Evidence informed?
The power of a learning model

Tom Sherrington
@teacherhead

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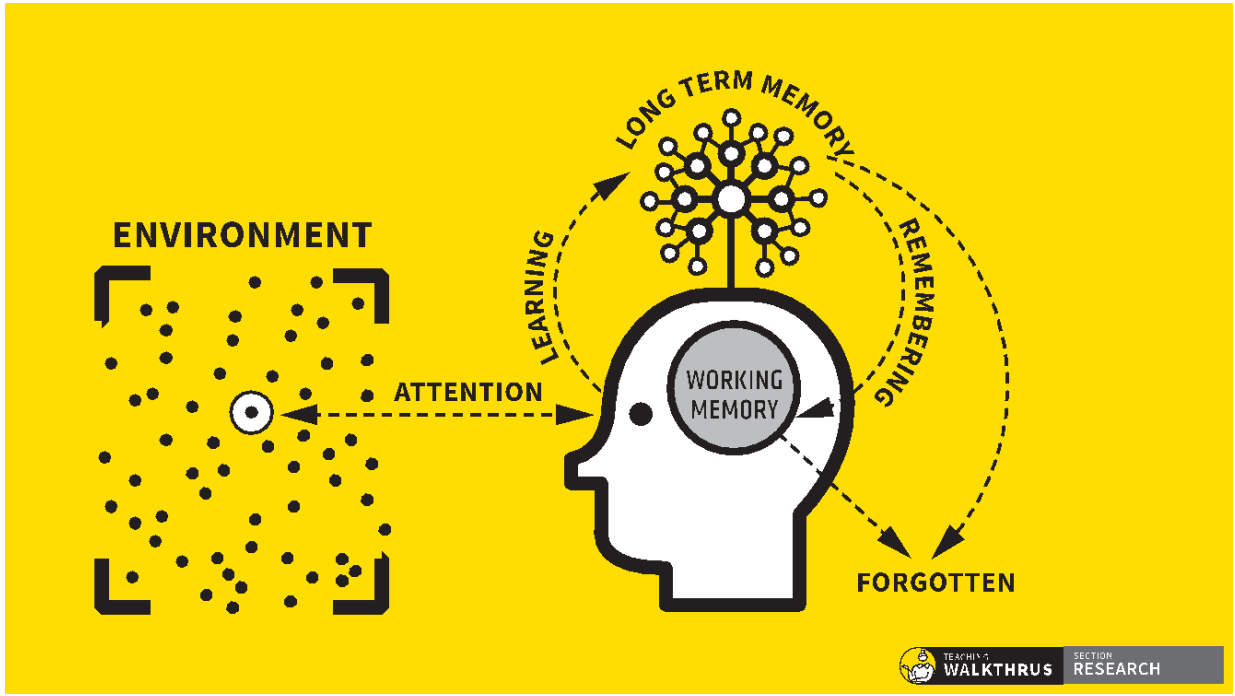
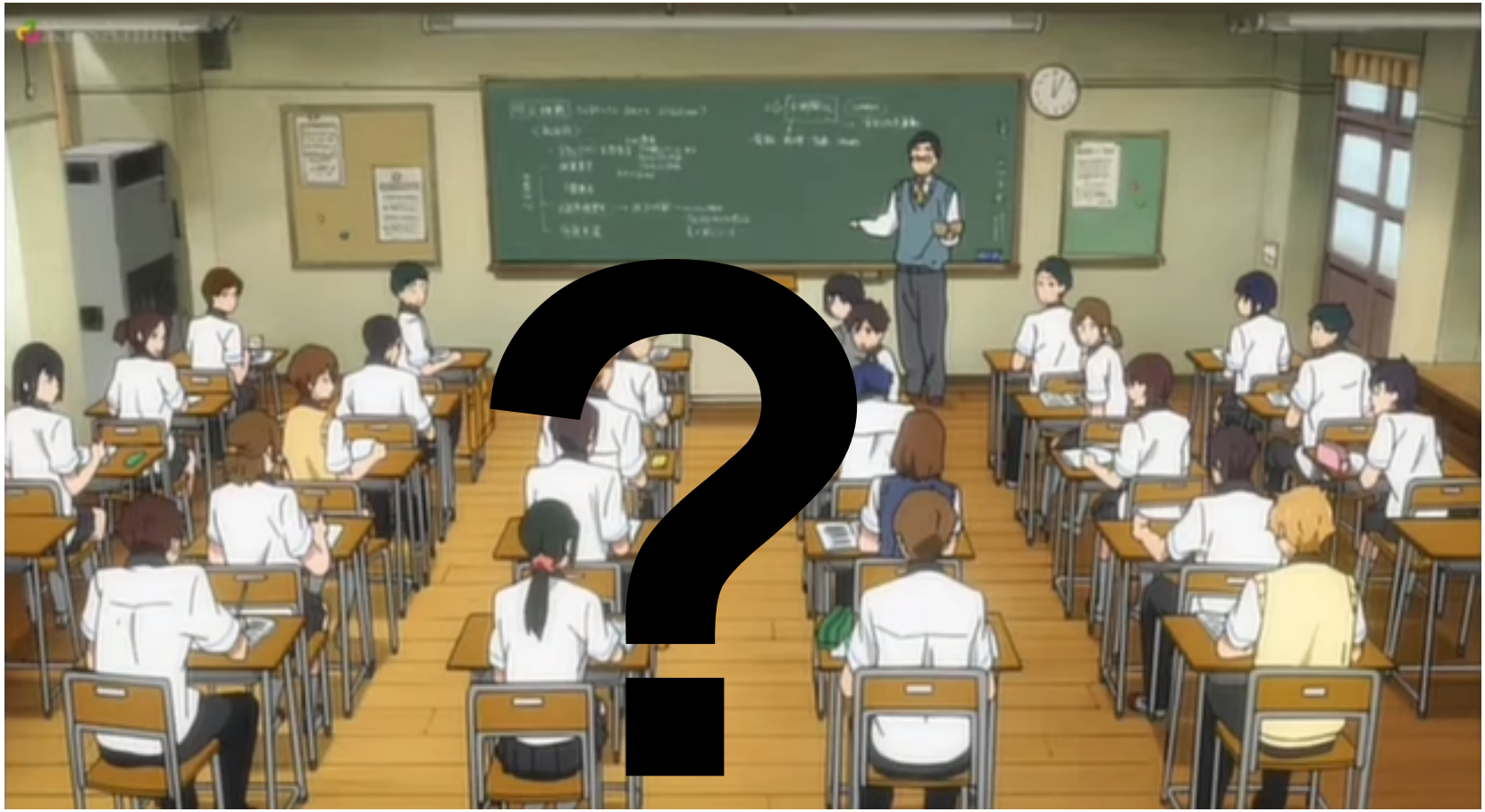
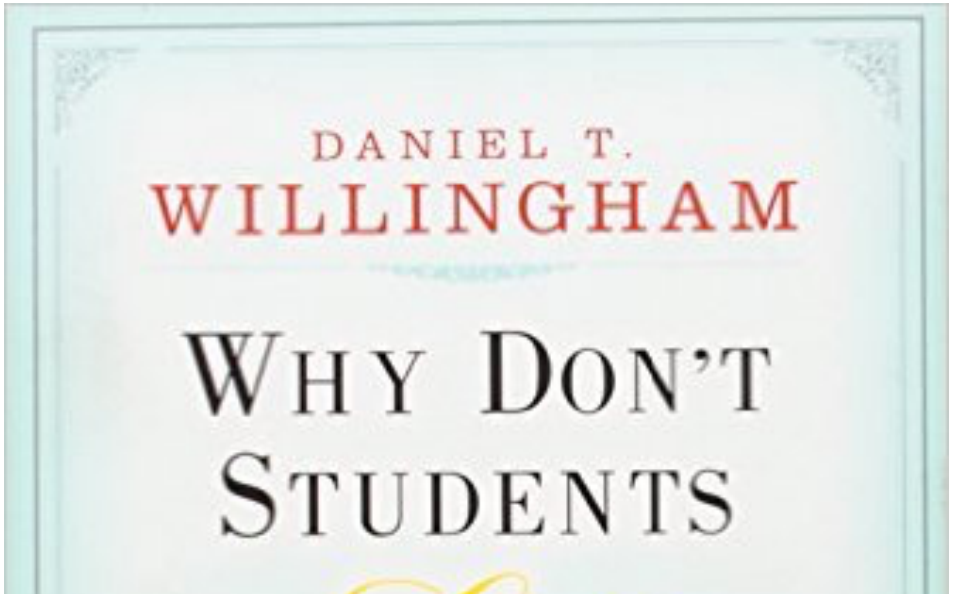


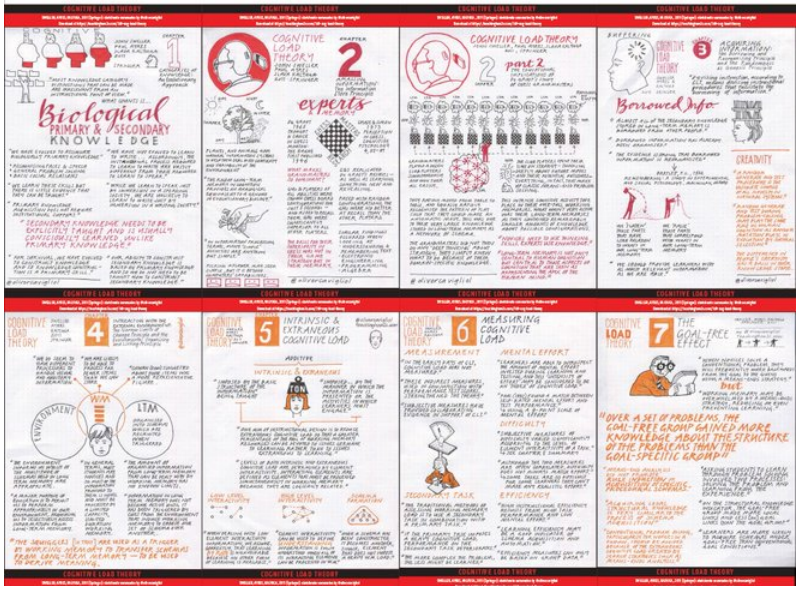


What's going on?
What works?

