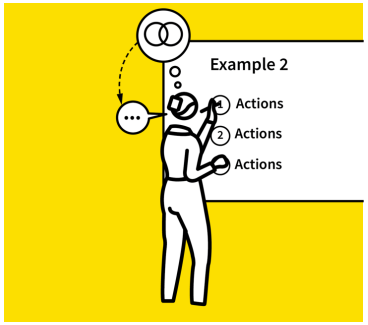

Extended Handover
TEACHER
I do it.
STUDENT
We do it together
You do it.

WORKED EXAMPLES & BACKWARD FADING

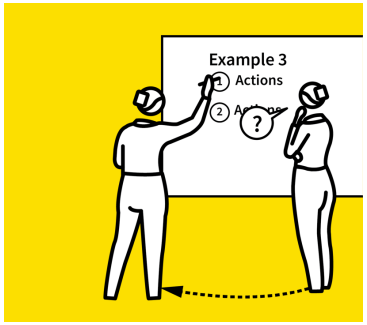
1 2 3 4 5



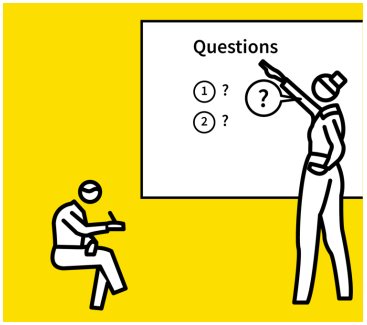
FULLY WORKED TO INTRODUCE THE METHOD OR IDEAS



FULLY WORKED FOR REINFORCEMENT



PARTIALLY WORKED FOR STUDENTS TO FINISH OFF



CUED START FOR STUDENT COMPLETION

COMPLETED INDEPENDENTLY

TEACHING WALKTHRUS
SERIES
EXPLAINING & MODELLING
A|D|A|P|T

- Cognitive Load Theory suggests novices learn more successfully studying complete worked examples than if asked to problem-solve independently.
- Cognitive load is reduced if we learn the overall method separately from trying to apply it.
- Often teachers do not model sufficient worked examples.
- Backward fading is good for moving from guided to independent practice.

Frankie: annotations

Piece A: Short story	Key
Prior to writing a short story set during World War 1, pupils wrote these short pieces to practise their skills in developing suspense and building tension in a familiar, everyday situation.	[C] composition [GP] grammar and punctuation [T] transcription

These 2 short pieces describe a midnight fridge-raid from contrasting third and first person perspectives, demonstrating confident control over language, sentence structures that are carefully chosen for effect and precise vocabulary choice.

A tense atmosphere is created across both paragraphs through the use of short sentences and phrases, and apt vocabulary choices (*darted, grabbed, bolted*). This is lightened by juxtaposing humour with tension (*distant snoring; his heart raced*) and the succinct integration of dialogue (*"Ewan!"*) as the climax to the first paragraph.

A range of cohesive devices links ideas

Opening the Fridge

Slowly, Ewan peeped through the crack in his door. All was black. He took a step out. He could hear distant snoring as he ~~creeped~~ crept across the landing.

As his heart raced he stared into the darkness; he could hear the fridge urging him on – willing him to move. Now the stairs. The tricky bit. Suddenly a THUD!... He raced down the creaking stairs – even the seventh one that makes an earsplitting ~~noise~~ creak. He could see the re white rectangle straight ahead of him. Then he opened it.

A series of short phrases in quick succession creates a sense of urgency and excitement, echoing Ewan's thoughts as he sneaks downstairs. The structure of the scene and the language employed mirror that from scenes in adventure or ghost narratives, applied here to a more humorous context.
[GP]

The selection of verb forms – past and present tense – distinguish between the past tense narrative and the current state of the seventh stair, placing the reader at the heart of the action.
[GP]

All of a sudden, the door flew open. It was Dad.

All of a sudden, the train stopped. She gripped her seat.

All of a sudden, it poured with rain. They ran for cover.

All of a sudden, the lawn-mower exploded. _____

All of a sudden, _____. _____

Modelling/ Scaffolding

Throughout the novel, the author….	a structure that helps to discuss a long-running theme.
At first glance, the character appears…… however…..	a structure supporting comparison between surface and deep features of a character.
Both poems….. However, poem A…… whereas poem B…….	a structure for comparing two poems.

Initially, the concentration is…..	50% X and 50% Y
Then, as the level of X increases….	the levels of Y decrease and the color of the mixture gets darker
This, in turn, causes…	the flask to get warm
So this is an…	exothermic reaction

Write an account of how events in Hungary became an international crisis during 1956. **[8 marks]**

The metacognitive process

- Reading the question – look for clues
- Recall of key knowledge elements
- Planning the sequence of ideas
- Planning the structure of paragraphs
- Linking back to the question
- Checking for overall flow

One reason how events in Hungary became an international crisis **was that the West criticised the violent Soviet reaction**. **For example**, when Nagy threatened to leave the Warsaw Pact, Khrushchev was afraid that this would weaken communist power. Khrushchev decided to send thousands of soldiers and tanks to Budapest, **which resulted in** over 10000 people being killed. **This was an international crisis because** it led to a war of words between the USA and USSR after the US objected and President Eisenhower openly criticised the Soviets.

Another reason why it was an international crisis was because it was the end of peaceful co-existence between the USSR and the West. **For example,** before the Hungarian Uprising**, Khrushchev tried to ease relations** between the USSR and the West, releasing political prisoners and criticising Stalin. **However,** after he was criticised in the UN by the USA and its allies, Khrushchev ended this policy. **This was an international crisis because the thaw ended and relations in the Cold War were damaged** after the West said that the USSR couldn't be trusted, which led to more problems in the 1960s.

Knowledge organiser: the origins of the Cold War, 1941—1958

PJB—2020.

Key individuals:

Presidents of the United States of America (USA)

Capitalists

Western bloc.

Franklin D. Roosevelt (1933—1945)

President during the Grand Alliance. Wanted to work with the USSR to at the Tehran and Yalta Conferences.

Harry Truman (1945—1953)

President the freezing of relations with USSR. Famous for dropping the first A-Bomb, the Truman Doctrine, Marshall Plan and Berlin Airlift. Sought to contain communism.

Dwight Eisenhower (1953—1961)

President during the Hungarian Uprising, and escalated the arms race by authorising US H-Bomb (1952) and ICBM tests (1957).

Leaders of the Union of Soviet Socialist Republics (USSR)

PJB 2020

Communists

Eastern bloc.

Josef Stalin (1929—1953)

Became unchallenged leader of the USSR in 1929. Joined the Grand Alliance after the Nazis invaded the USSR in 1941.

Stalin was a ruthless dictator, who wanted to prevent the USSR being invaded again. He built a buffer-zone in Eastern Europe as he felt that the capitalist powers would eventually invade again. He sought to build up the USSR's strength for a future war and spread communism. An example of this is the Berlin Blockade in 1948.

Nikita Khrushchev (1953—1965)

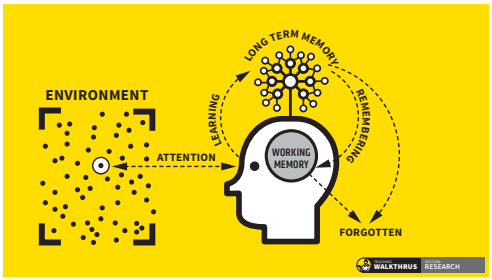
Famous for a policy of peaceful-coexistence with the USA. He created the Warsaw Pact (1955) and ordered the invasion of Hungary (1956).

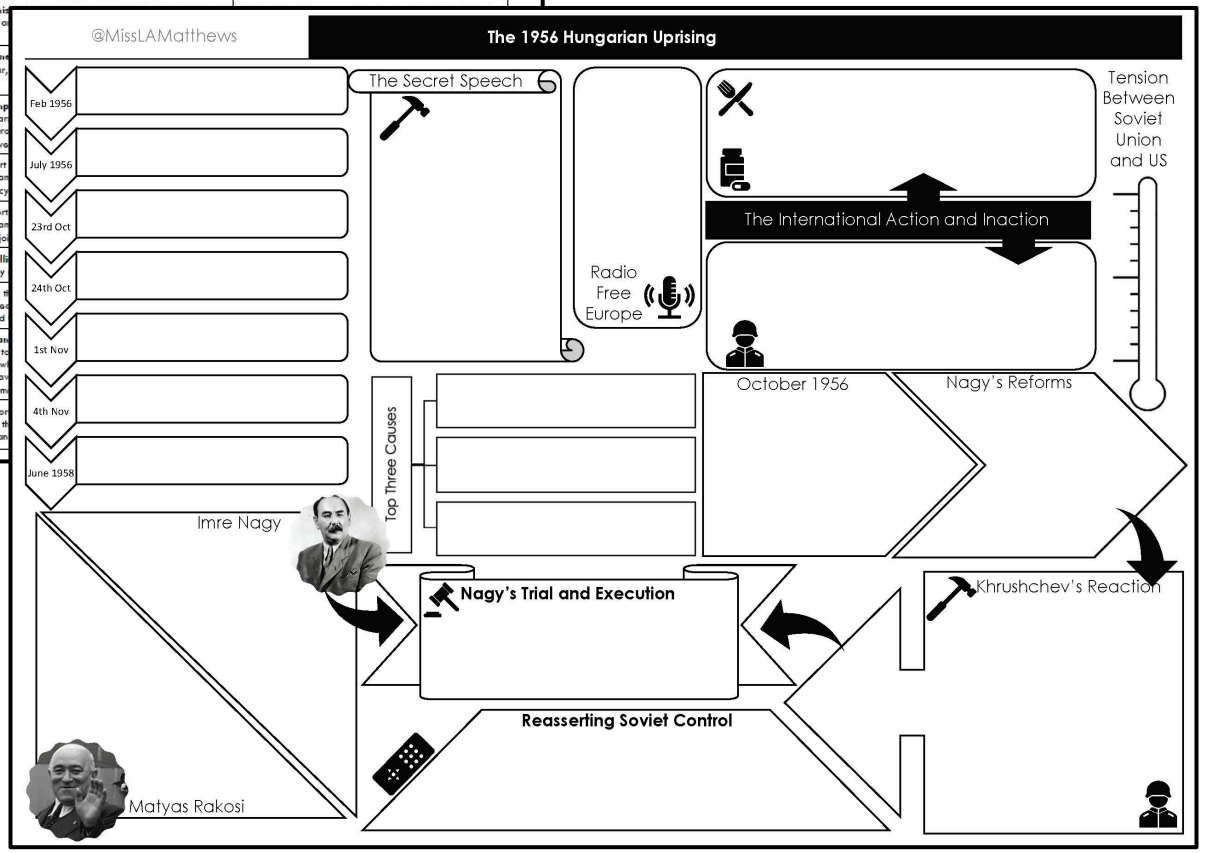
Timeline:

- November 1943: Tehran Conference
- August 1945: A-Bomb
- July 1945: Potsdam Conference
- February 1945: Yalta Conference
- 5 March 1946: Churchill's 'Iron Curtain' speech
- 27 September 1946: Novikov telegram
- 22 February 1946: Kennan's 'long' telegram
- January 1947: Communist takeover of Poland
- 5 June 1947: Marshall Plan announced
- 7 October 1949: Cominform set up
- 12 March 1949: Truman Doctrine
- February 1948: Communist takeover of Czechoslovakia
- 24 June 1948—12 May 1949: Berlin Blockade
- January 1949: Comecon set up
- 7 October 1949: Formation of German Democratic Republic
- 25 May 1949: Formation of Federal Republic of Germany
- 4 April 1949: NATO set up
- 14 May 1955: Warsaw Pact formed
- 23 June—11 November 1956: Hungarian Uprising

Glossary of key terms:

A-bomb: the atom bomb was the first nuclear weapon. Two were dropped on Japan in August 1945. The USSR raced to develop its own A-bomb, which was done in 1949.	**Ideology:** a set of shared beliefs. In 1941, the USA and USSR had different ideologies about how a country should be governed.
Arms race: a race to have more bigger, powerful weapons than another country.	**Iron Curtain speech:** a speech given by former Prime Minister, Winston Churchill, on 5 March 1946. He made it plain that he thought the USSR was a threat to freedom and world peace.
Berlin Crisis, 1948: disagreements over the running of the German and Berlin zones of occupation led to the Berlin Blockade and Berlin Airlift. It ended when the USSR backed down and lifted the blockade.	**Marshall Plan:** also known as the European Recovery Program (ERP), offered economic aid to the countries of western Europe to help them rebuild and to prevent them becoming communist.
Capitalism: the belief that everyone should be free to own property and businesses to make money.	**Military Alliances:** armed groups of countries that support each other if attacked. The USA led NATO and the USSR led the Warsaw Pact.
Comecon: its full name was the Council for Mutual Economic Assistance. It was the USSR's version of the Marshall Plan in the Eastern bloc.	**Potsdam Conference:** the final conference between the Grand Alliance to solve the problems of WW2. It met in Potsdam in Germany.
Cominform: its full name was the Communist Information Bureau. It was set up by Stalin to allow him to control the governments of the satellite states.	**Satellite state:** a nation that was once independent but is now under the control of another.
Communis the state o wealth.	
Containme Cold War,	
Dollar Imp of the Mar divide Eur control ove	
FRG: short the full nam democracy	
GDR: short the full nam state. It jo	
Grand Alli when they	
H-bomb: t atomic wea 1952 and	
Hungarian Hungary to invaded wi would leav Soviet com	
ICBM: shor a rocket, t fired at an	





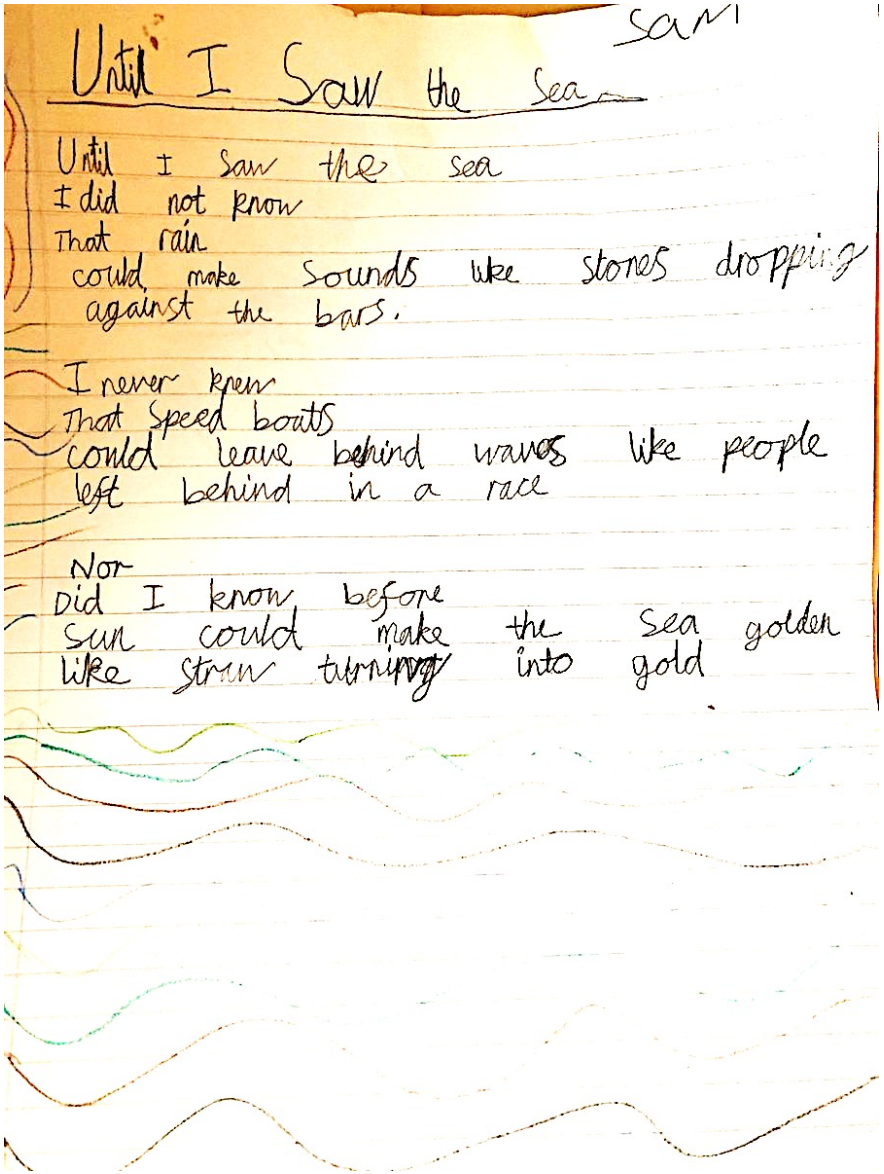
Until I Saw the Sea

Until I saw the sea
I did not know
that wind
could wrinkle water so.