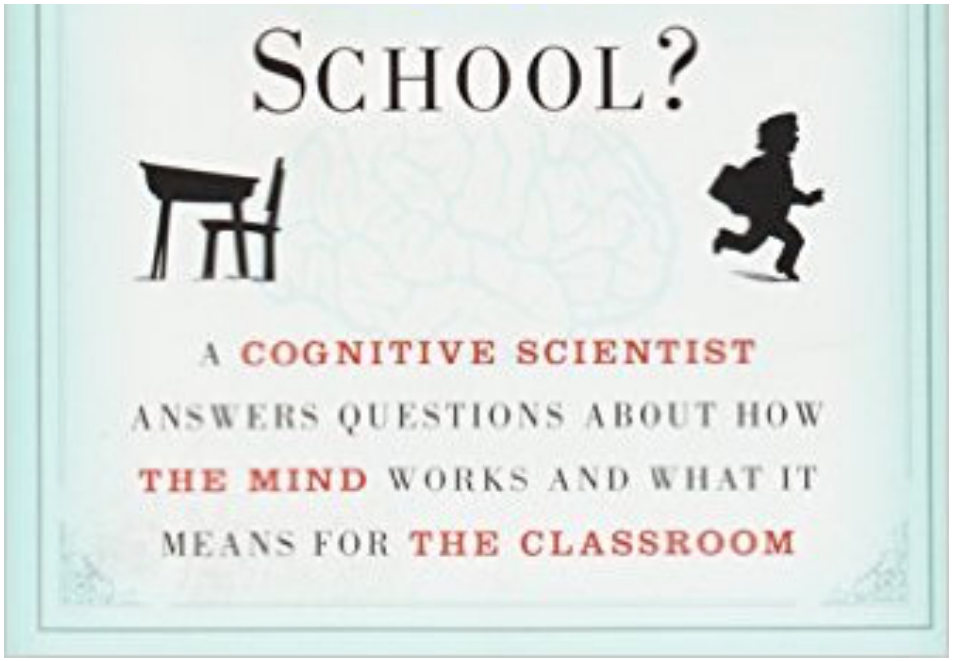
‘Evidence-informed wisdom’



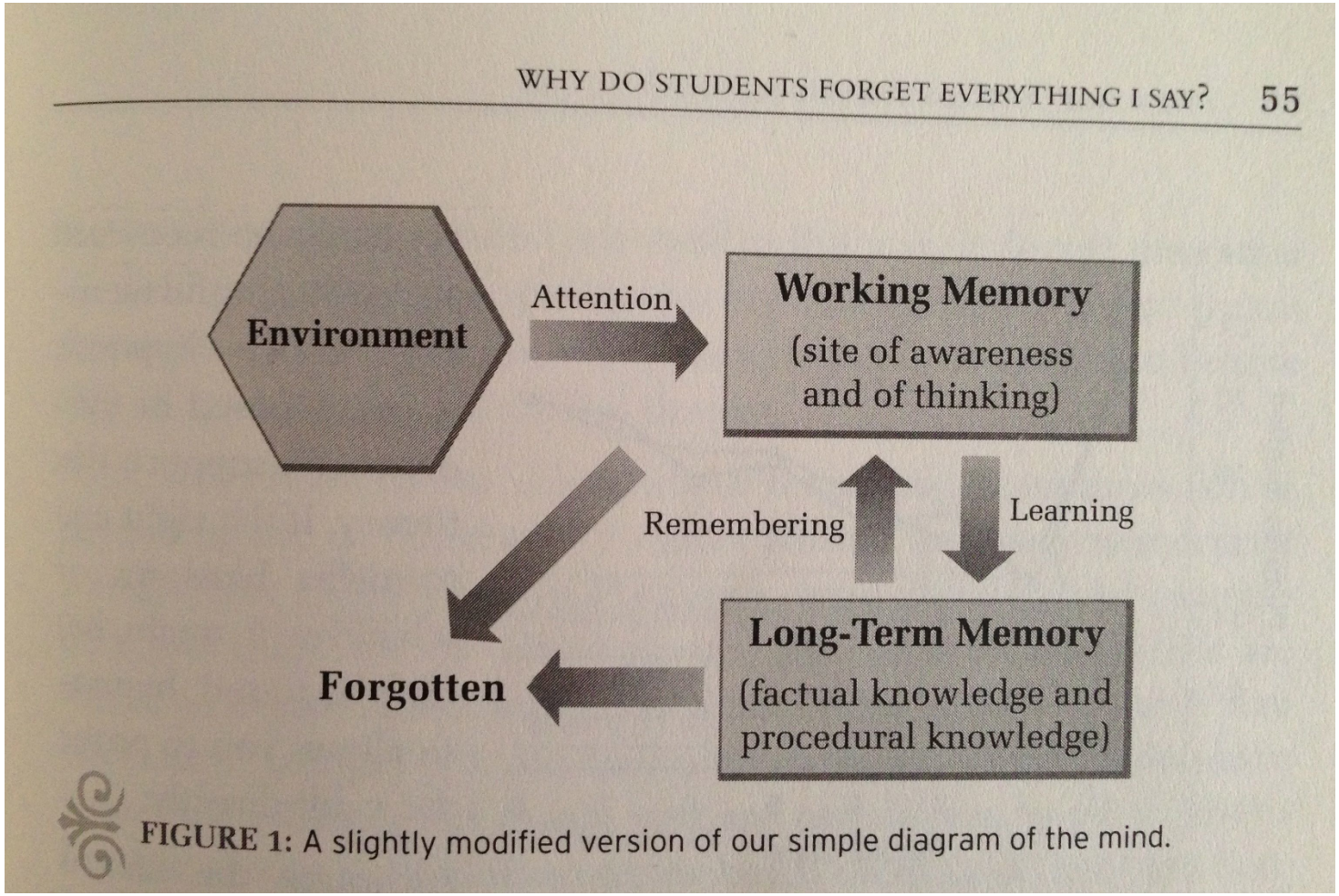
Willingham:
Why don't students like school?



Sweller:
Cognitive Load Theory



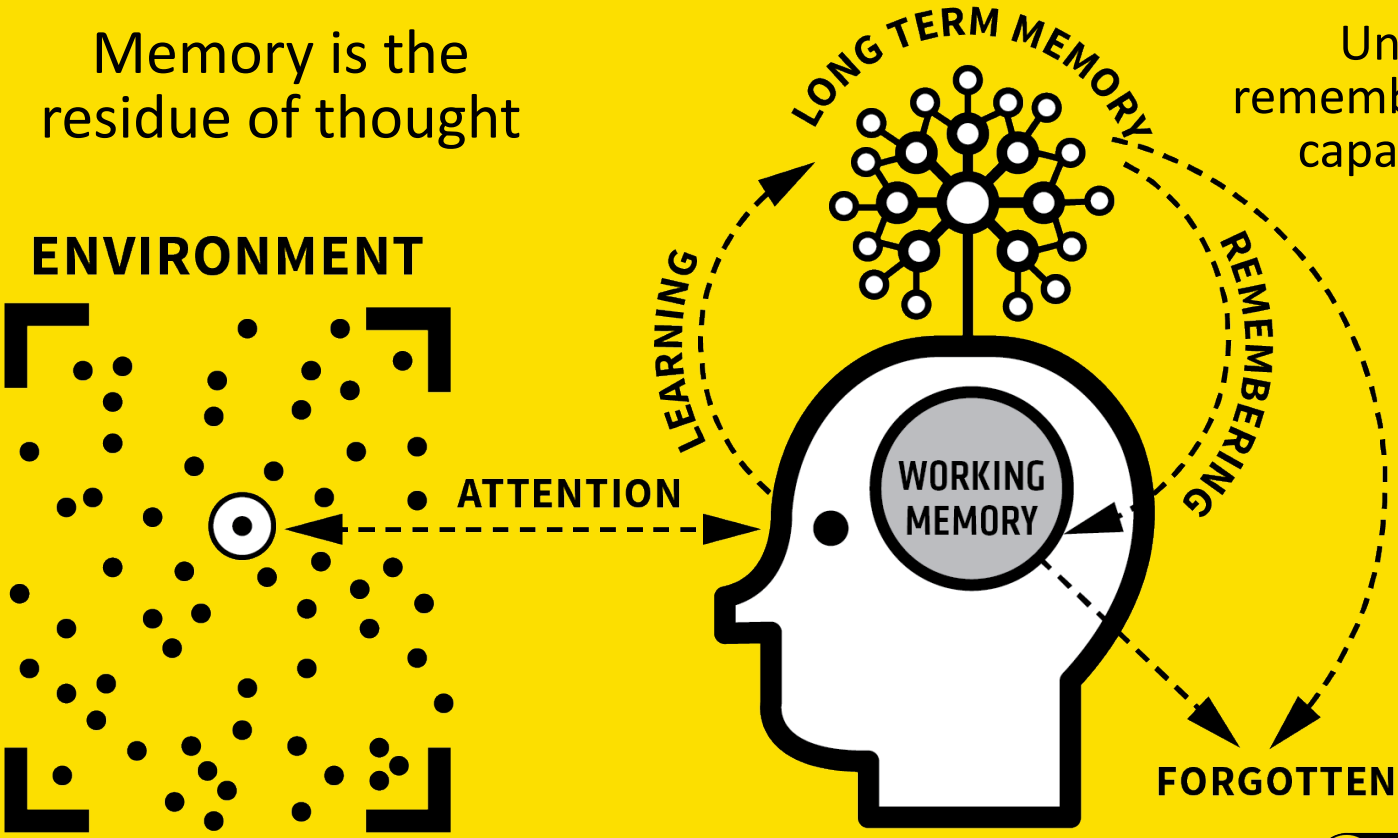
Daniel Willingham:



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

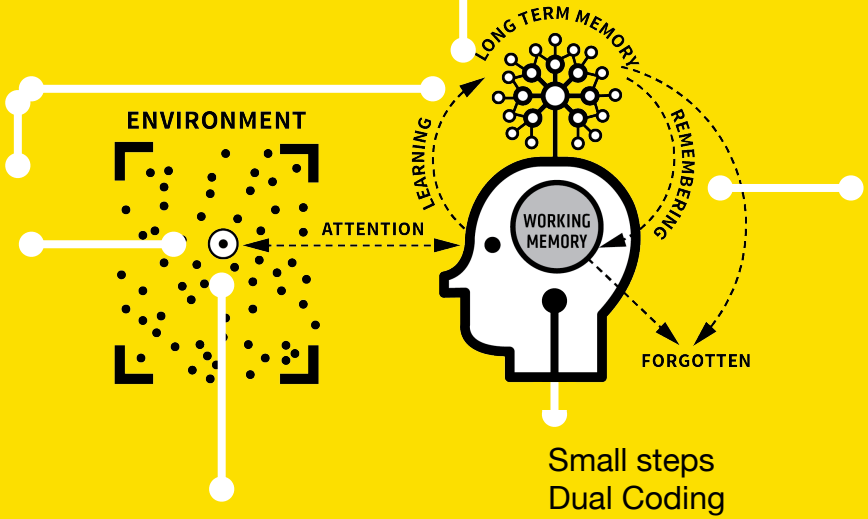
Further layers of complexity…

Home | social context;
life opportunities

Prior knowledge
Experience. Habits
Sense of self; motivation

School curriculum
Quality of education to date; reading

Clarity of communication
Resources and activity design
"Memory is the residue of thought"
Nuthall's 'three times' rule

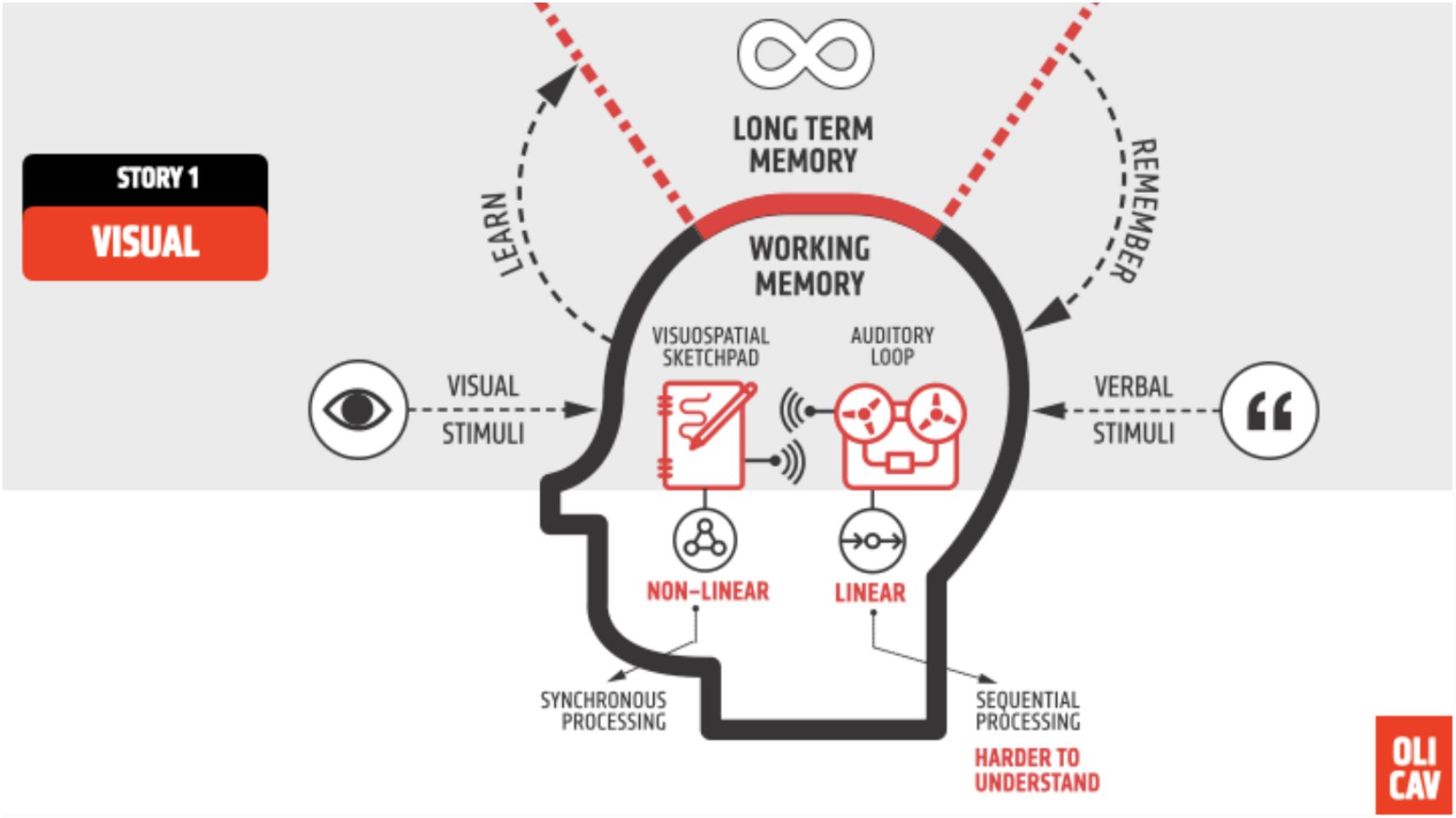


Generative Activities:
Range, depth, variety, frequency, intensity.
Removing recency and cue
Spaced; interleaved
Big Picture, fine detail
Practice:
Fluency, automaticity
"Understanding is remembering in disguise."

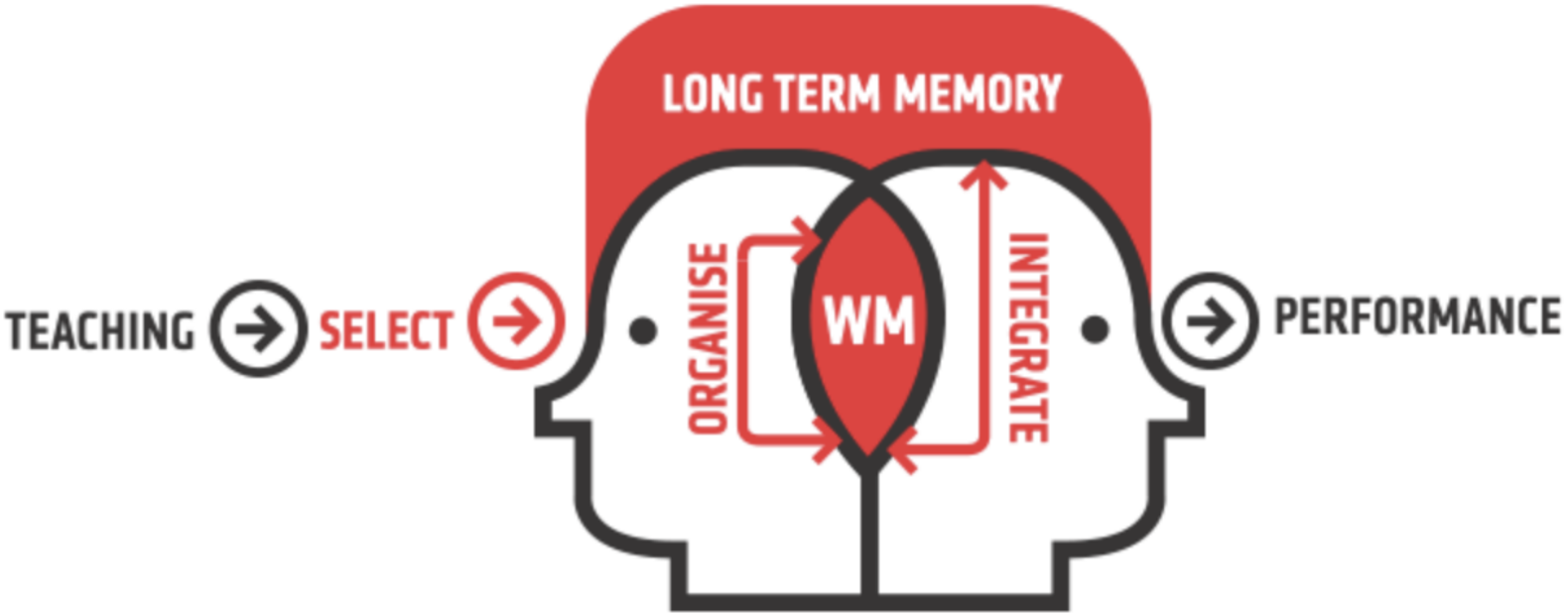
Small steps
Dual Coding
Active schema-building
Knowledge builds on knowledge

Learning Environments
Study Habits
Concentration

TEACHING WALKTHRUS SECTION RESEARCH

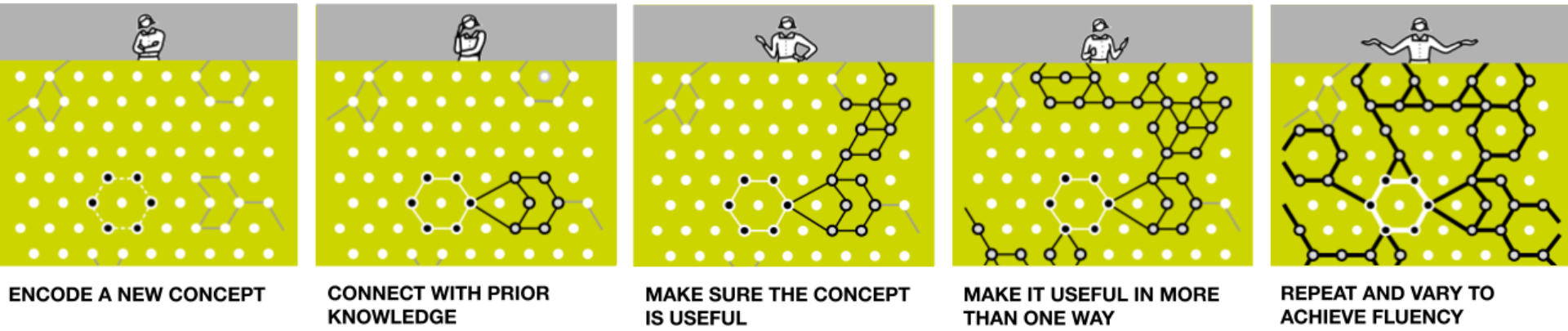

STORY 1
VISUAL
LONG TERM MEMORY
LEARN
REMEMBER
WORKING MEMORY
VISUOSPATIAL SKETCHPAD
AUDITORY LOOP
VISUAL STIMULI
VERBAL STIMULI
NON-LINEAR
LINEAR
SYNCHRONOUS PROCESSING
SEQUENTIAL PROCESSING
HARDER TO UNDERSTAND
OLI CAV