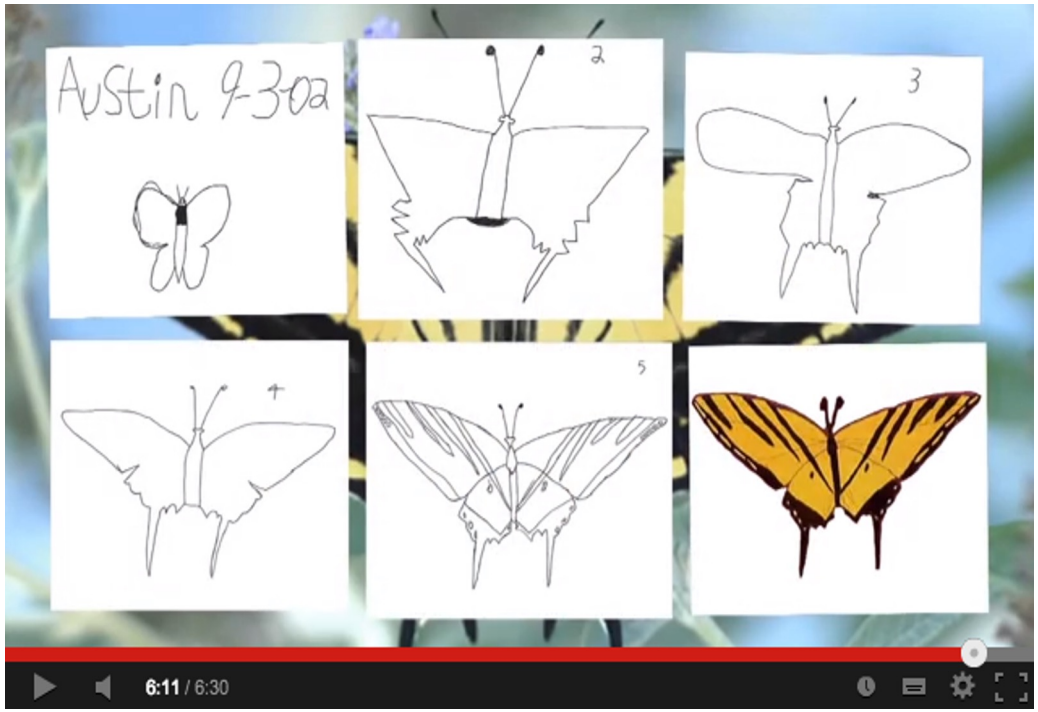
I never knew
that sun
could splinter a whole sea of blue.

Nor
did I know before,
a sea breathes in and out
upon a shore.

--Lilian Moore, all rights reserved



Austin's Butterfly: An ethic of excellence.



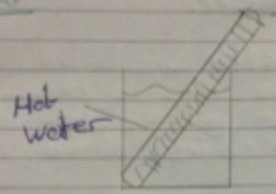
"Once students have had a taste of excellence, they never satisfied with anything less."

Ron Berger

10th September 2014

Solids liquids and gasses

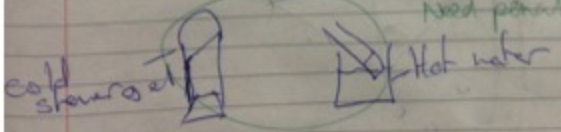
Experiment: Volume of ice and water



Prediction:
The volume will stay the same.

observation:
my observation was wrong (Say exactly what you saw)

cold 2.58secs
Hot 0.30secs



Prediction
I think the quicker one will be the hot gel.

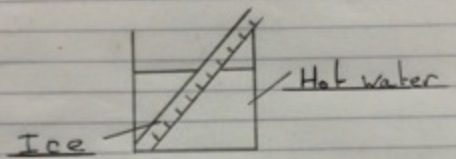
observation
my prediction was right.

conclusion
cold = 2minutes. 58 secs Hot = 3seconds

10th september 2014

solids, liquids and gasses

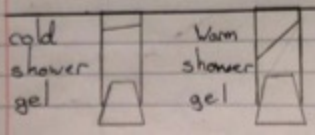
Experiment: Volume of ice and water



Prediction:
I predict that the volume of water will stay the same.

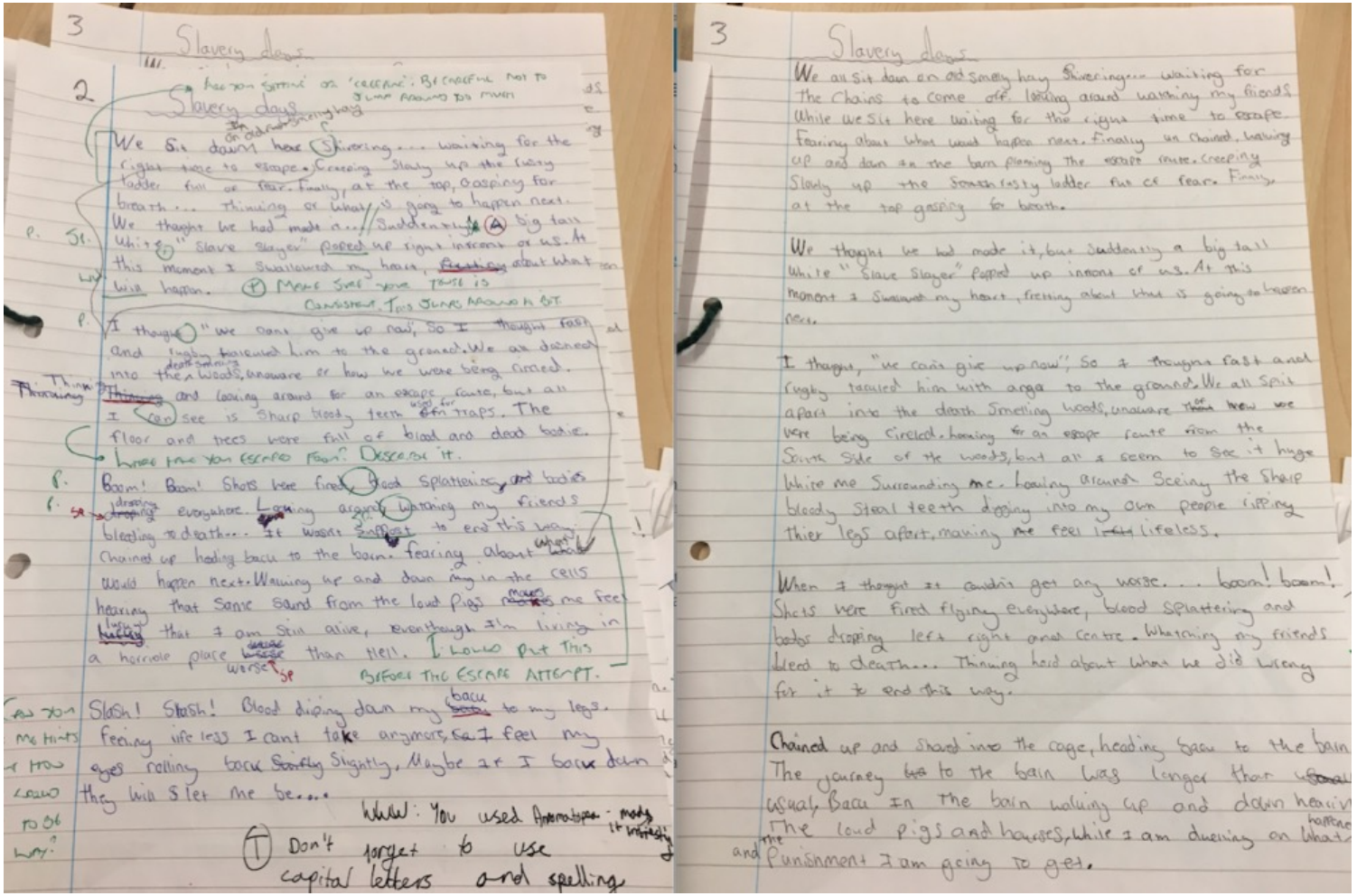
Observation:
My prediction was wrong. Because of the hot water The ~~ice~~ melted and the volume got ~~bigger~~ smaller.

Conclusion
When the ice froze the molecules spread a little so the ice was bigger than the volume of water. When the ice was exposed to heat The molecules got closer together and this made the volume get lower.



Prediction:

Third Time for Excellence



Slavery days

We sit down here Shivering.... waiting for the right time to escape. Creeping Slowly up the rusty ladder full of fear. Finally, at the top, Gasping for breath... thinking of what is going to happen next. We thought we had made it... Suddenly a big tall White "Slave Slayer" popped up right infront of us. At this moment I Swallowed my heart, fretting about what will happen. Make sure your Tense is Consistent. This Stands Around at 87.

I thought "we can't give up now", So I thought fast and rugby tackled him to the ground. We all Split apart into the death Smelling woods, unaware of how we were being Circled. Looking for an escape route, but all I can see is Sharp bloody teeth used for traps. The floor and trees were full of blood and dead bodies. Where the fuck do you escape from? Describe it.

Boom! Boom! Shots were fired, blood Splattering and bodies dropping everywhere. Looking around, Watching my friends bleeding to death... It wasn't fair to end this way. Chained up heading back to the barn. fearing about what would happen next. Walking up and down in the cells hearing that Same Sound from the loud Pigs noises me feel lucky that I am Still alive, even though I'm living in a horrible place worse than Hell. I WISH I'd PUT THIS BEFORE THE ESCAPE ATTEMPT.

Slash! Slash! Blood diping down my back to my legs. Feeling life less I can't take anymore, So I feel my eyes rolling back Slightly. Maybe if I back down they will let me be...

Why? You used Apostrophes - make it interesting

Don't forget to use capital letters and spelling

3

Slavery days

We all Sit down on old Smelly hay Shivering... waiting for The Chains to come off leading around warning my friends While we Sit here waiting for the right time to escape. Fearing about what would happen next. Finally we chained, having up and down in the barn planing the escape route. Creeping Slowly up the Sometimes rusty ladder full of fear. Finally at the top gasping for breath.

We thought we had made it, but Suddenly a big tall White "Slave Slayer" popped up infront of us. At this moment I Swallowed my heart, fretting about what is going to happen next.

I thought, "we can't give up now", So I thought fast and rugby tackled him with arga to the ground. We all Split apart into the death Smelling woods, unaware of how we were being Circled. looking for an escape route from the South Side of the woods, but all I seem to See it huge White me Surrounding me. looking around Seeing the Sharp bloody Steal teeth dipping into my own people ripping thier legs apart, making me feel lifeless.

When I thought it couldn't get any worse... boom! boom! Shots were fired flying everywhere, blood Splattering and bodies dropping left right and centre. Watching my friends bleed to death... Thinking hard about what we did wrong for it to end this way.

Chained up and Shoved into the cage, heading back to the barn The journey to the barn was longer than usual, Back in the barn walking up and down hearing The loud pigs and horses, while I am dwelling on what happens and the Punishment I am going to get.

BUILDING A CULTURE OF READING

BUILDING A CULTURE OF READING

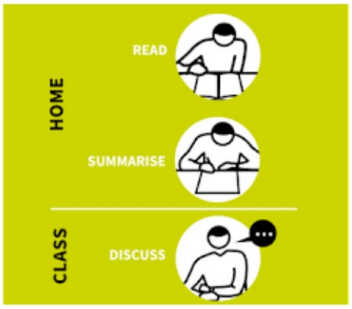
1 2 3 4 5

MODEL & CELEBRATE READING

READ ACROSS THE CURRICULUM

EMBRACE READING ALOUD

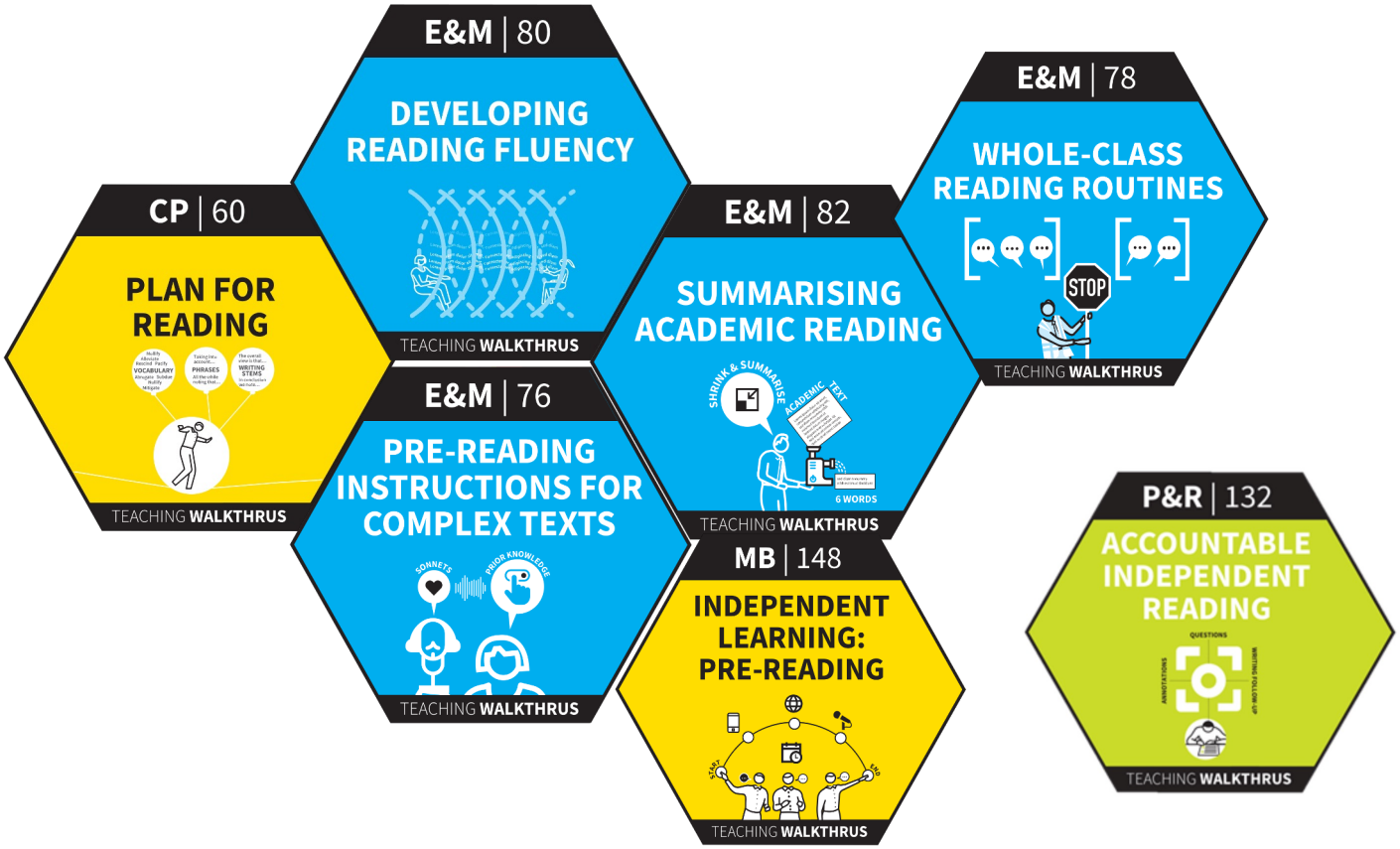
VALUE READING RECORDS AND DIARIES



EMBED READING IN HOMEWORK TASKS

WALKTHRUs CLUSTERS

Literacy: Writing; Speaking; Reading



Plan the reading

Space storms cause decade of damage

Radiation could hang about

David Shiga

A MAJOR solar storm would not only damage Earth's infrastructure, it could also leave a legacy of radiation that keeps killing satellites for years.

When the sun belches a massive cloud of charged particles at Earth, it can damage our power grids and fry satellites' electronics. But that's not all. New calculations suggest that a solar megastorm could create a persistent radiation problem in low-Earth orbit, disabling satellites for up to a decade after the storm first hit.

It would do this by destroying a natural buffer against radiation – a cloud of charged particles, or plasma, that normally surrounds Earth out to a distance of four times the planet's radius.

The relatively high density of plasma in the cloud prevents the formation of electromagnetic waves that would otherwise accelerate electrons to high speeds, turning them into a form of radiation. This limits the amount of radiation in the innermost of two radiation belts that surround Earth.

But solar outbursts can erode the cloud. In October 2003, a major outburst whittled the cloud down so that it only extended to two Earth radii. A repeat of a huge outburst that occurred in 1859 – which is expected – would erode the cloud to almost nothing.