THE S-O-I MODEL



OLI CAV

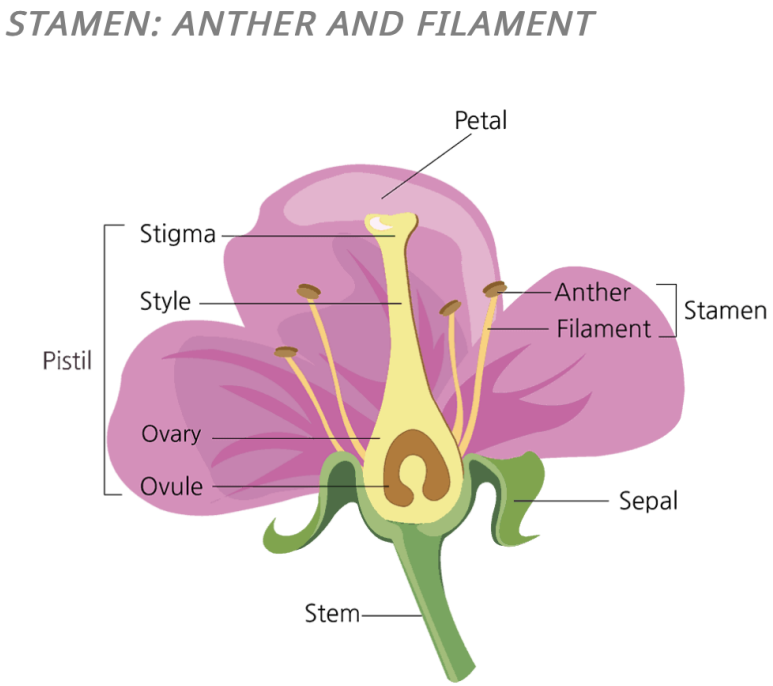
HOW MEMORIES ARE CONSTRUCTED: A MODEL

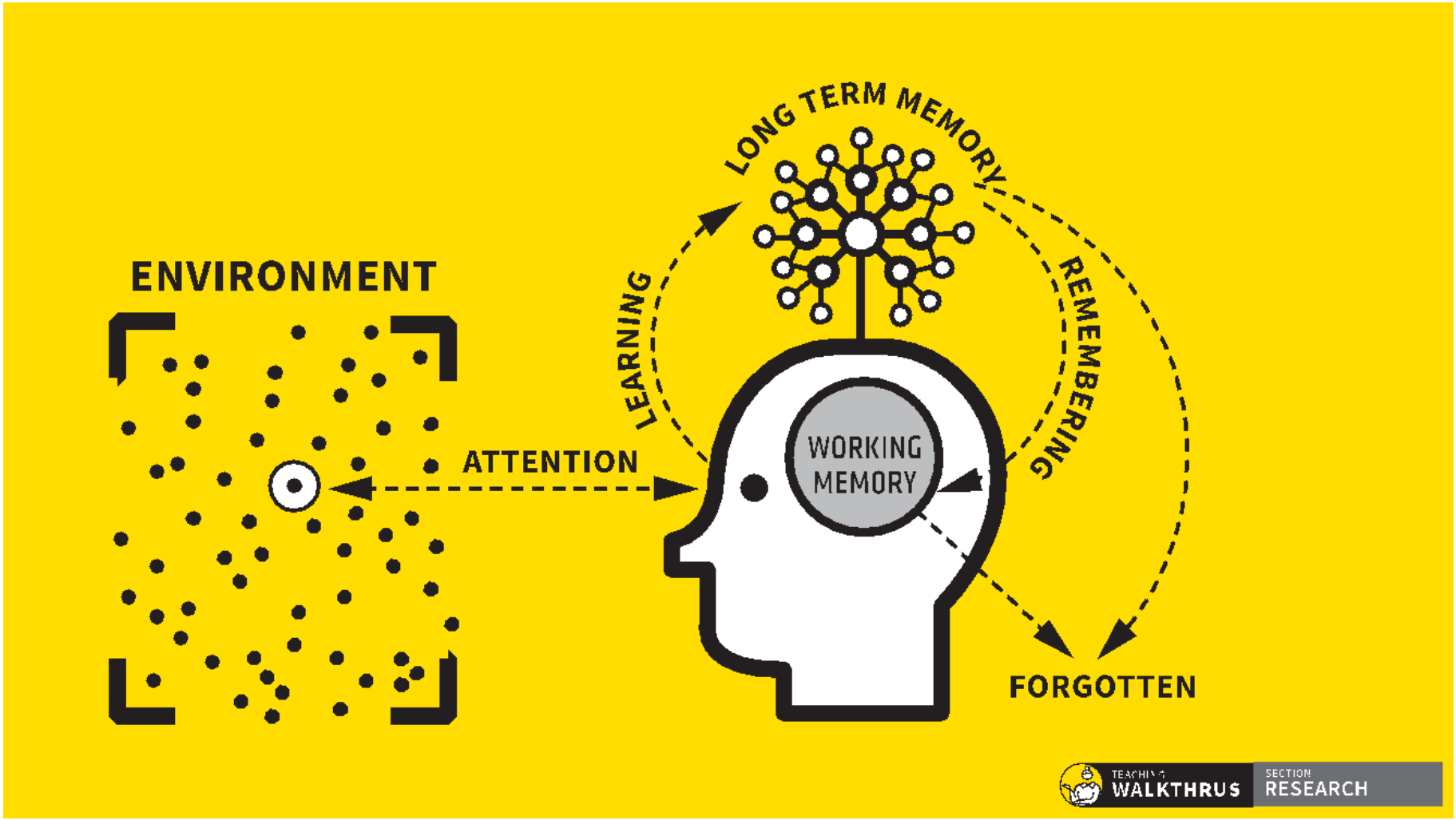


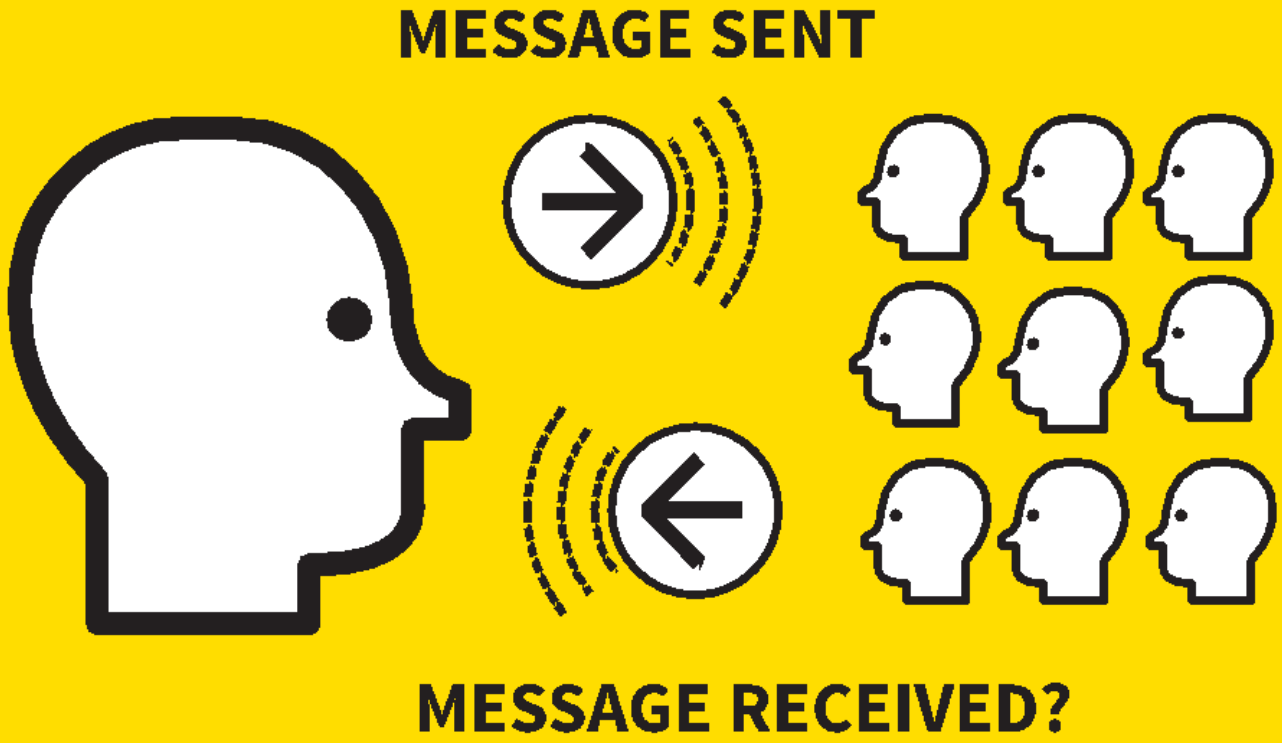
From Efrat Furst in Walkthrus Volume 3

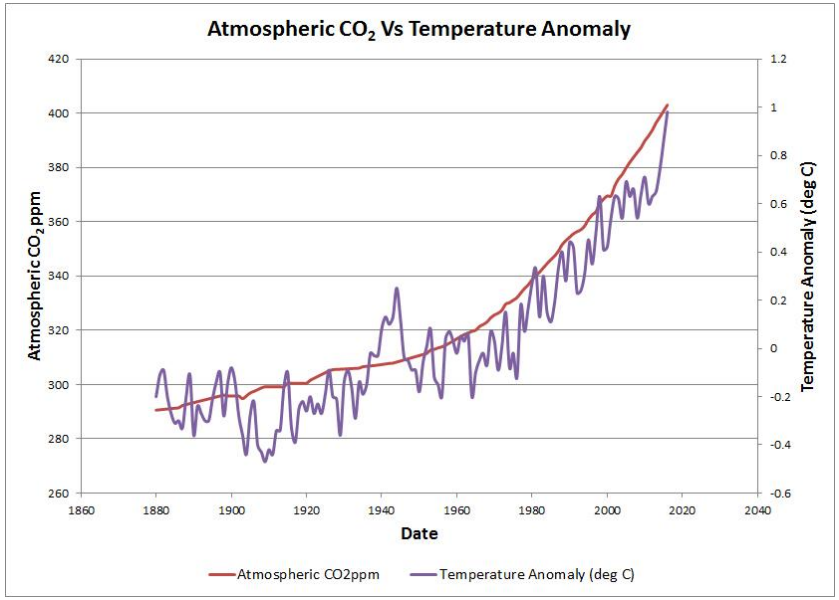
? Rehearsal first; retrieval practice later

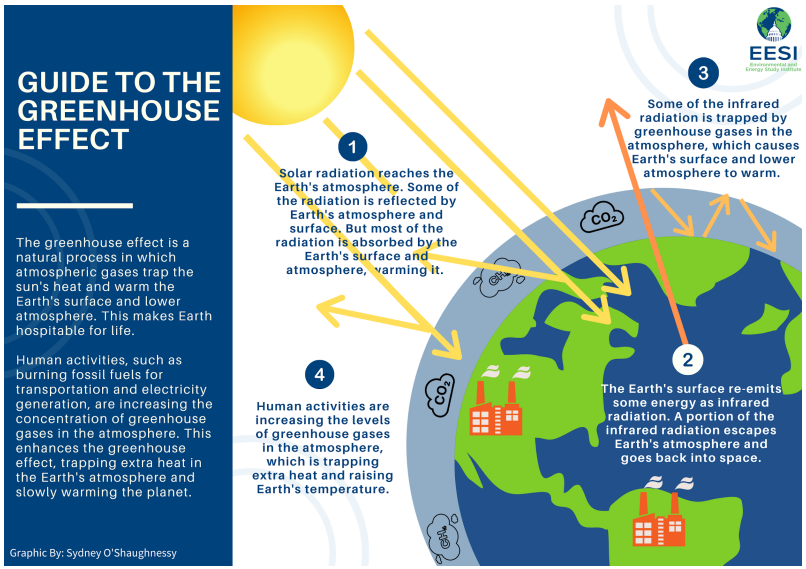
What is a stamen? What does it do?




ENVIRONMENT
ATTENTION
LEARNING
LONG TERM MEMORY
REMEMBERING
WORKING MEMORY
FORGOTTEN
TEACHING WALKTHRUS
SECTION RESEARCH

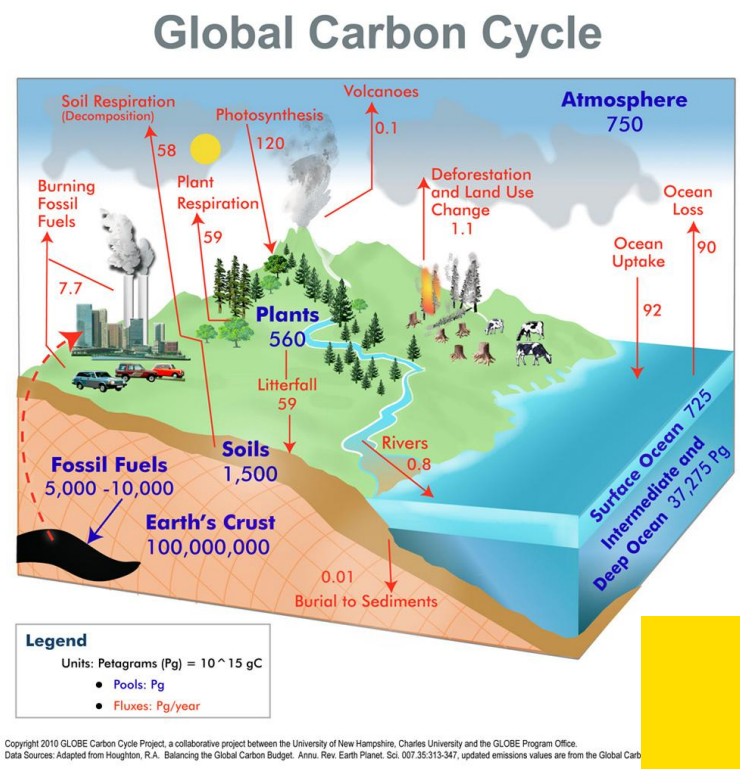

MESSAGE SENT
MESSAGE RECEIVED?