Yuri Shprits of the University of California in Los Angeles led a team that simulated how such a large storm would affect the radiation around Earth.

They found that in the absence of the cloud, electromagnetic waves accelerated large numbers of electrons to high speed in Earth's inner radiation belt, causing a huge increase in radiation there. The inner radiation belt is densest at about 3000 kilometres above Earth's equator, which is higher than low-Earth orbit. But the belt hugs Earth more tightly above high latitude regions, overlapping with satellites in low-Earth orbit.

Speeding electrons cause electric charge to accumulate on satellite electronics, prompting sparks and damage. Increasing the number of speeding electrons would drastically shorten the lifetime of a typical satellite, the team calculates (*Space Weather*, DOI: 10.1029/2011SW000662).

The researchers say that the destructive radiation could hang about for a long time, spiralling around Earth's magnetic field lines. In 1962, a US nuclear test carried out in space flooded low-Earth orbit with radiation that lasted a decade and probably ruined several satellites.

"Solar megastorms would destroy our natural radiation buffer, killing satellites for a decade"

"When you get this radiation that far in, it tends to be quite long-lived and very persistent," says Ian Mann of the University of Alberta in Edmonton, Canada, who was not involved in the study.

Thicker metal shielding around satellite electronics would help, says Shprits. The persistent radiation would also be hazardous for astronauts and electronics on the International Space Station. ■

Single molecule is tiniest electric motor ever

FOR the first time, an electric motor has been made from a single molecule. At 1 nanometre long, that makes the organic compound the smallest electric motor ever.

Its creators plan to submit their design to Guinness World Records, but the teeny motor could also have practical applications, such as pushing fluid through narrow pipes in "lab-on-a-chip" devices.

Molecules have previously converted energy from light and chemical reactions into directed motion like rolling or flapping. Electricity has also set an oxygen molecule spinning randomly. But controlled, electrically driven motion – necessary for a device to be classed as a motor – had not yet been observed in a single molecule.

To address this, E. Charles Sykes at Tufts University in Boston and colleagues turned to asymmetric butyl methyl sulphide, a sulphur atom with a chain of four carbons on one side and a single carbon atom on the other. They anchored the molecule to a copper surface via the sulphur atom, producing a lopsided, horizontal "propeller" that was free to rotate about the vertical copper-sulphur bond (see diagram).

Above the molecule they placed a metal needle a few atoms wide at its tip. When they flowed a current from this tip, through the molecule, to the conductive copper below, the molecule converted the electrical energy into rotational energy. It bounced around in jittery hops at a rate of about 50 turns per second.

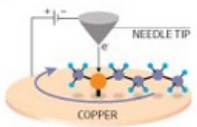
Because the propeller is asymmetrical, there are two ways it can be oriented with respect to the copper. In one orientation – but not the other – the molecule's hops were not random but slightly biased towards rotating clockwise, allowing the researchers to classify it as a motor (*Nature Nanotechnology*, DOI: 10.1038/nnano.2011.142).

It's not clear why the bias occurs but Sykes suspects that an inherent asymmetry in the tip of the metal needle could explain why it only occurs in one molecular orientation. He hopes to harness his motor to fight the friction that slows fluid flow in nanosized tubes. Melissae Fellet ■

Nano-propeller

Butyl methyl sulphide converts electricity into rotational energy

● Sulphur ● Carbon ● Hydrogen



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Anglo-Saxons and Scots

REACH OUT

YEAR 4

SPRING ONE

NAME:

CLASS:

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Where's the evidence?

We have lots of written evidence of what life was like during Roman Britain, because the Romans were so good at keeping written records. However, after the Romans left Britain in around 410 CE we don't have much writing from England. We know that lots of people invaded England and there was lots of fighting, but the facts aren't clear.

(People re-enacting what Anglo-Saxons people might have looked like.)

Sometimes this period is called the **Dark Ages** because historians find it difficult to be really sure about events that took place. Although we don't much writing, we do have some archaeological evidence – **artefacts** and buildings that have been **excavated**. For example, in 2010, a huge collection of treasure from this time was discovered: **the Staffordshire Hoard**.

(Source: Shropshire Star)

1. **Which of these statements more accurately describes our understanding of Anglo-Saxon times?**

☐ ***Historians know lots about Anglo-Saxon Britain because there are so many books from the period.***

☐ ***Historians aren't sure about life in Anglo-Saxon Britain because there isn't much written evidence.***

Very few people would have been able to read and write at this time, and historians think that Britons were not very organised after the Romans left. What we do know is that this seems to have been a very bloody and violent time, with lots of fighting. They must had got so used to the Romans being in charge and running everything!

2. What do you think school would be like if one day all of the teachers went home, and the children were left by themselves?

Gildas the Wise

One of the people who did write about life in England was called Gildas, who was a monk. He was born about a hundred years after the Romans left, in about 500 CE. was sometimes known as Gildas *Sapiens* (or Gildas the Wise). He wrote a book

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Britain in the fifth century

The Romans had a special word for anyone who wasn't a member of the Roman Empire; they called them **barbarians** (or strangers). In the fourth century, the Romans Empire was being attacked by **barbarian** tribes all over Europe: The Goths, the Vandals, the Huns, the Franks and the Saxons. Perhaps most famous of these is **Attila the Hun**, who is pictured below. Attila invaded Roman cities and defeated Roman armies all over Europe.

The **barbarian** attacks led to the end of the Roman Empire, which had become too big to defend itself. From 383 CE to 410 CE, the Roman leaders and armies left Britain forever.

There will still people left in Britain, of course. The Celts, who had lived in Britain before the Romans arrived, became known as Romano-Britons or just '**Britons**'. People living in what we now call Scotland were called the **Picts** at this time. In Ireland, there were people called the **Scots** (who would go on to invade and settle in what we call **Scot**land today).

1. Read the last paragraph again. Can you label the map of Great Britain above to show where the 'Scots', 'Picts' and 'Britons' lived?

The invasions begin

With the Romans gone, the Britons were very vulnerable to attack. The Scots would cross the Irish sea and raid Wales and the west of England. The Picts would attack from the north and raid the northern English towns.

2. Add arrows to the map above to show these invasions.

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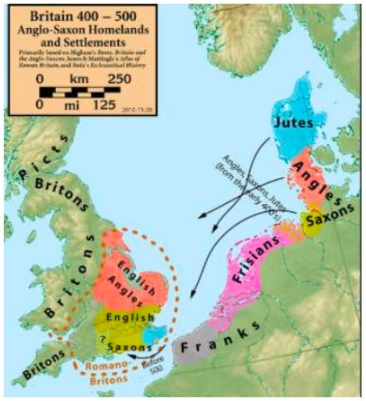
The Britons couldn't fight back effectively against the Scots or the Picts. They needed help. Just across the North Sea in Europe, there were three barbarian tribes who were very effective fighters: the Jutes, the Angles and the Saxons. Bede and Gildas both wrote that an English Chief called **Vortigern** (Vortigern actually means Great Chief) invited these tribes to England to help them fight against the Scots and Picts. In return the British paid tribes gold, and gave them land in the south and east of England. Many people in these tribes wanted to move to Britain anyway, because there was not much farmland where they lived.

3. Can you match these people with the areas that they came from?

Area	People
Jutland	Saxons
Angeln	Jutes
Saxony	Angles



The Saxons could see that the British were not good fighters, and used this to their advantage, taking more land and demanding more money from **Vortigern**. Two famous brothers called **Hengist** and **Horsa** led a Saxon army against the Brits. Gildas reported that this was a very violent time, with entire villages being burnt down by the Saxons. The Angles and the Saxons (or Anglo-Saxons) took complete control of the east of England, whilst the Britons stayed in the west.

4. Why did the British welcome the invaders from Jutland, Angeln and Saxony?

One British chief did try to fight back against the Saxons after they started taking so much land. **Ambrosius Aurelianus**, whose parents had been killed by the Saxon invaders, led a group of British in a **rebellion**. Legends say that Aurelianus was the nephew of King Arthur, but there are no records in the three main written texts that Arthur actually existed. At the **Battle of Badon Hill**, the Saxon army was defeated. However, it was only one victory, and over the next few centuries the Anglo-Saxons took more and more land.

This is why the east of the country today is called East **Angl**ia, and our whole country is called England, (Angle-land). Other towns and cities today still have Anglo-Saxon names.

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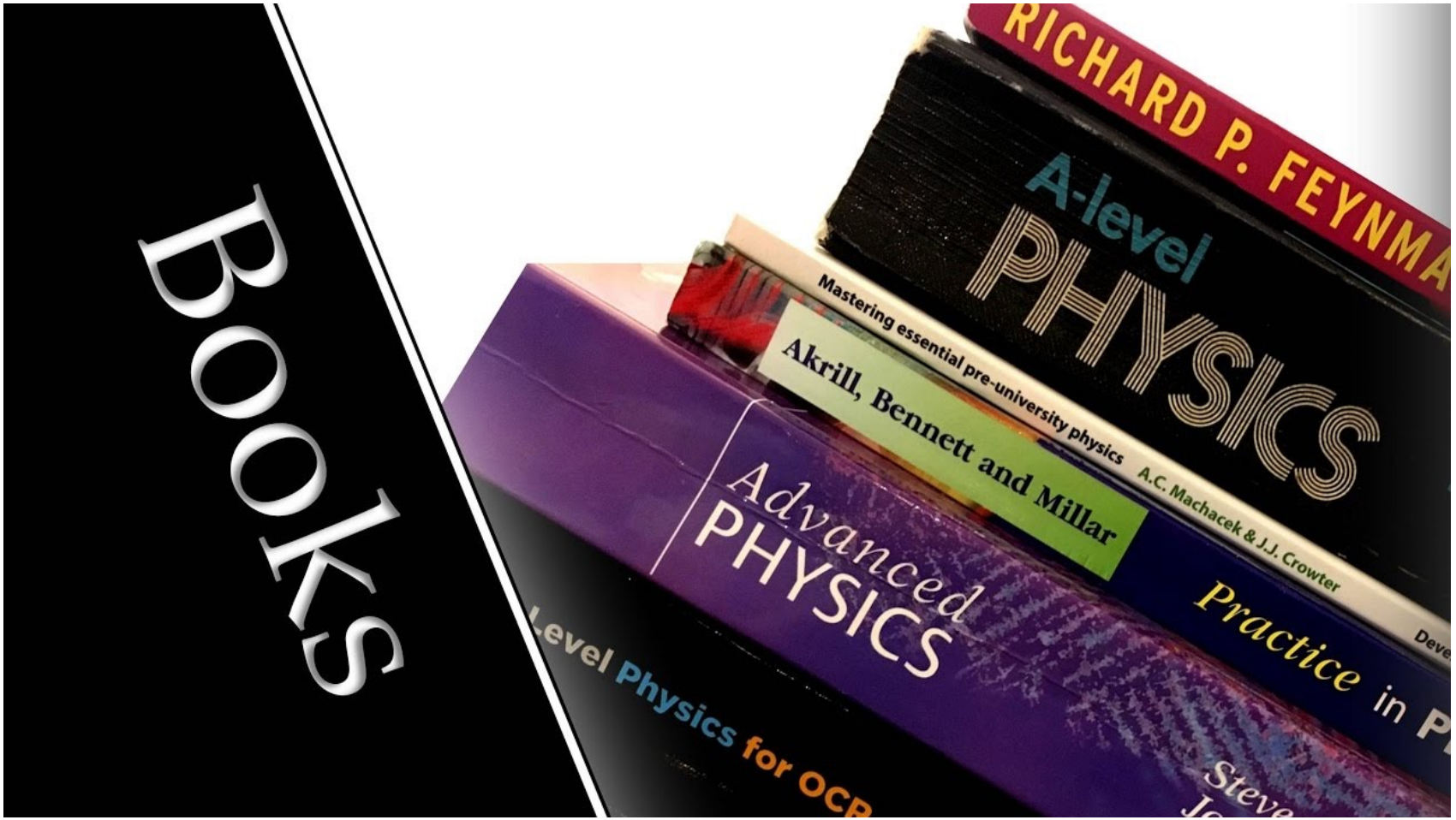
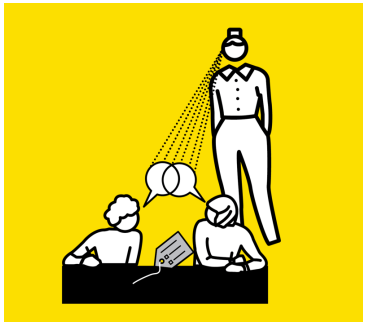
Provide Excellent Resources:



DELIBERATE VOCABULARY DEVELOPMENT

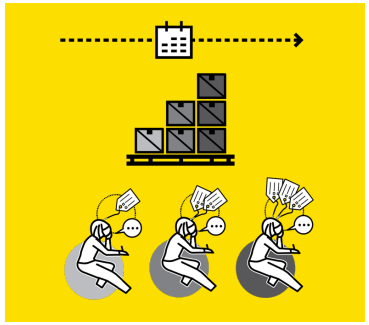
1 2 3 4 5

SPECIFY AND DEFINE THE WORDS

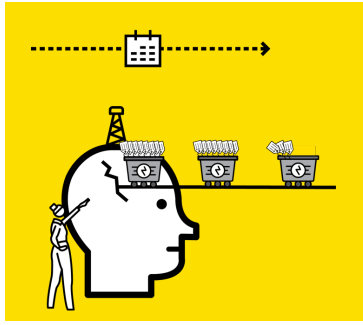


SAY THE WORDS

READ WORDS IN CONTEXT



PRACTISE USING THE WORDS VERBALLY AND IN WRITING



ENGAGE IN WORD-BASED RETRIEVAL PRACTICE

TEACHING WALKTHRUS

SERIES EXPLAINING & MODELLING

A|D|A|P|T

Vocab Test

Build the words

- Stercoraceous
- Sesquipedalian
- Defervesence
- Eucatastrophe
- Commensalism
- Prosopagnosia

Words in context

In a panic about his prosopagnosia, Tom scanned the room. He drew a blank as usual. Thank goodness; he could feel the defervesence after having eaten that stercoraceous porridge for breakfast.

He hoped for a degree of commensalism between himself and the audience - despite his habitual sesquipedalian delivery - and the usual eucatastrophe as he delivered the punchline. Laughter. Relief. It was over.

Word	Meaning
Stercoraceous	consisting of or resembling dung or faeces.
Sesquipedalian	characterised by long words; long-winded.
Defervesence	the abatement of a fever (cease boiling)
Eucatastrophe	a sudden and favourable resolution; a happy ending.
Commensalism	two organisms; one benefits; the other derives neither benefit or harm
Prosopagnosia	inability to recognise faces of familiar people.

Word	Meaning
	consisting of or resembling dung or faeces.
Sesquipedalian	
	the abatement of a fever (cease boiling)
Eucatastrophe	a sudden and favourable resolution; a happy ending.
Commensalism	
	inability to recognise faces of familiar people.

Which is correct?

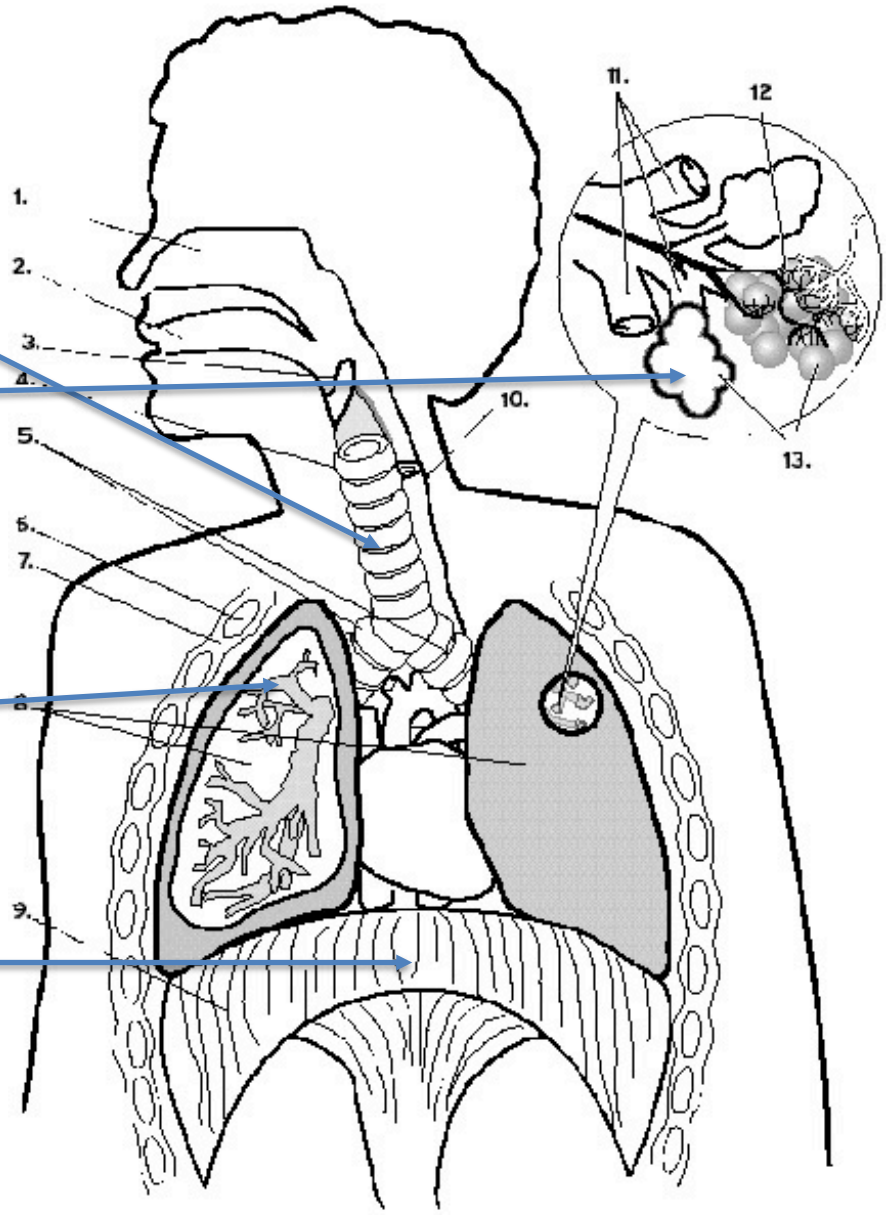
A. Sesquipedalian people are in their 70s.
B. The man felt sesquipedalian after his operation.
C. John was a rather sesquipedalian speaker; his audiences would sometime lose focus.
D. The speech was full of sesquipelalian facts that didn't support her main argument.

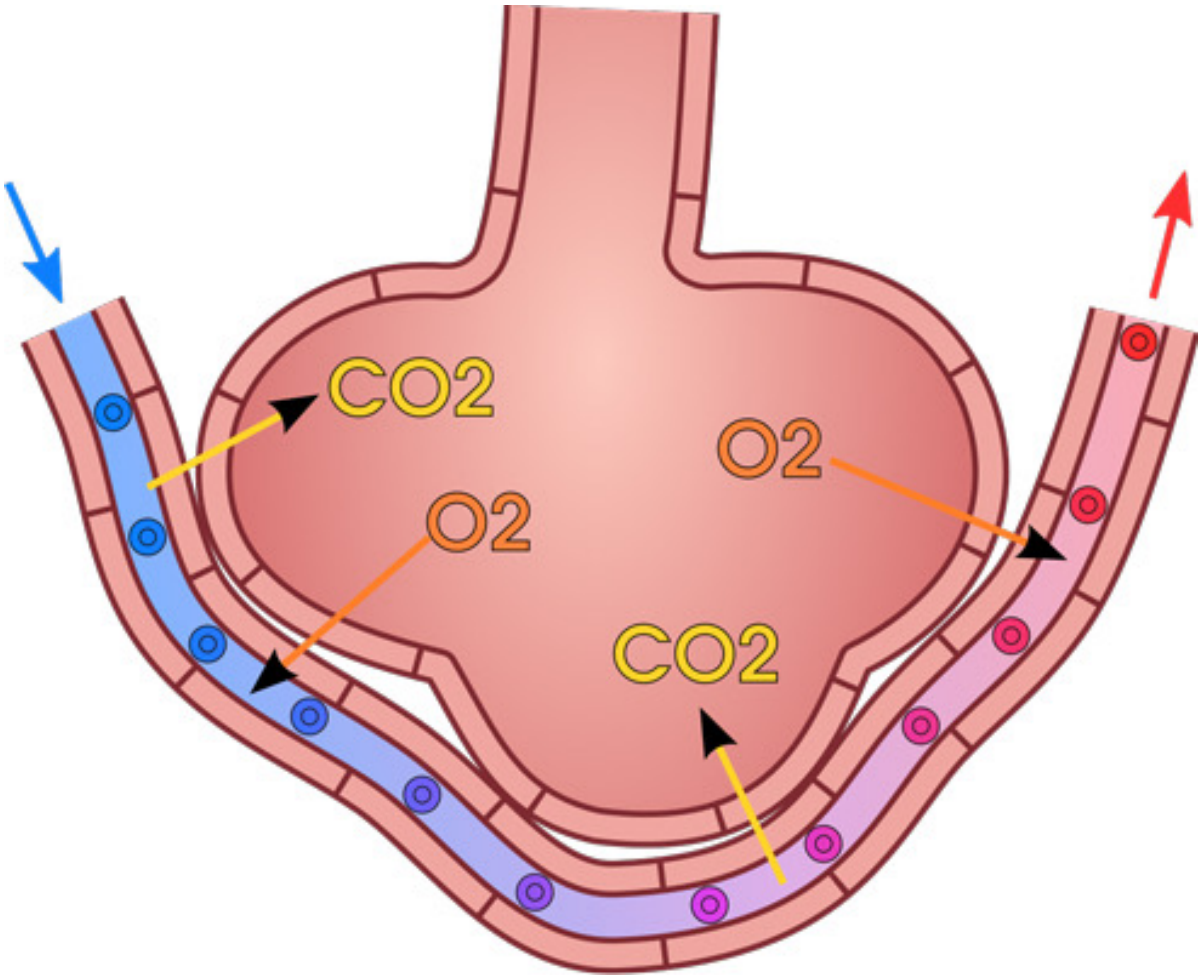
Trachea

Alveolus

Bronchiole

Diaphragm




CO2
O2
O2
CO2

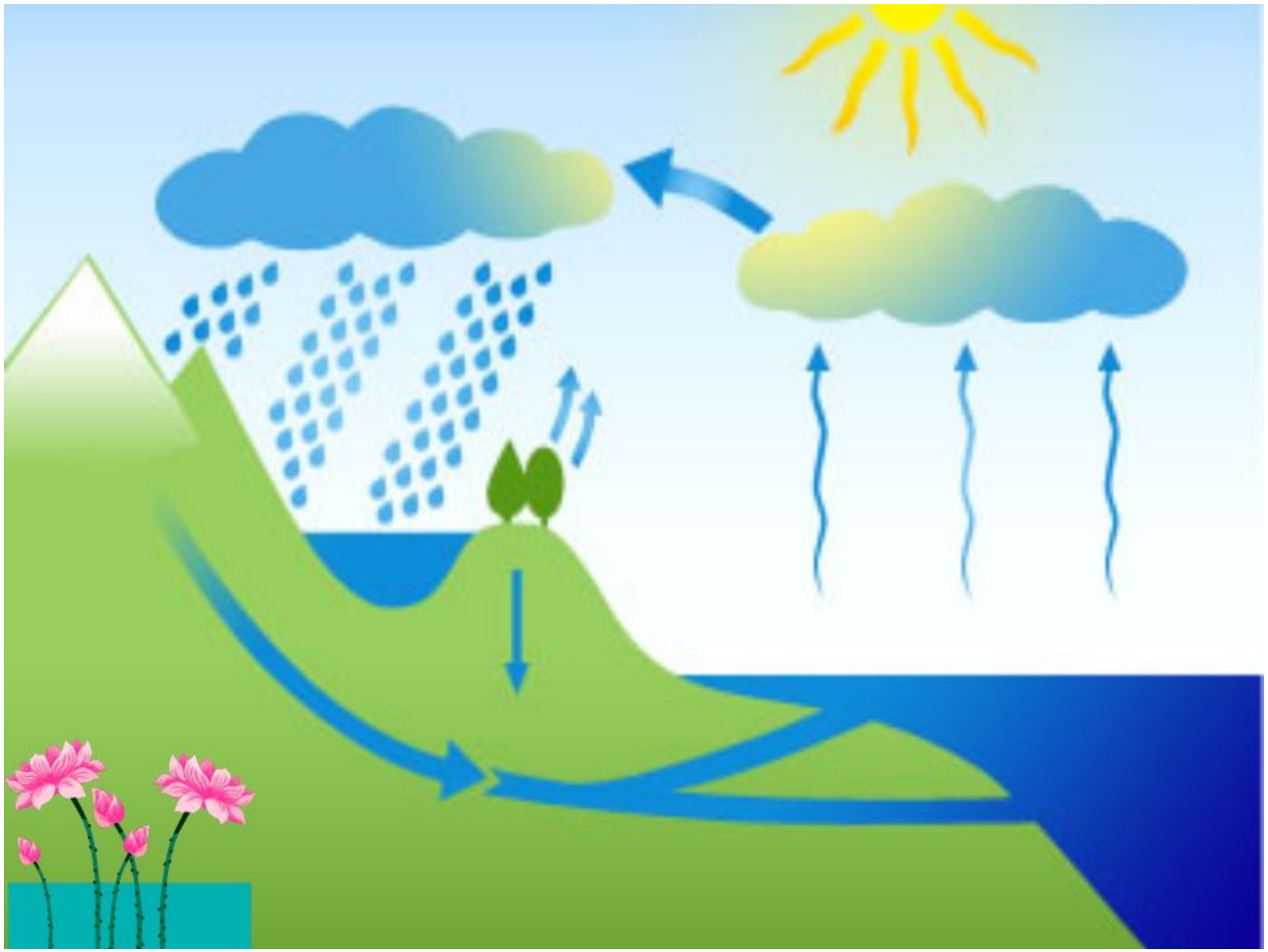
Key concepts

- Capillary – small, bring blood close to surface
- Oxygen from air – needed for respiration
- Carbon dioxide – waste product of respiration
- Diffusion (high conc to low conc)
- Large surface area; gas exchange
- Deoxygenated; oxygenated

French:
Specific phrases to be learned:

French	English

Summarise the process: “Tell the story”
Harness narrative structures.



Key Words

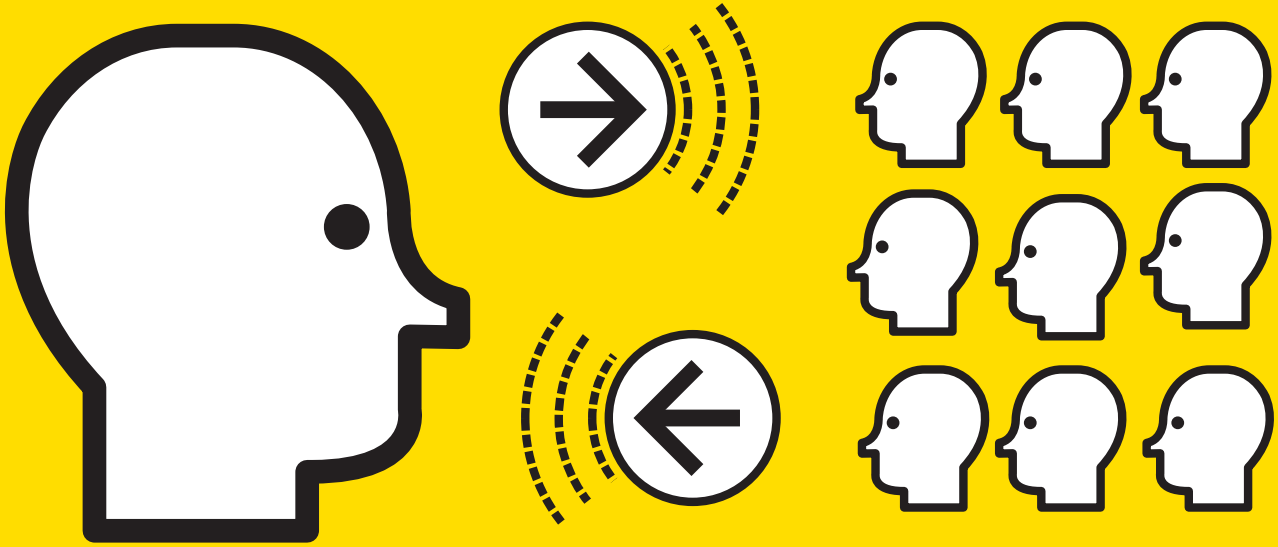
Evaporation
Convection
Condensation
Precipitation
Energy
Warm/Cool
Flow
Vapour
Fall/rise

Thank you.

Tom Sherrington
@teacherhead

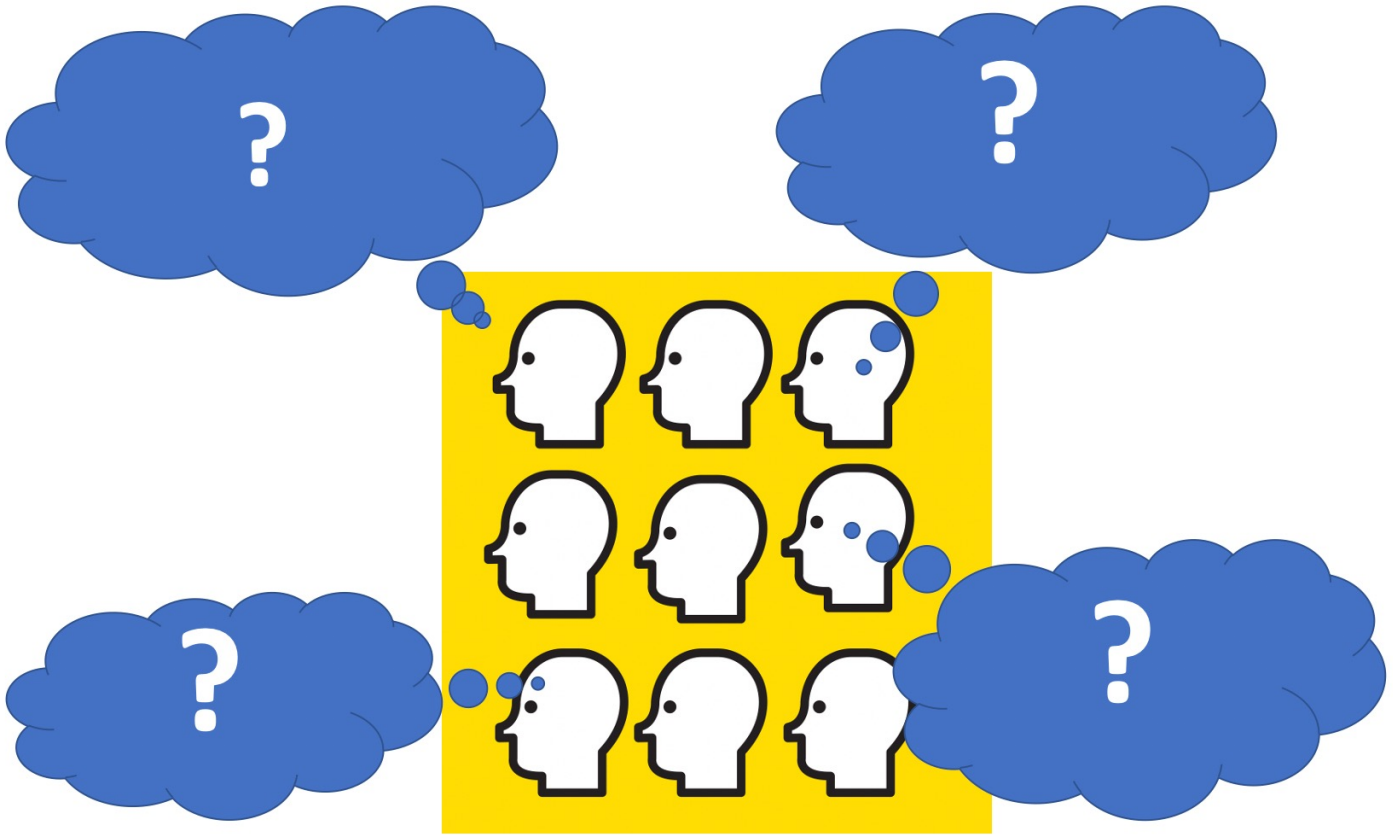
teacherhead.com

MESSAGE SENT



MESSAGE RECEIVED?

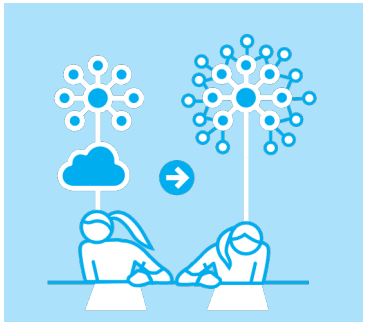
Is everyone thinking?