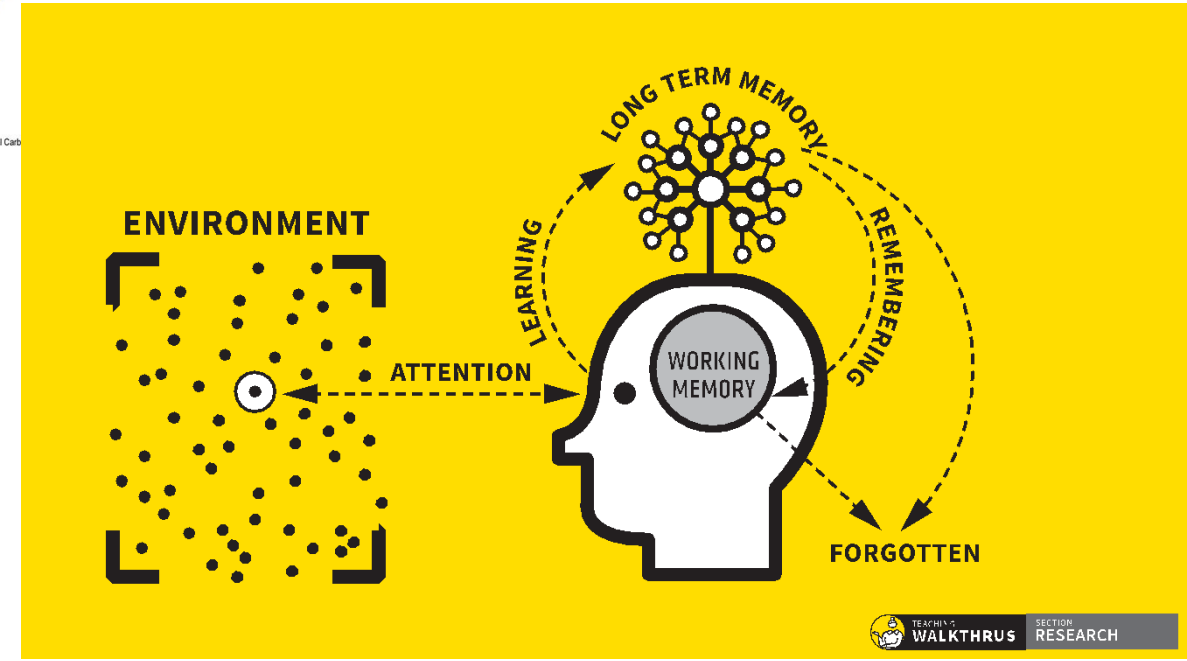


What's the link between the greenhouse effect and global warming?

Why do we need wind farms?



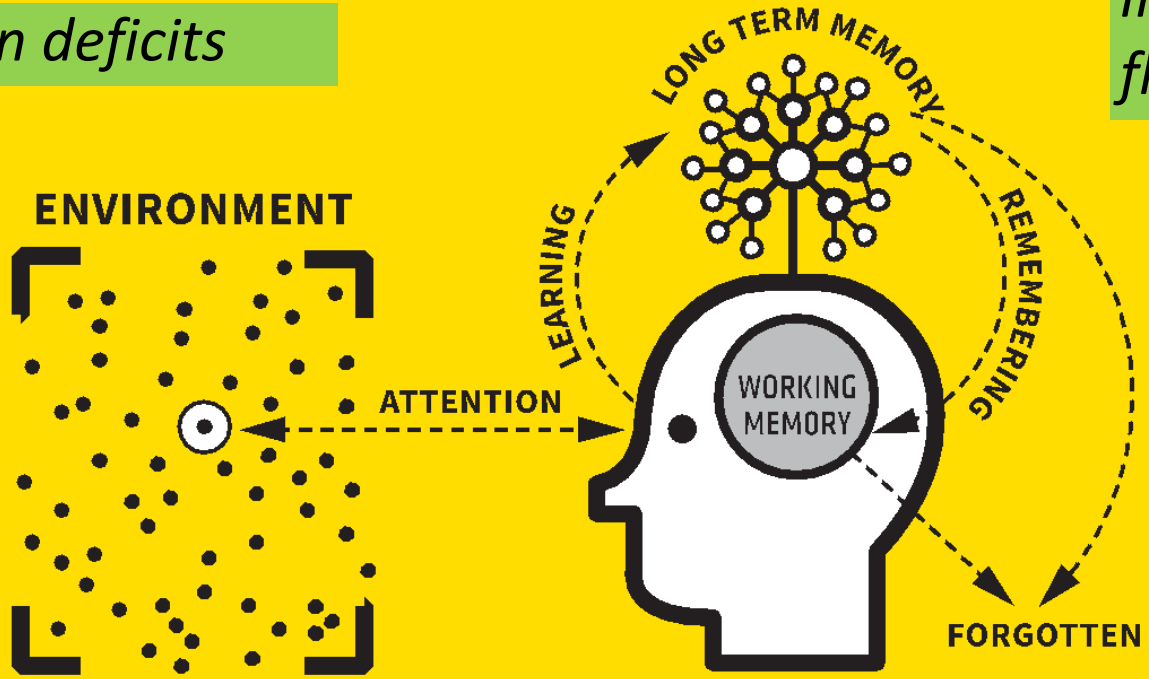
Curriculum as schema-building



Lack of prior knowledge

Attention deficits

Insufficient fluency of recall



Task completion poor proxy for learning:

Memory overload:

PROFESSOR ARTHUR SHIMAMURA'S

A WHOLE-BRAIN LEARNING APPROACH FOR STUDENTS AND TEACHERS

M — MOTIVATE

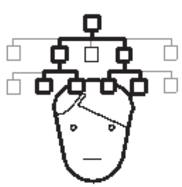
We need to be motivated to use energy to keep focused on the learning process. Designed well, motivation can be intrinsic to learning, for example, by generating curiosity, framing new material as a quest to answer big questions, organising ideas within a wider schema, story-telling and asking the 'aesthetic question': *"What do you think? How does it make you feel? Why is it good?"* *"The aesthetic question engages emotional brain circuits and forces us to attend to and organise our knowledge."*

A — ATTEND

Academic learning is a 'top-down' activity whereby we consciously attend to the information needed to build our schema from all the stimuli we're exposed to. This is hard so 'mind wandering' is common and teachers need to expect it. Ideally students will consciously attend to the learning goals and consciously make connections – but sometimes an instructor needs grab attention, acting as their students' prefrontal cortex to direct their top-down processing.

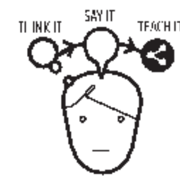
R — RELATE

Shimamura offers numerous biological insights about how we store and connect information through memory consolidation. The practical strategies include deploying elaborative-interrogative questioning – asking how and why – using mental images, analogies, constructing concept maps as schematic representations of sets of connected ideas and training students to make notes organised in hierarchical structures.



G — GENERATE

Shimamura suggests: "*Think it, say it, teach it! These are the simplest things to do to improve your memory*". He details multiple ways in which our memories are strengthened when we generate information from our memory, not simply restating it but using our own words. If we tell someone what we've learned we can improve our memory by 30-50%. Explained in terms of brain functions, Generate reinforces the widely known retrieval practice concept.

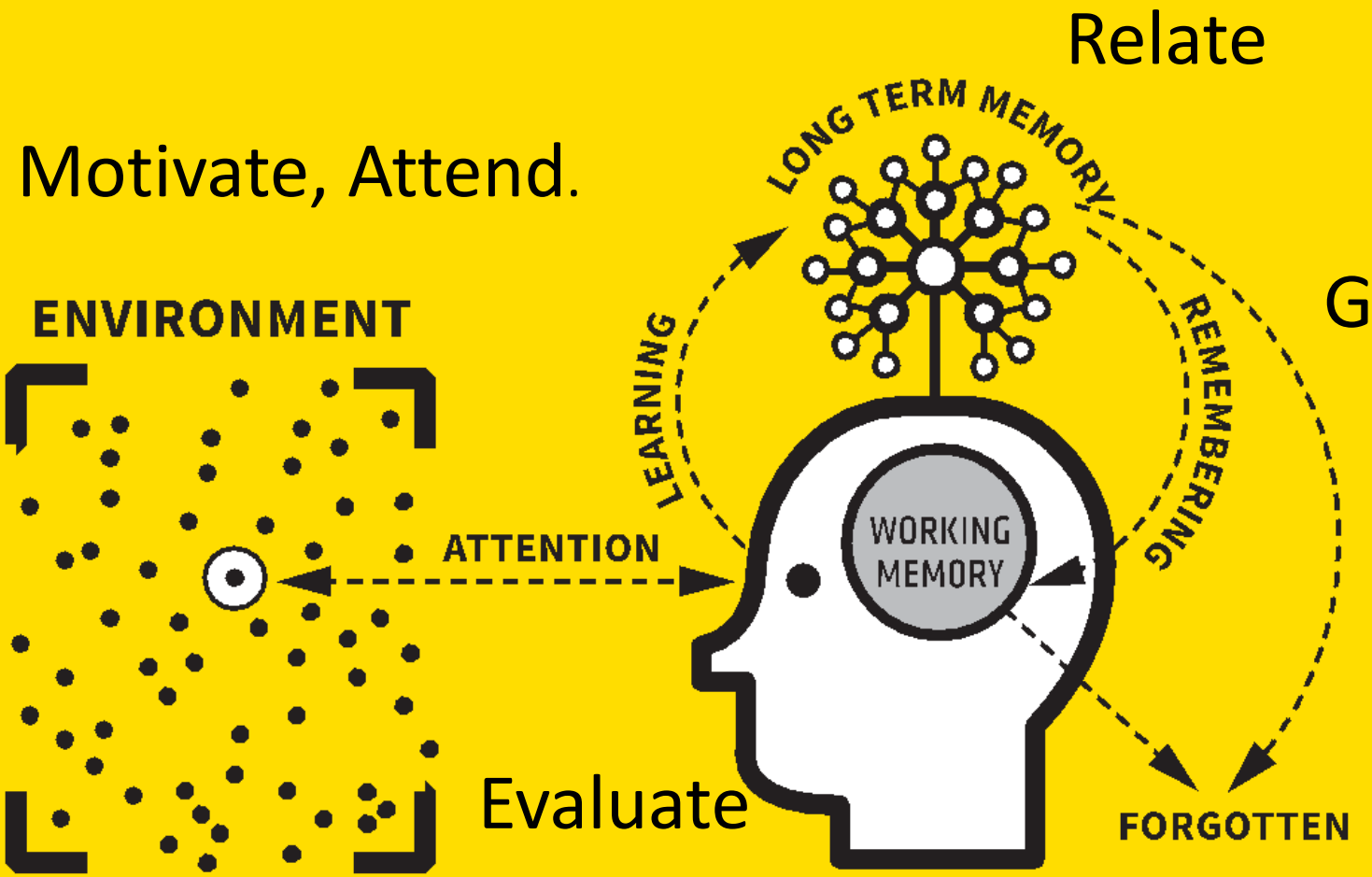


E — EVALUATE

This is the territory of metacognition with a nice metaphor of the prefrontal cortex acting as the conductor of the orchestra of brain functions. There's a problem with the illusion of knowing when we are familiar with information even when we cannot fully recollect it. We stop trying to learn more if we kid ourselves into thinking we already know it. Students should, therefore, be taught to check their understanding using spaced retrieval practice, generating information by explaining their learning to others as a form of self-test.