MAKE EVERYONE THINK

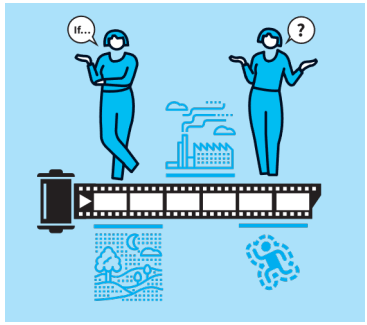
1 2 3 4 5

ACTIVATE PRIOR KNOWLEDGE

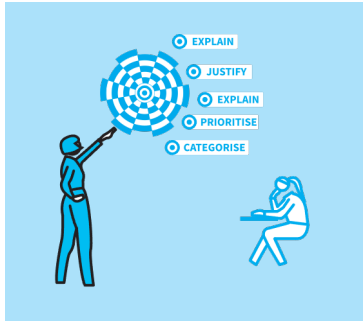


STIMULATE SCHEMA-BUILDING

SYSTEMATICALLY INVOLVE ALL STUDENTS



USE NARRATIVES AND CONFLICTS



EMBED THINKING GOALS WITHIN TASK GOALS

TEACHING WALKTHRUS
SERIES
PRACTICE & RETRIEVAL
A|D|A|P|T

- A central idea about learning in Willingham's *Why Don't Students Like School?*, is that memory is the residue of thought.
- He suggests teachers should review lessons by considering what students will think about as this is what they will be learning.
- It requires routines that involve all students, requiring them all to think, activating their prior knowledge, deliberately connecting new ideas to what they already know.

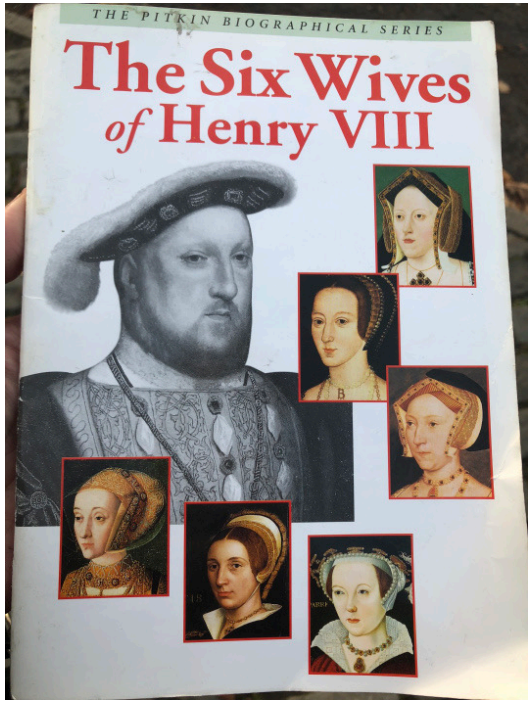
MAKE EVERYONE THINK

1 2 3 4 5

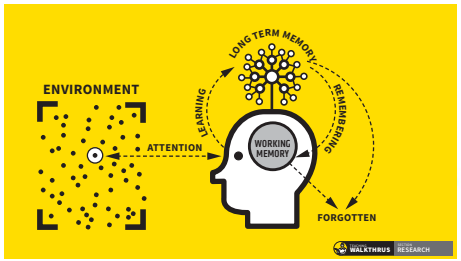
ACTIVATE PRIOR KNOWLEDGE

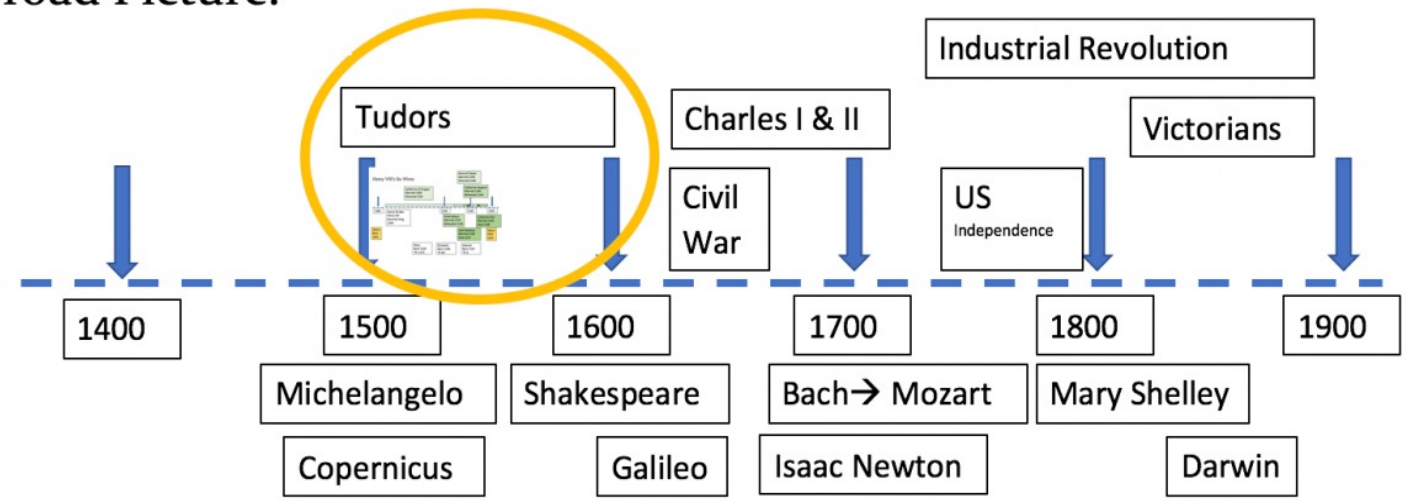
- Begin a learning sequence or lesson by engaging all students in activating their prior knowledge.
- Give everyone a question, problem or task that stimulates thinking about prior knowledge:
  - A question exactly like those covered in the previous lesson.
  - A generative task – e.g. to recall advantages and disadvantages or summarise the key learning points from the previous topic.

Catherine of Aragon
Anne Boleyn
Jane Seymour
Anne of Cleves
Catherine Howard
Catherine Parr



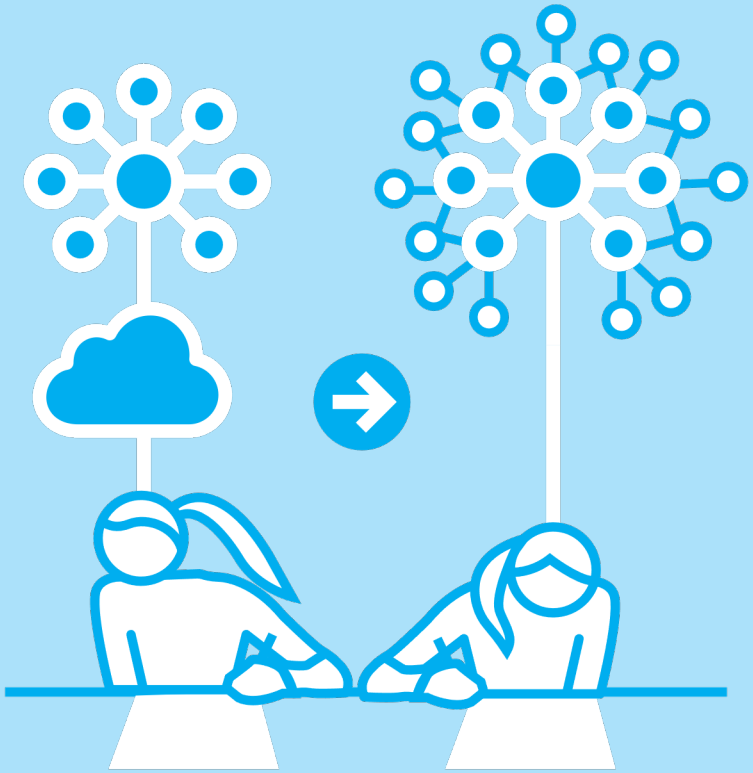
Broad Picture.





	Catherine of Aragon	Anne Boleyn	Jane Seymour	Anne of Cleves	Catherine Howard	Catherine Parr
Years as Henry's Wife	1509 – 1533	1533-36	1536-37	1540 Six Months	1540-42	1543 until his death in 1548.
How known to Henry	Married to his brother 1501	Courtier. Consorted with Henry 1526-32	Lady-in-waiting to her predecessors.	Met just before marriage. Arranged for alliance building	Anne of Cleves' Lady in Waiting	Known to family. Friend of Mary.
Heirs?	Mary Later Queen No male heir.	Elizabeth Later Queen	Edward Later King	No	No	No
What Happened	**Divorced** so H could marry AB. Henry changed law so divorce not blocked by Pope.	**Beheaded** Tower of London	**Died** with childbed fever.	**Divorced.** Marriage annulled after six months.	**Beheaded**	**Survived** Henry Died a year later in Childbirth with new marriage.
Significant information	Catholic From Spain Daughter of Ferdinand and Isabella. 'Pious' Divorce was origin of separation from Rome leading path to England as Protestant state	From Norfolk European Education Miscarriages Accused and sentenced for treason and adultery.	Henry 'grief stricken'. Then not married for over two years.	From Germany A Protestant state. Strategic marriage but a disaster Thomas Cromwell blamed for arranging it - amongst other things - and was also beheaded.	Found to have had affairs before marrying Henry and during marriage. Henry 'wept with rage and self-pity'	Cared for Elizabeth and Edward. Later married Thomas Seymour, Jane's brother. Had child with Thomas but died with child-bed fever.

MAKE EVERYONE THINK

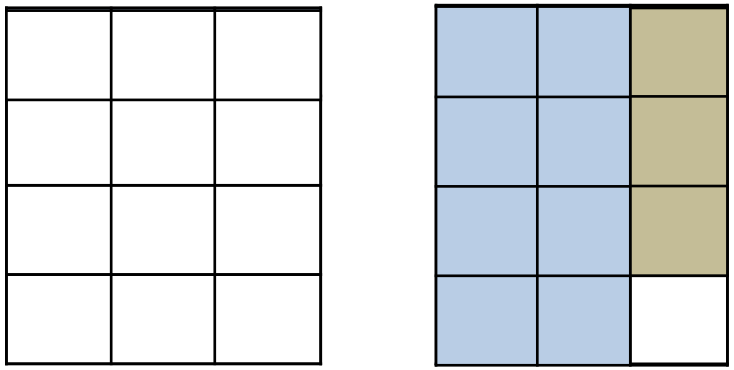


STIMULATE SCHEMA-BUILDING

- Design tasks so students bridge from what they know to new knowledge.
- Embed elements of generative recall so students can't just follow instructions blindly or copy from prompts.
- Inject complexity by requiring students to use the 3Cs, generate patterns, give explanations, justify choices, rehearse language elements, use explanatory mental models or give further examples.

Practise all the steps

$$\frac{1}{4} + \frac{2}{3} = ?$$



$$\frac{3}{12} + \frac{8}{12} = \frac{11}{12}$$

Model for each fraction. What does each one mean?

Terminology: Numerator, denominator

Which fractions can we add directly ?

Concept of multiples, finding lowest common multiples.

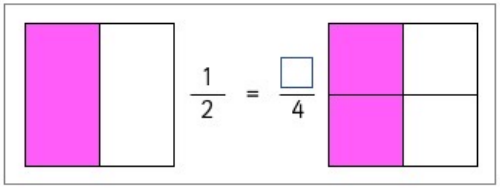
Finding a common denominator

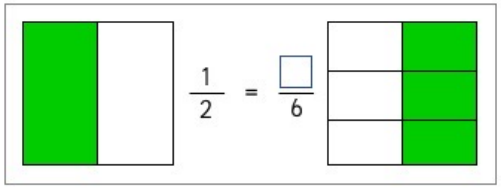
Scaling up numerator to keep fraction same size

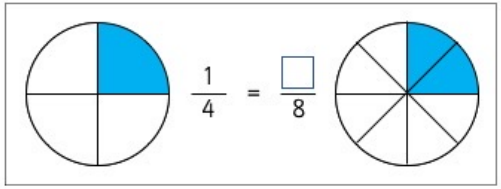
Adding fractions with same denominator.

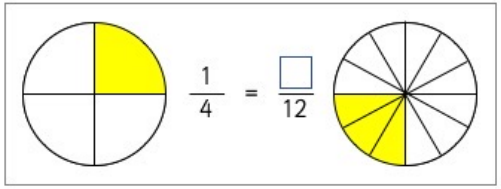
Check against the model

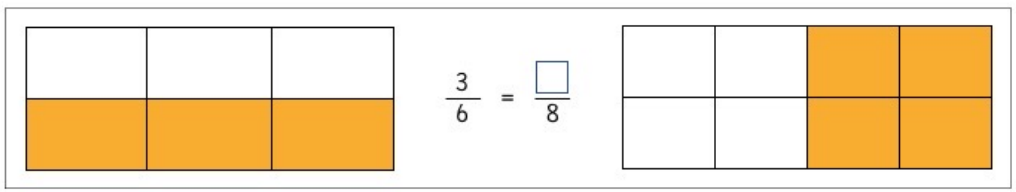
Write an equivalent fraction for each of these:

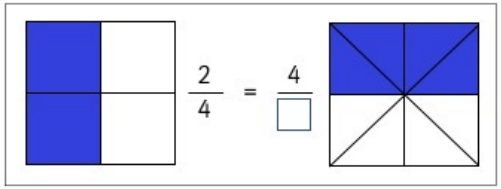


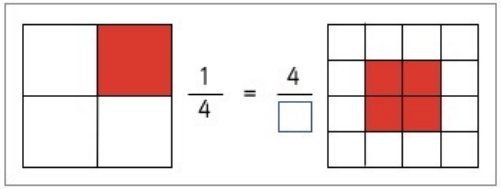


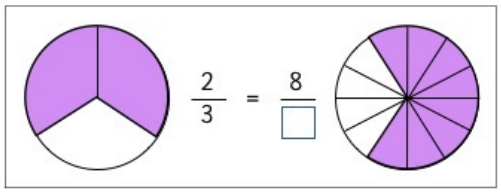


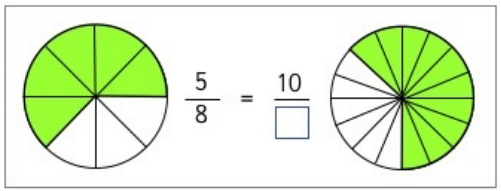


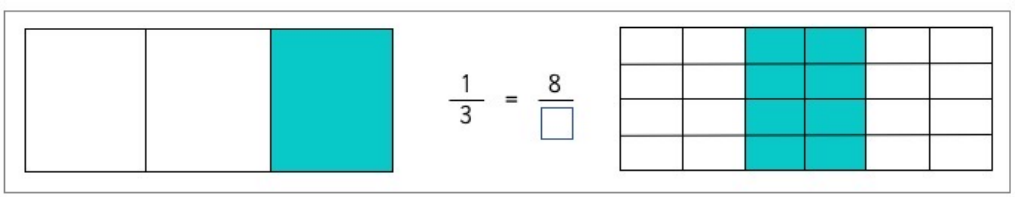




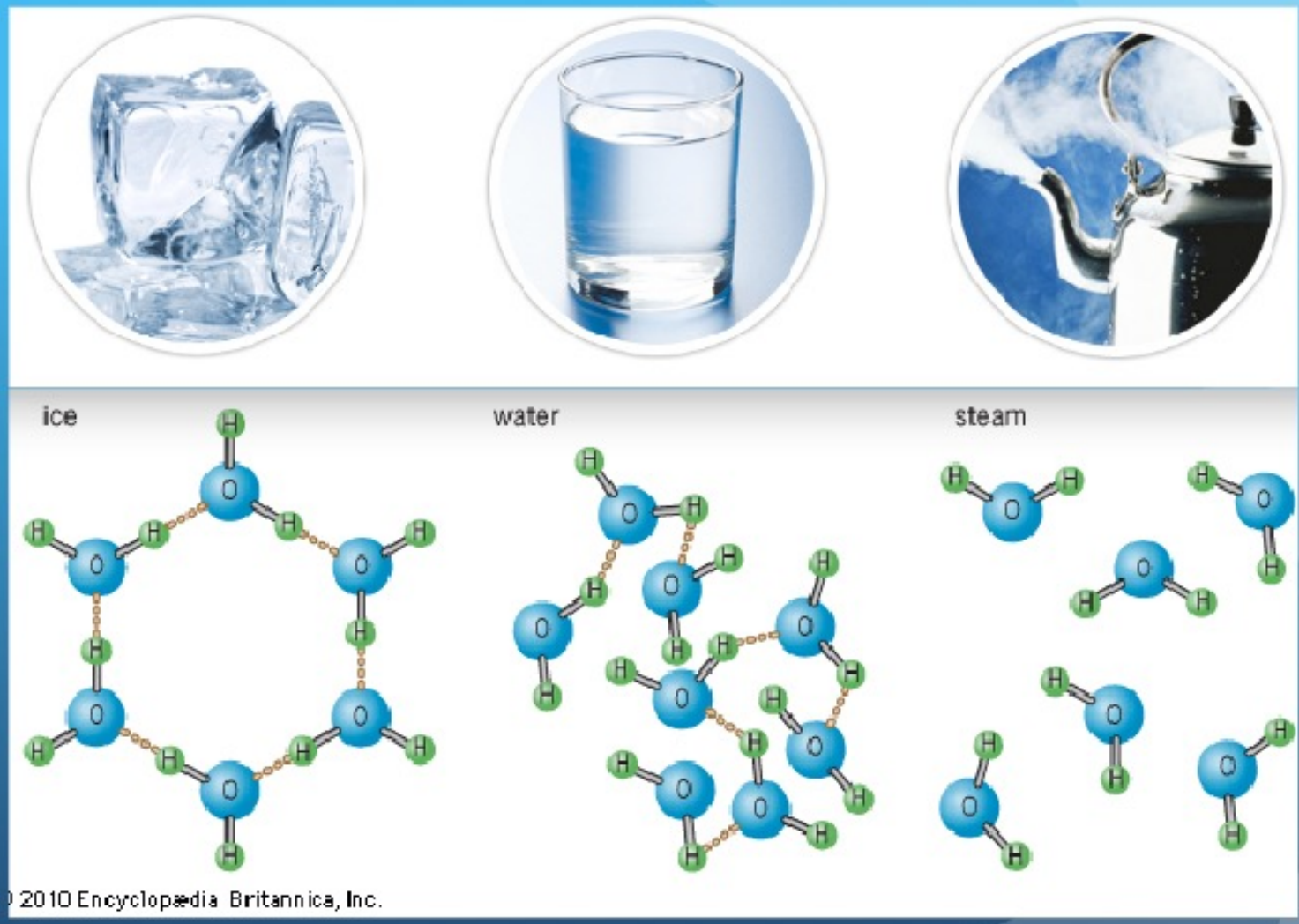








.walkthrus.co.uk


ice
water
steam
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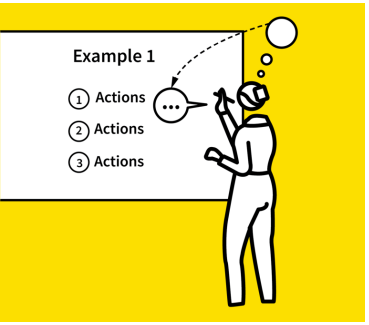
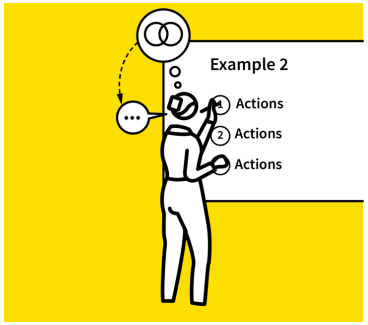
WORKED EXAMPLES & BACKWARD FADING

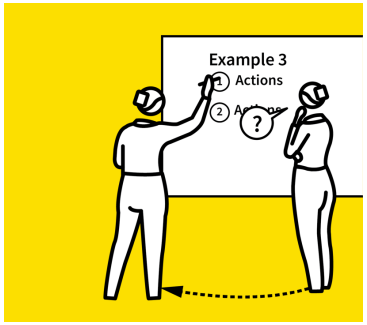
1 2 3 4 5



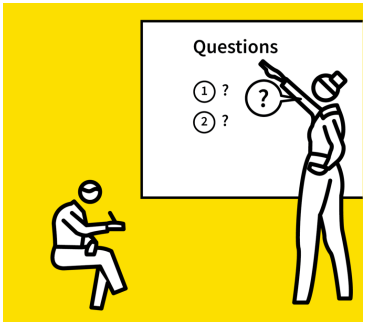
FULLY WORKED TO INTRODUCE THE METHOD OR IDEAS



FULLY WORKED FOR REINFORCEMENT



PARTIALLY WORKED FOR STUDENTS TO FINISH OFF



CUED START FOR STUDENT COMPLETION

COMPLETED INDEPENDENTLY

TEACHING WALKTHRUS
SERIES
EXPLAINING & MODELLING
A|D|A|P|T

- Cognitive Load Theory suggests novices learn more successfully studying complete worked examples than if asked to problem-solve independently.
- Cognitive load is reduced if we learn the overall method separately from trying to apply it.
- Often teachers do not model sufficient worked examples.
- Backward fading is good for moving from guided to independent practice.

Worked Examples

18% of $65

$\frac{18}{100}$ x 65

= 0.18 x 65

= $11.70

37% of $120

$\frac{37}{100}$ x 120

= 0.37 x 120

= $44.40

68% of $1050

$\frac{68}{100}$ x 1050

= 0.68 x 1050

= $714.00

Frankie: annotations

Piece A: Short story	Key
Prior to writing a short story set during World War 1, pupils wrote these short pieces to practise their skills in developing suspense and building tension in a familiar, everyday situation.	[C] composition [GP] grammar and punctuation [T] transcription

These 2 short pieces describe a midnight fridge-raid from contrasting third and first person perspectives, demonstrating confident control over language, sentence structures that are carefully chosen for effect and precise vocabulary choice.

A tense atmosphere is created across both paragraphs through the use of short sentences and phrases, and apt vocabulary choices (*darted, grabbed, bolted*). This is lightened by juxtaposing humour with tension (*distant snoring; his heart raced*) and the succinct integration of dialogue (*"Ewan!"*) as the climax to the first paragraph.

A range of cohesive devices links ideas

Opening the Fridge

Slowly, Ewan peeped through the crack in his door. All was black. He took a step out. He could hear distant snoring as he ~~creeped~~ crept across the landing.

As his heart raced he stared into the darkness; he could hear the fridge urging him on – willing him to move. Now the stairs. The tricky bit. Suddenly a THUD!... He raced down the creaking stairs – even the seventh one that makes an earsplitting ~~noise~~ creak. He could see the re white rectangle straight ahead of him. Then he opened it.

A series of short phrases in quick succession creates a sense of urgency and excitement, echoing Ewan's thoughts as he sneaks downstairs. The structure of the scene and the language employed mirror that from scenes in adventure or ghost narratives, applied here to a more humorous context.
[GP]

The selection of verb forms – past and present tense – distinguish between the past tense narrative and the current state of the seventh stair, placing the reader at the heart of the action.
[GP]

All of a sudden, the door flew open. It was Dad.

All of a sudden, the train stopped. She gripped her seat.

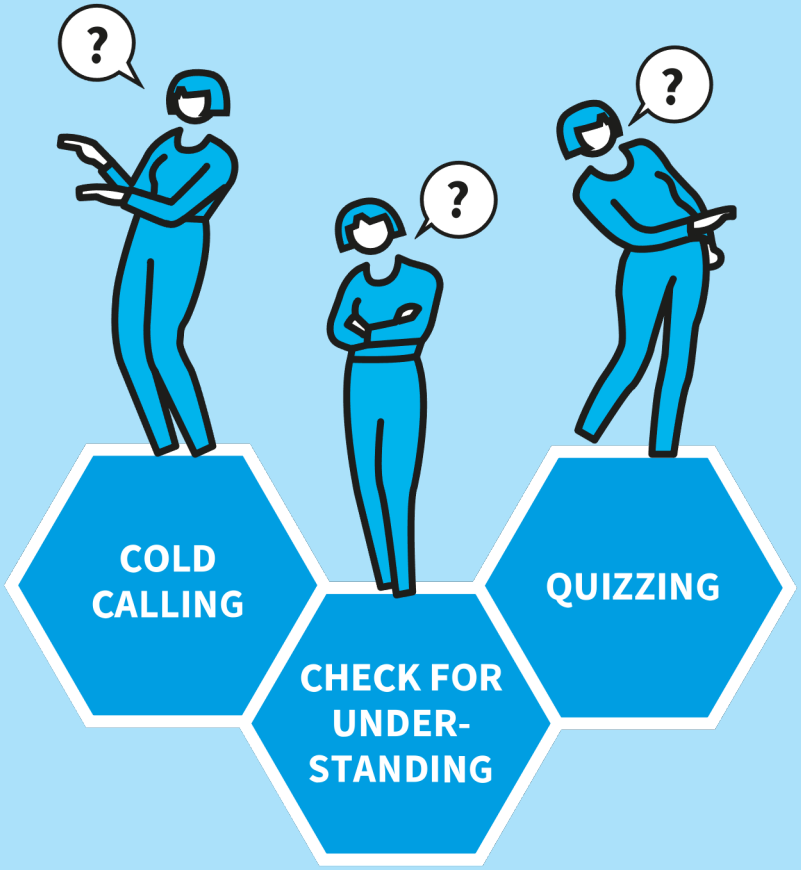
All of a sudden, it poured with rain. They ran for cover.

All of a sudden, the lawn-mower exploded. _____

All of a sudden, _____. _____

MAKE EVERYONE THINK

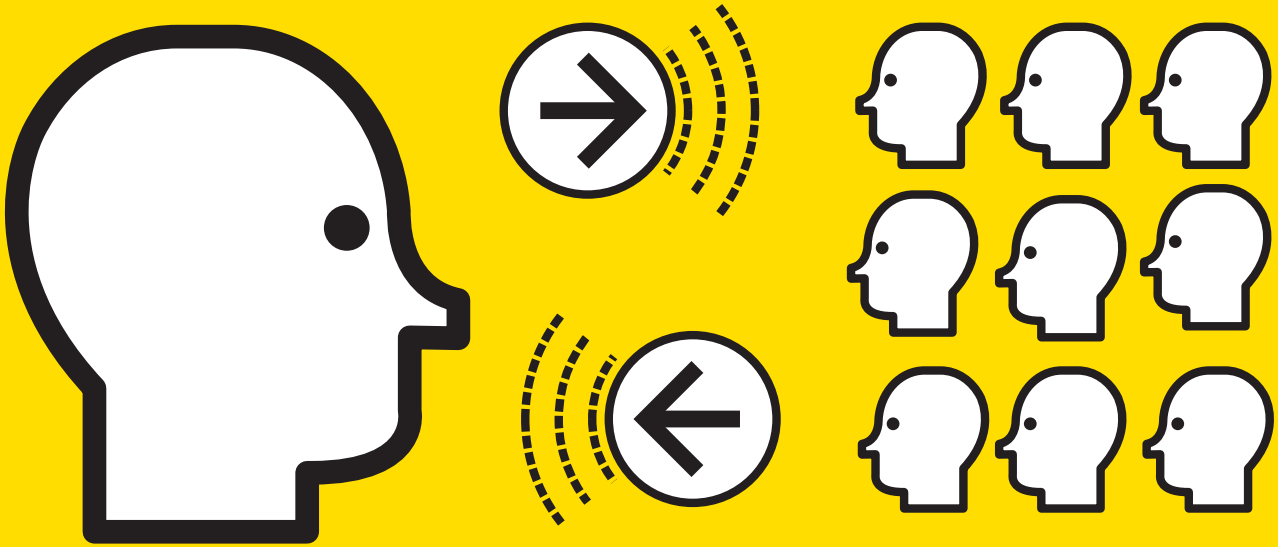
1 2 3 4 5



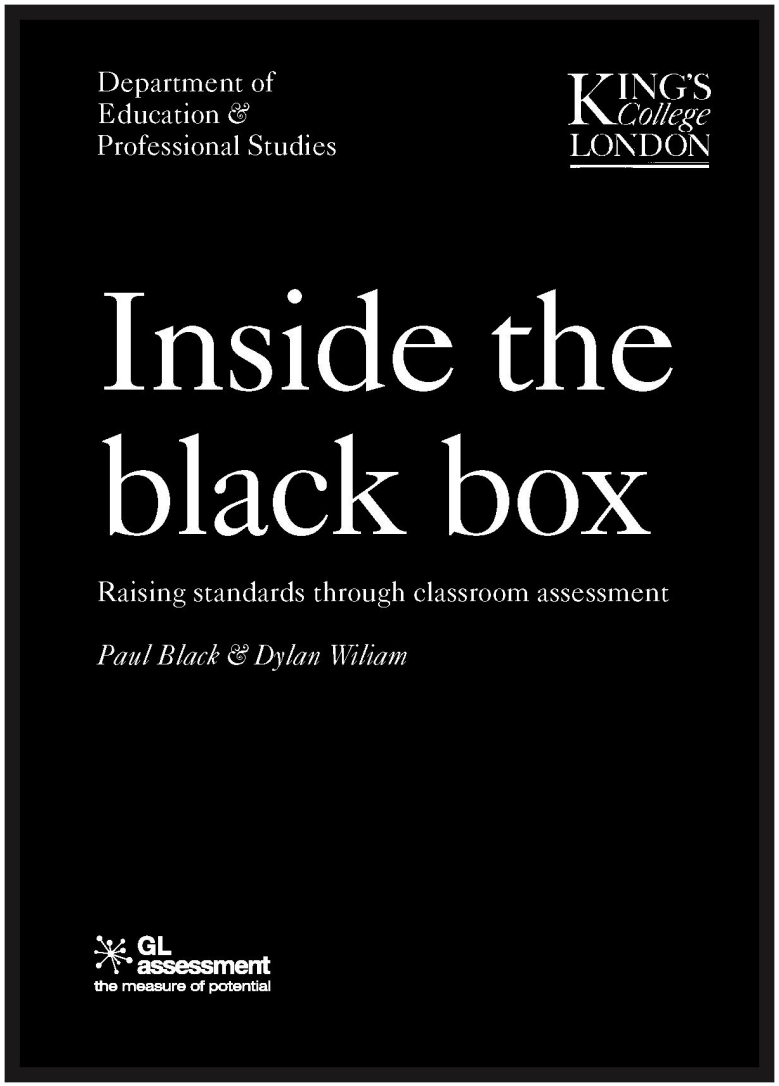
SYSTEMATICALLY INVOLVE ALL STUDENTS

- Ensure routines involve every student:
  - **Cold Calling:** so every student expects to think of answers
  - **Check for Understanding:** students expect to explain their thinking.
  - Ensure any group task requires each student to demonstrate their understanding as part of the activity.
  - Conduct retrieval activities so all students answer all the questions.

MESSAGE SENT



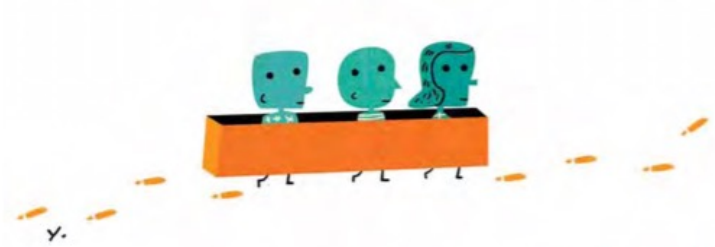
MESSAGE RECEIVED?



"The teacher, by lowering the level of questions and by accepting answers from a few, can keep the lesson going but is ***out of touch with the understanding of most of the class***.."

Principles of Instruction

Research-Based Strategies That All Teachers Should Know



By Barak Rosenshine

This article presents 10 research-based principles of instruction, along with suggestions for classroom practice. These principles come from three sources: (a) research in cognitive science, (b) research on master teachers, and (c) research on cognitive supports. Each is briefly explained below.

A: Research in cognitive science: This research focuses on how our brains acquire and use information. This cognitive research also provides suggestions on how we might overcome the limitations of our working memory (i.e., the mental "space" in which thinking occurs) when learning new material.

B: Research on the classroom practices of master teachers: Master teachers are those teachers whose classrooms made the highest gains on achievement tests. In a series of studies, a wide range of teachers were observed as they taught, and the investigators coded how they presented new material, how and whether they checked for student understanding, the types of support they provided to their students, and a number of other instructional activities. By also gathering student achievement data, researchers were able to identify the ways in which the more and less effective teachers differed.

C: Research on cognitive supports to help students learn complex tasks: Effective instructional procedures—such as thinking aloud, providing students with scaffolds, and providing students with models—come from this research.

Barak Rosenshine is an emeritus professor of educational psychology in the College of Education at the University of Illinois at Urbana-Champaign. A distinguished researcher, he has spent much of the past four decades identifying the hallmarks of effective teaching. He began his career as a high school history teacher in the Chicago public schools. This article is adapted with permission from Principles of Instruction *by Barak Rosenshine. Published by the International Academy of Education in 2010, the original report is available at www.ibe.unesco.org/fileadmin/user_upload/Publications/Educational_Practices/EdPractices_21.pdf.*

ILLUSTRATIONS BY JAMES YANG

Even though these are three very different bodies of research, there is *no conflict at all* between the instructional suggestions that come from each of these three sources. In other words, these three sources supplement and complement each other. The fact that the instructional ideas from three different sources supplement and complement each other gives us faith in the validity of these findings.

Education involves helping a novice develop strong, readily accessible background knowledge. It's important that background knowledge be readily accessible, and this occurs when knowledge is well rehearsed and tied to other knowledge. The most effective teachers ensured that their students efficiently acquired, rehearsed, and connected background knowledge by providing a good deal of instructional support. They provided this support by teaching new material in manageable amounts, modeling, guiding student practice, helping students when they made errors, and providing for sufficient practice and review. Many of these teachers also went on to experiential, hands-on activities, but they always did the experiential activities *after*, not before, the basic material was learned.

The following is a list of some of the instructional principles that have come from these three sources. These ideas will be described and discussed in this article:

- Begin a lesson with a short review of previous learning.[1]
- Present new material in small steps with student practice after each step.[2]
- Ask a large number of questions and check the responses of all students.[3]
- Provide models.[4]
- Guide student practice.[5]
- Check for student understanding.[6]
- Obtain a high success rate.[7]
- Provide scaffolds for difficult tasks.[8]
- Require and monitor independent practice.[9]
- Engage students in weekly and monthly review.[10]

More effective teachers frequently checked to see if all students were learning the new material.

This has two purposes:

a) answering the questions might cause students to elaborate on material they have learned and augment connections to other learning in their LTM

b) alerting the teacher to when part of material need to be retaught.

Check for understanding

Have you understood?

What have you understood?

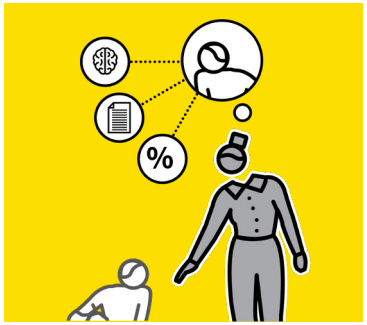
Q&F | 92
THINK, PAIR, SHARE
TEACHING WALKTHRUS
Q&F | 90
COLD CALLING
TEACHING WALKTHRUS
Q&F | 96
CHECK FOR UNDERSTANDING
TEACHING WALKTHRUS
Q&F | 98
SAY IT AGAIN BETTER
TEACHING WALKTHRUS
Q&F | 102
PROCESS QUESTIONS
TEACHING WALKTHRUS
Q&F | 100
PROBING QUESTIONS
TEACHING WALKTHRUS

COLD CALLING

1 2 3 4 5

ASK THE CLASS THE QUESTION

GIVE THINKING TIME



SELECT SOMEONE TO RESPOND

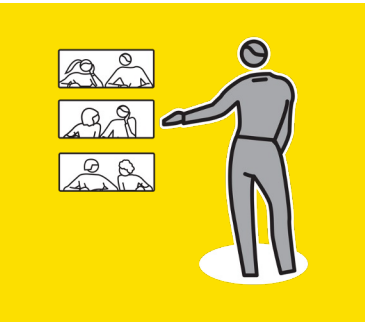
RESPOND TO THE ANSWERS

SELECT ANOTHER STUDENT AND RESPOND AGAIN

TEACHING WALKTHRUS
SERIES
QUESTIONING & FEEDBACK
A|D|A|P|T

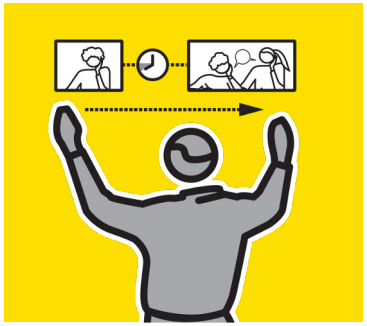
THINK, PAIR, SHARE

1 2 3 4 5



ESTABLISH TALK PARTNERS FOR EVERY STUDENT

SET THE QUESTION WITH A GOAL AND A TIMEFRAME



BUILD IN THINKING TIME

CIRCULATE TO LISTEN AS PAIRS ARE TALKING

USE COLD CALL TO SAMPLE PAIRS' RESPONSES

TEACHING WALKTHRUS
SERIES
QUESTIONING & FEEDBACK
A|D|A|P|T

METACOGNITION AND SELF-REGULATED LEARNING

Guidance Report

Education Endowment Foundation

4

Set an appropriate level of challenge to develop pupils' self-regulation and metacognition

5

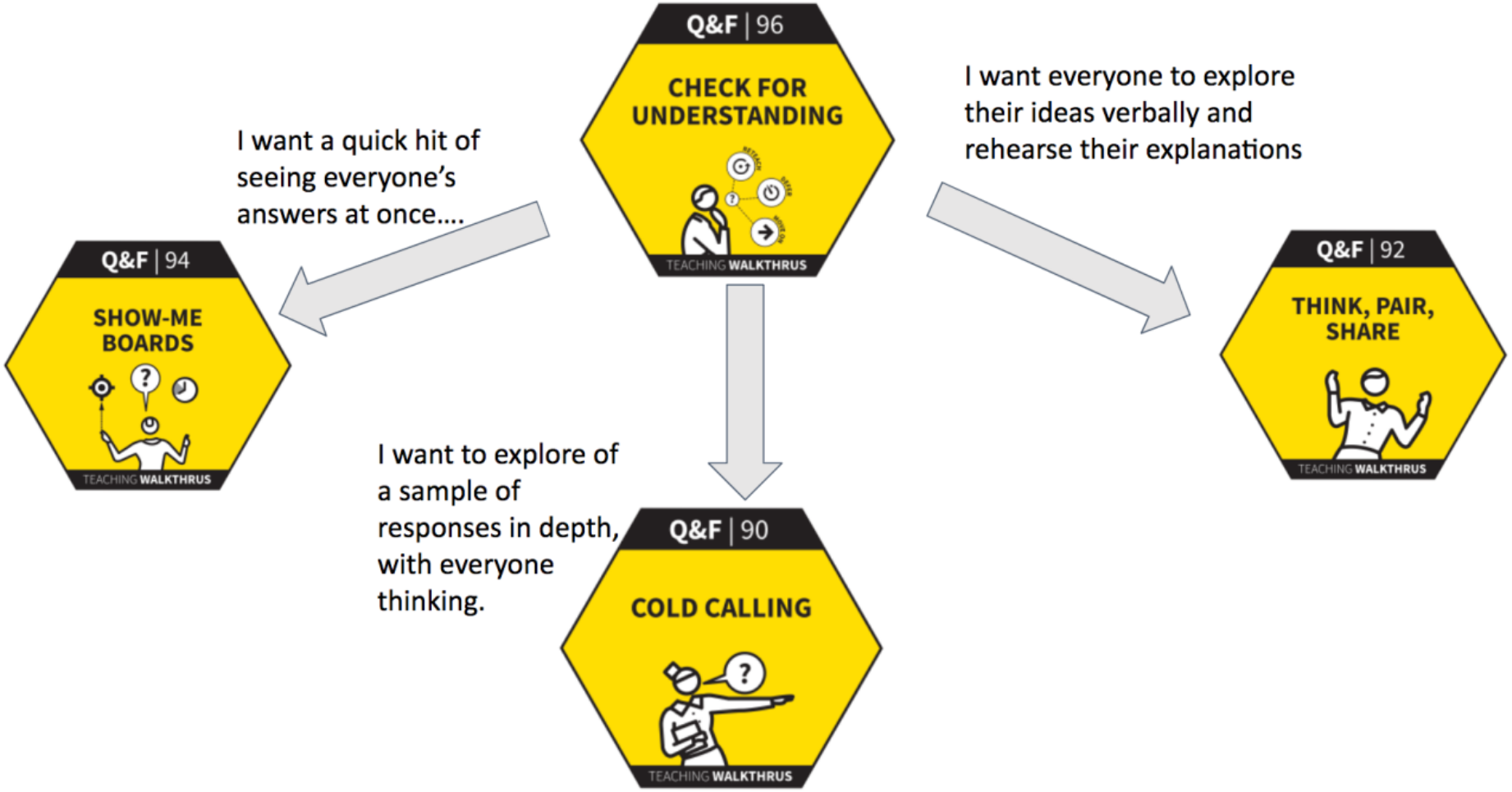
Promote and develop metacognitive talk in the classroom

6

Explicitly teach pupils how to organise and effectively manage their learning independently

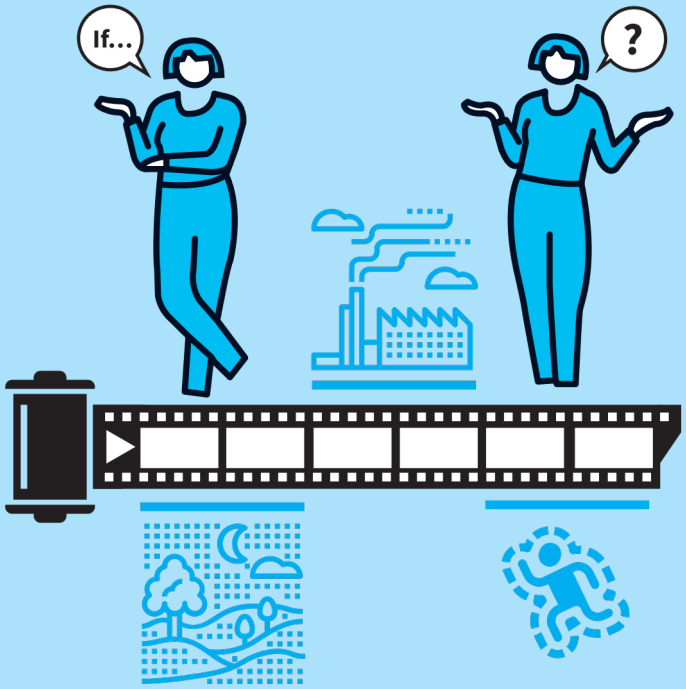
Ask “process questions”

- What is 7 cubed? → *How did you work it out?*
- What is the main cause of global warming? → *Why did you chose that one?*
- What do you think Heaney means by ‘space is a salvo’? → *How did you come to that conclusion?*


Q&F | 96
CHECK FOR UNDERSTANDING
TEACHING WALKTHRUS
I want a quick hit of seeing everyone's answers at once....
Q&F | 94
SHOW-ME BOARDS
TEACHING WALKTHRUS
I want everyone to explore their ideas verbally and rehearse their explanations
Q&F | 92
THINK, PAIR, SHARE
TEACHING WALKTHRUS
I want to explore of a sample of responses in depth, with everyone thinking.
Q&F | 90
COLD CALLING
TEACHING WALKTHRUS

MAKE EVERYONE THINK

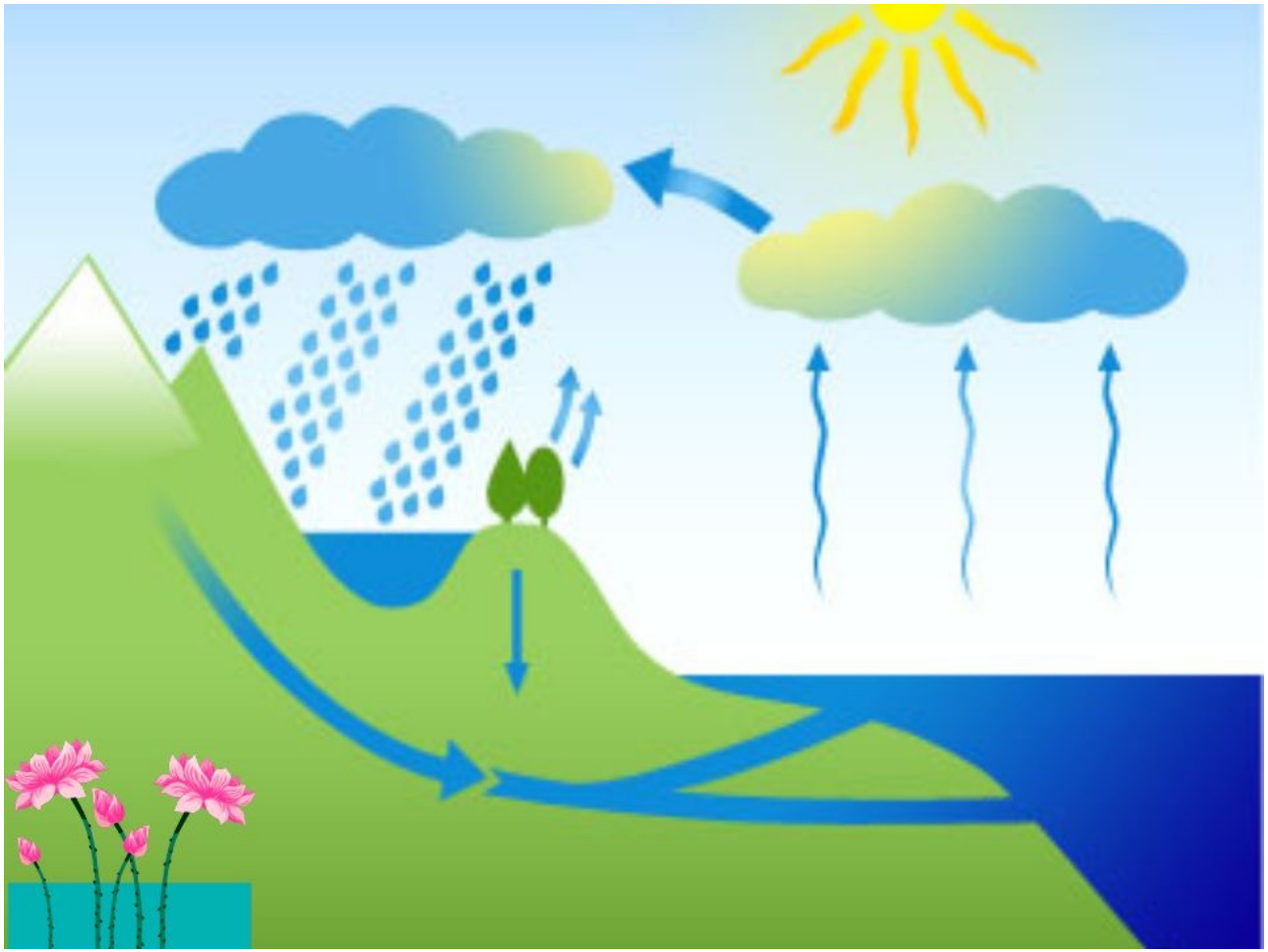
1 2 3 4 5



USE NARRATIVES AND CONFLICTS

- Invite students to engage by thinking about connections and sequences.
- Narrative structures promote effective thinking patterns:
  - *What happened next? Why?*
  - *What changes if X happens to Y?*
  - *What possible outcomes are there?*
- Conflicts provide a focus for thinking:
  - *Which argument is stronger?*
  - *Which sample is better?*
  - *What is wrong in this example?*

Summarise the process: “Tell the story”
Harness narrative structures.



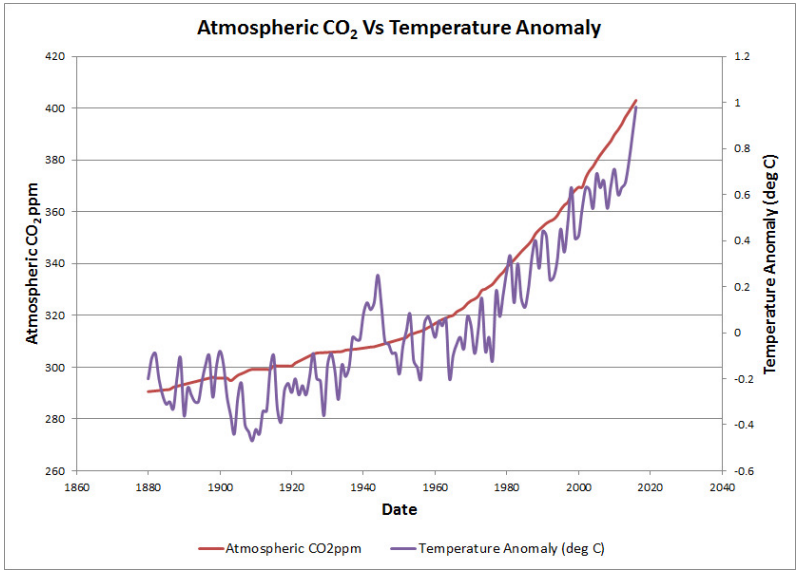
Key Words

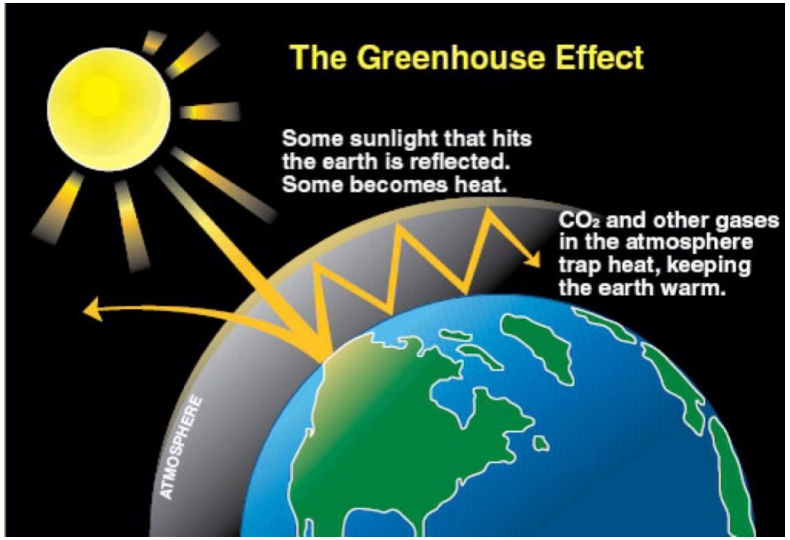
Evaporation
Convection
Condensation
Precipitation
Energy
Warm/Cool
Flow
Vapour
Fall/rise

Is Harry Windsor ‘a sympathetic character’?