Relate

Motivate, Attend.

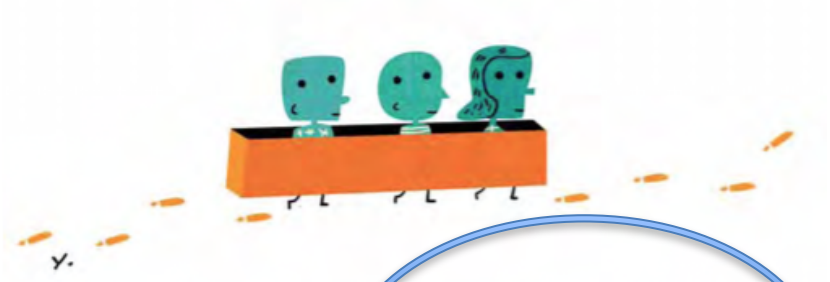


Generate

Evaluate

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

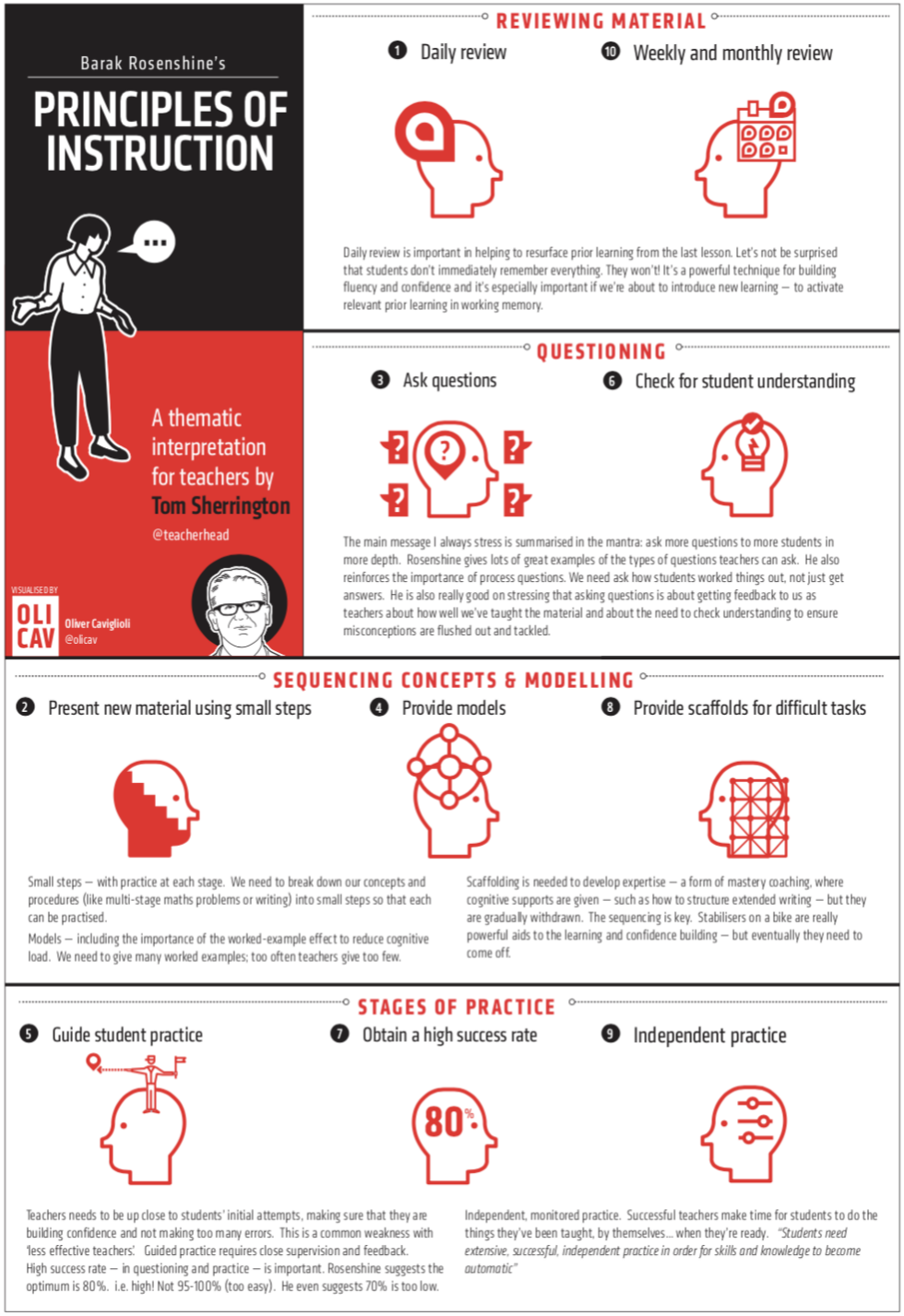
Even though these are three very different bodies of research, there is *no conflict at all* between the instructional suggestions that come from each of these three sources. In other words, these three sources supplement and complement each other. The fact that the instructional ideas from three different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

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.