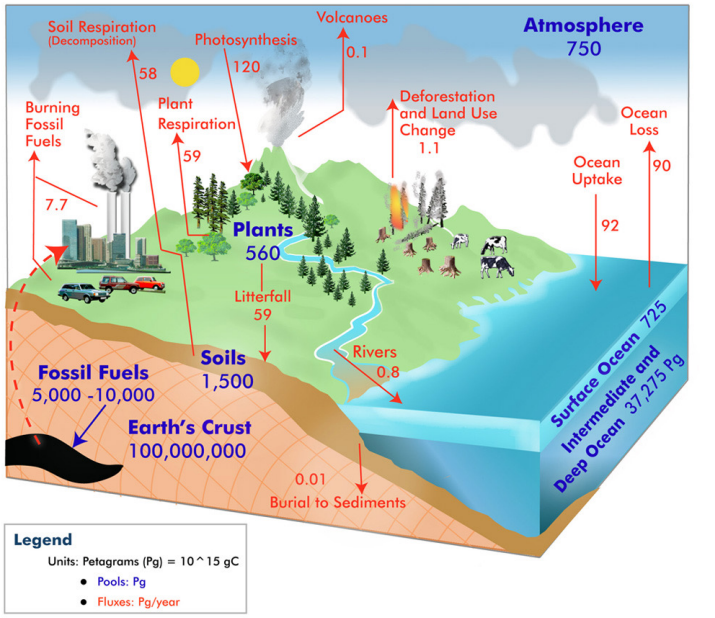
On one hand…

But on the other hand…





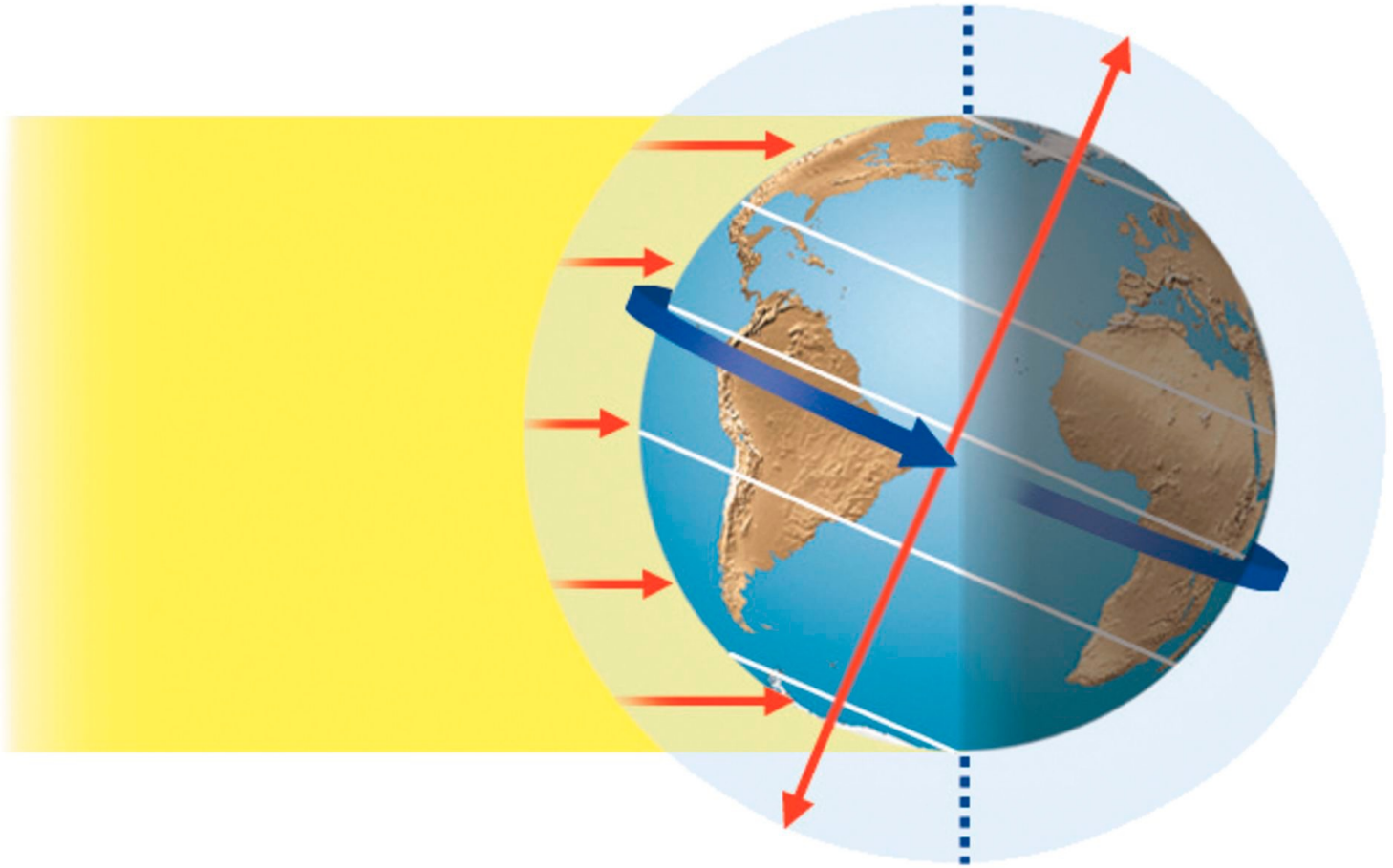
Global Carbon Cycle



Copyright 2010 GLOBE Carbon Cycle Project, a collaborative project between the University of New Hampshire, Charles University and the GLOBE Program Office.
Data Sources: Adapted from Houghton, R.A. Balancing the Global Carbon Budget. Annu. Rev. Earth Planet. Sci. 007.35:313-347, updated emissions values are from the Global Carbon Project: Carbon Budget 2009.

What's the link between the greenhouse effect and global warming?

Why does the sun rise in the East?



MAKE EVERYONE THINK

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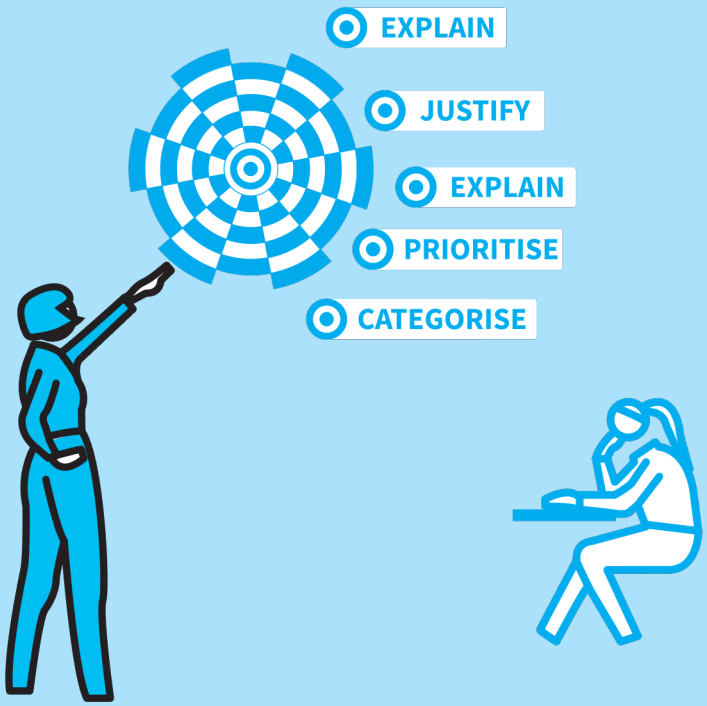


EMBED THINKING GOALS WITHIN TASK GOALS

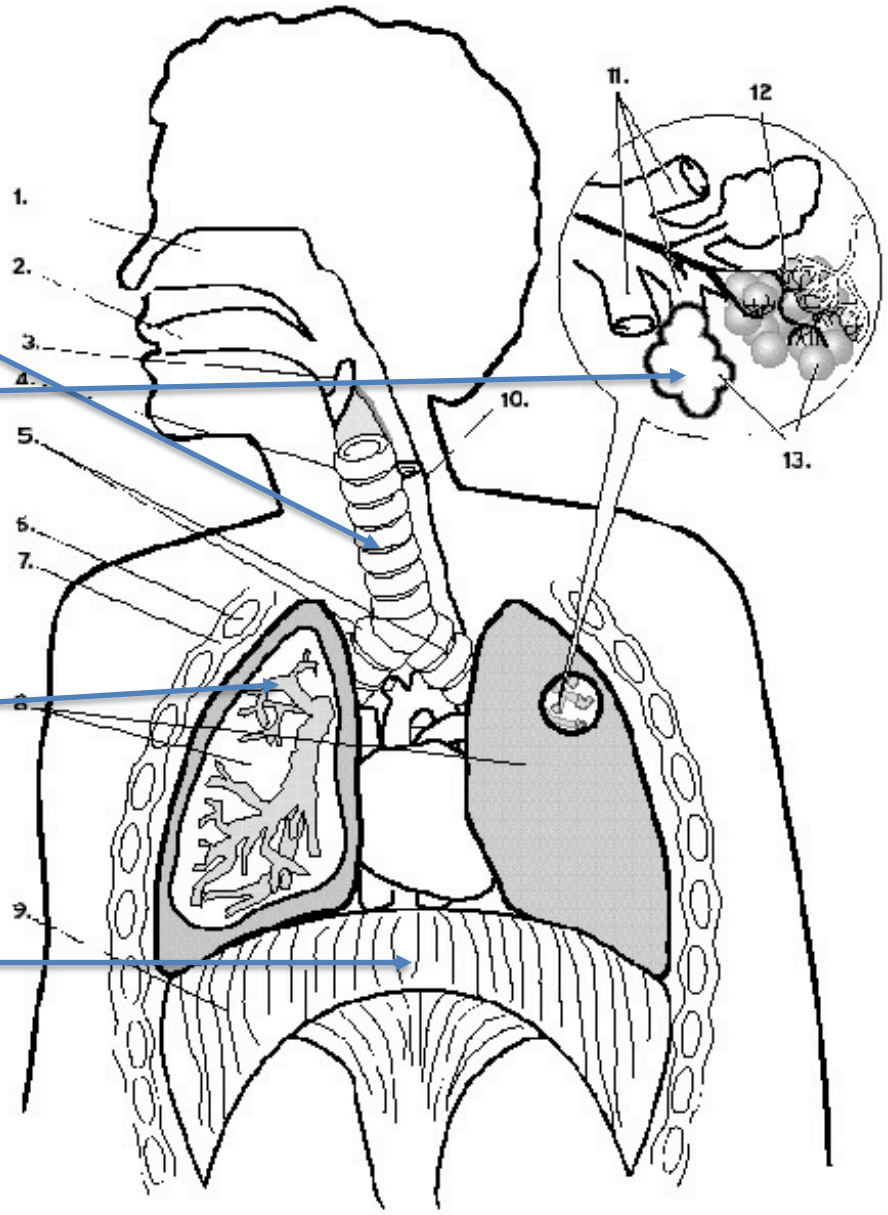
- Make goals explicitly for students to be able to explain, justify, categorise, prioritise, rank, apply their knowledge, independently, even without notes.
- This will ensure the level of thinking and engagement is higher all along.
- Goals might take the form of needing to predict the end of the story, explain something to the class or tackle a new, related question or problem.

Trachea

Alveolus

Bronchiole

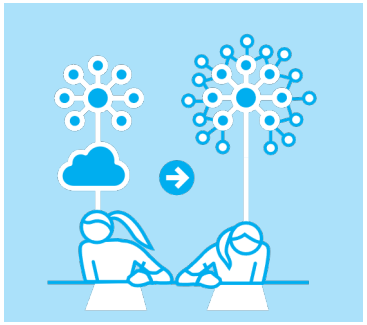
Diaphragm



MAKE EVERYONE THINK

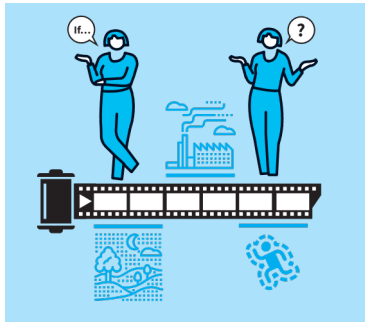
1 2 3 4 5

ACTIVATE PRIOR KNOWLEDGE

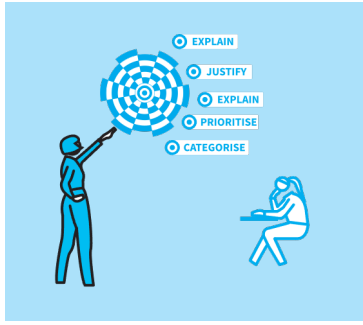


STIMULATE SCHEMA-BUILDING

SYSTEMATICALLY INVOLVE ALL STUDENTS



USE NARRATIVES AND CONFLICTS



EMBED THINKING GOALS WITHIN TASK GOALS

TEACHING WALKTHRUS
SERIES
PRACTICE & RETRIEVAL
A|D|A|P|T

- A central idea about learning in Willingham's *Why Don't Students Like School?*, is that memory is the residue of thought.
- He suggests teachers should review lessons by considering what students will think about as this is what they will be learning.
- It requires routines that involve all students, requiring them all to think, activating their prior knowledge, deliberately connecting new ideas to what they already know.

Solution: switch into the right mindset:

From **“Does <u>anyone</u> know”?** to **“Does <u>everyone</u> know?”**

From “Can anyone do it?” to “Can everyone do it?”

From “Well done to those getting it right” to “Let’s find out who still can’t get this right and help them out”.

From a dominant emphasis on seeking affirmation in correctness to familiar routines around seeking out residual errors and difficulties.

	Catherine of Aragon	Anne Boleyn	Jane Seymour	Anne of Cleves	Catherine Howard	Catherine Parr
Years as Henry's Wife	1509 – 1533	1533-36	1536-37	1540 Six Months	1540-42	1543 until his death in 1548.
How known to Henry	Married to his brother 1501	Courtier. Consorted with Henry 1526-32	Lady-in-waiting to her predecessors.	Met just before marriage. Arranged for alliance building	Anne of Cleves' Lady in Waiting	Known to family. Friend of Mary.
Heirs?	Mary Later Queen No male heir.	Elizabeth Later Queen	Edward Later King	No	No	No
What Happened	**Divorced** so H could marry AB. Henry changed law so divorce not blocked by Pope.	**Beheaded** Tower of London	**Died** with childbed fever.	**Divorced.** Marriage annulled after six months.	**Beheaded**	**Survived** Henry Died a year later in Childbirth with new marriage.
Significant information	Catholic From Spain Daughter of Ferdinand and Isabella. 'Pious' Divorce was origin of separation from Rome leading path to England as Protestant state	From Norfolk European Education Miscarriages Accused and sentenced for treason and adultery.	Henry 'grief stricken'. Then not married for over two years.	From Germany A Protestant state. Strategic marriage but a disaster Thomas Cromwell blamed for arranging it - amongst other things - and was also beheaded.	Found to have had affairs before marrying Henry and during marriage. Henry 'wept with rage and self-pity'	Cared for Elizabeth and Edward. Later married Thomas Seymour, Jane's brother. Had child with Thomas but died with child-bed fever.

Thank you.

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