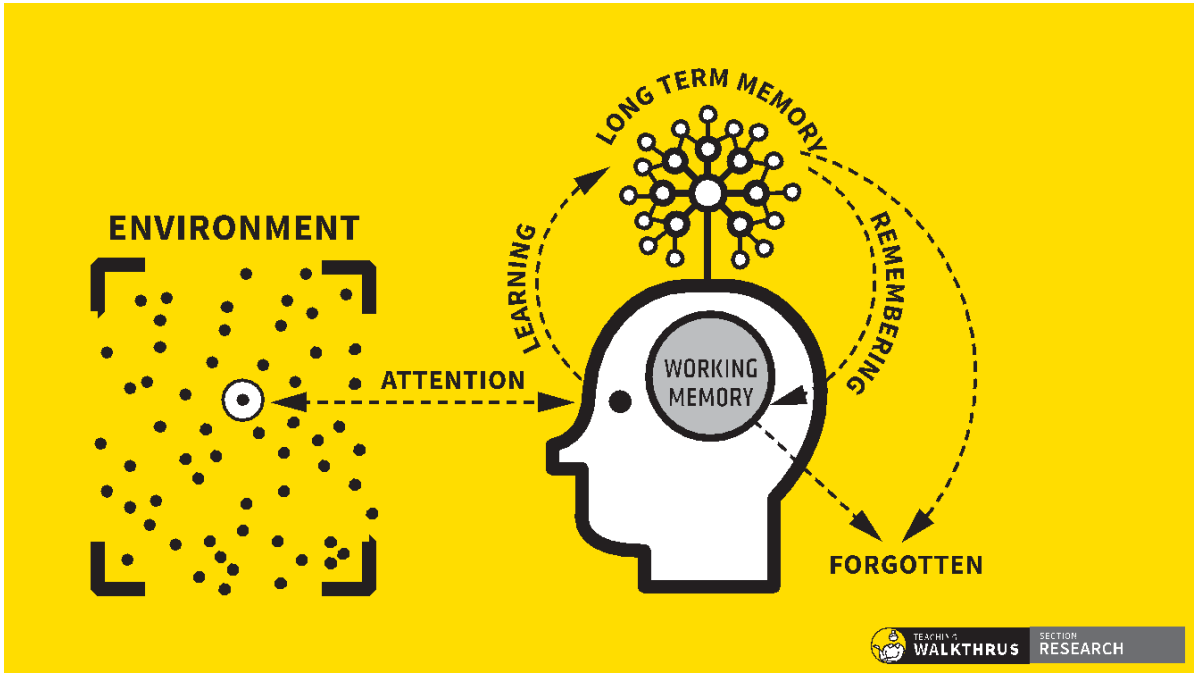


Spaced and interleaved review; retrieval practice

Lots of questions and checking for understanding

New material in small steps – working memory is small
Models and scaffolds

Practice – from guided to independent
High success rate

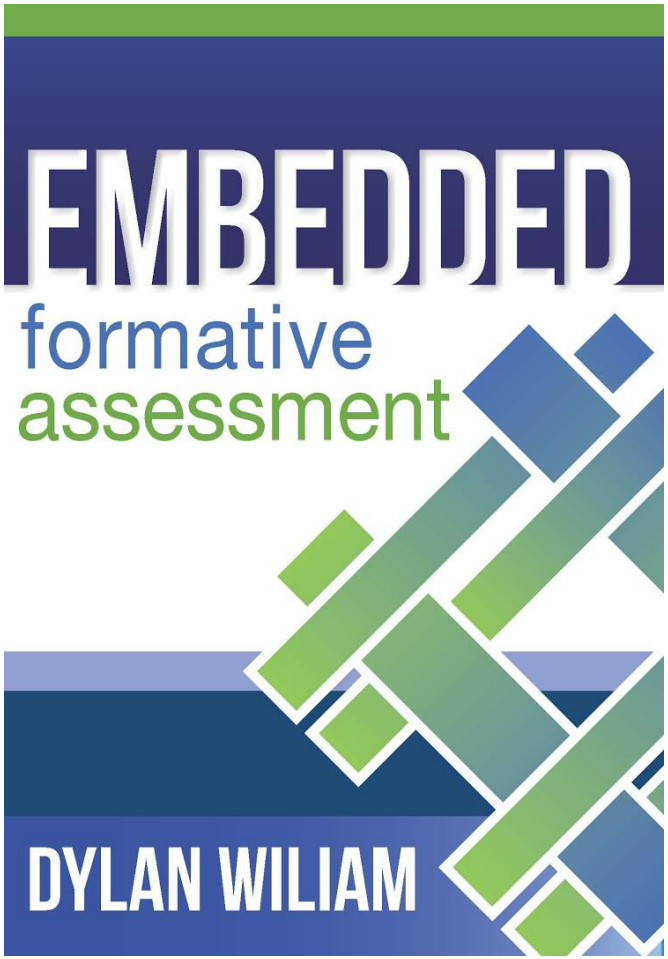


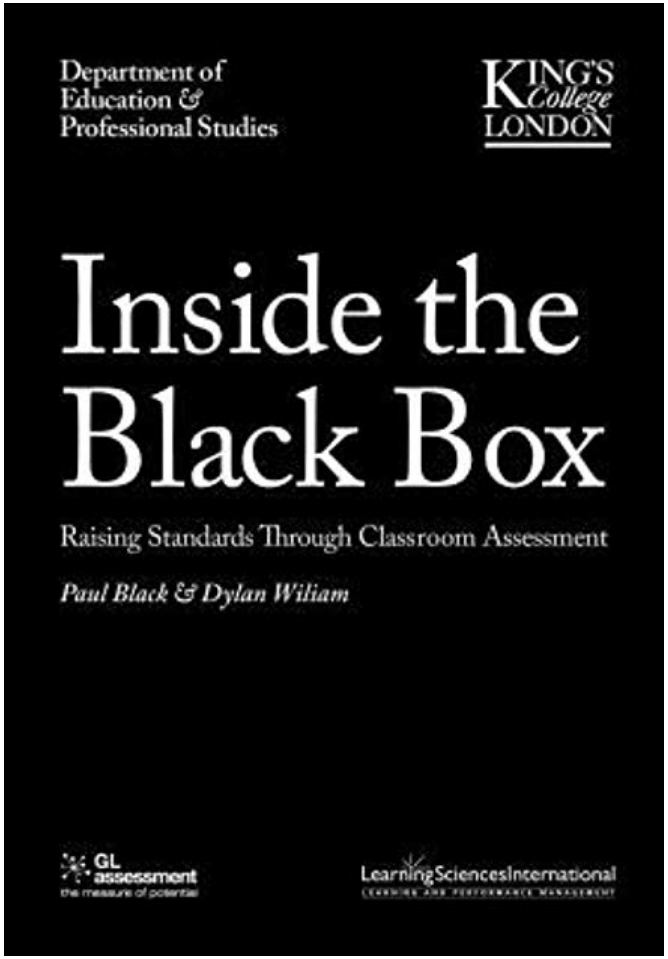
Reviewing material

Questioning and checking for understanding

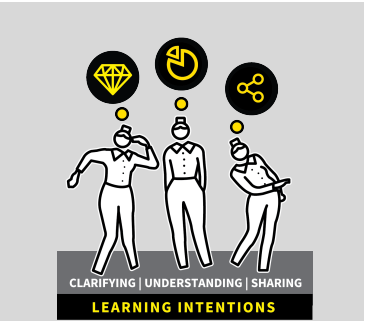
Sequencing concepts; modelling; scaffolding

Stages of practice

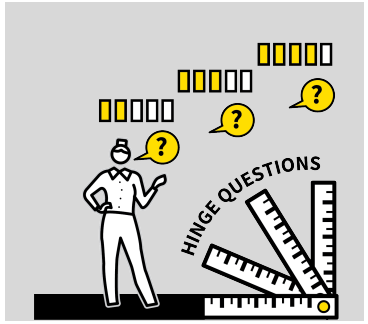

EMBEDDED
formative
assessment
DYLAN WILIAM


Department of
Education &
Professional Studies
KING'S College LONDON
Inside the Black Box
Raising Standards Through Classroom Assessment
Paul Black & Dylan Wiliam
GL assessment
the measure of potential
LearningSciencesInternational

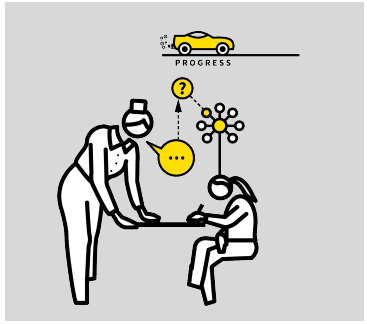
WILIAM'S 5 FORMATIVE ASSESSMENT STRATEGIES



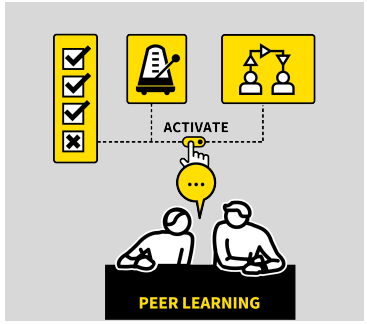
CLARIFY LEARNING INTENTIONS



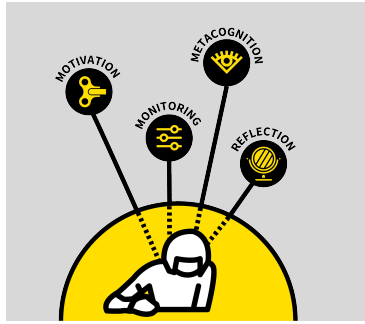
ELICIT EVIDENCE OF LEARNING



FEEDBACK THAT MOVES LEARNERS FORWARD

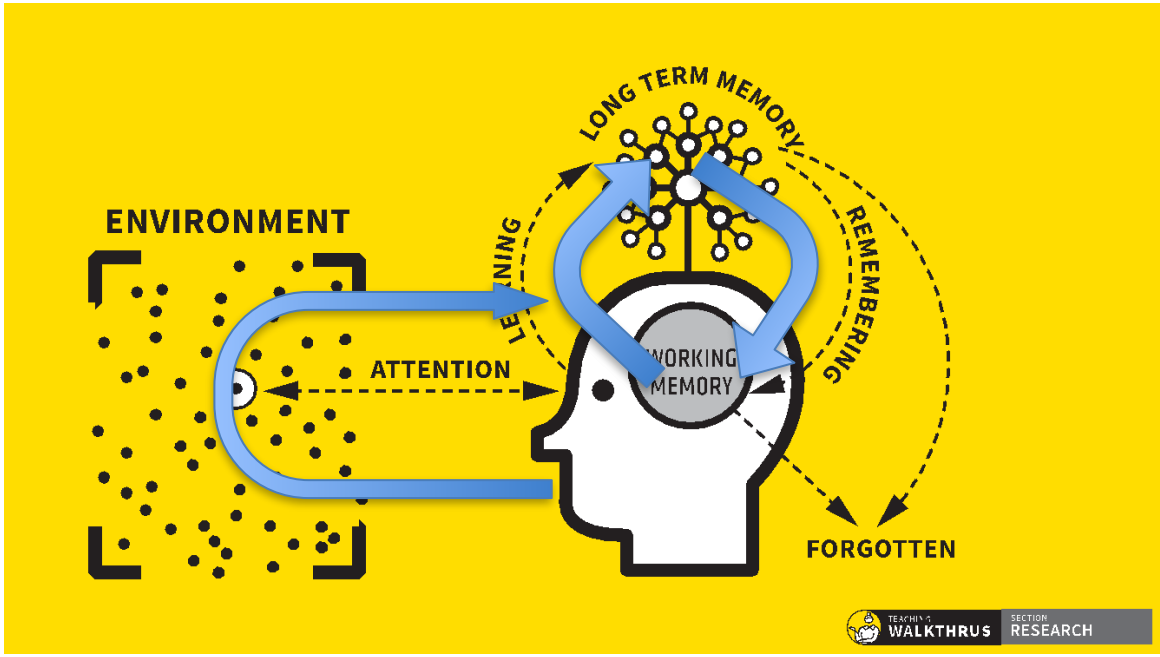


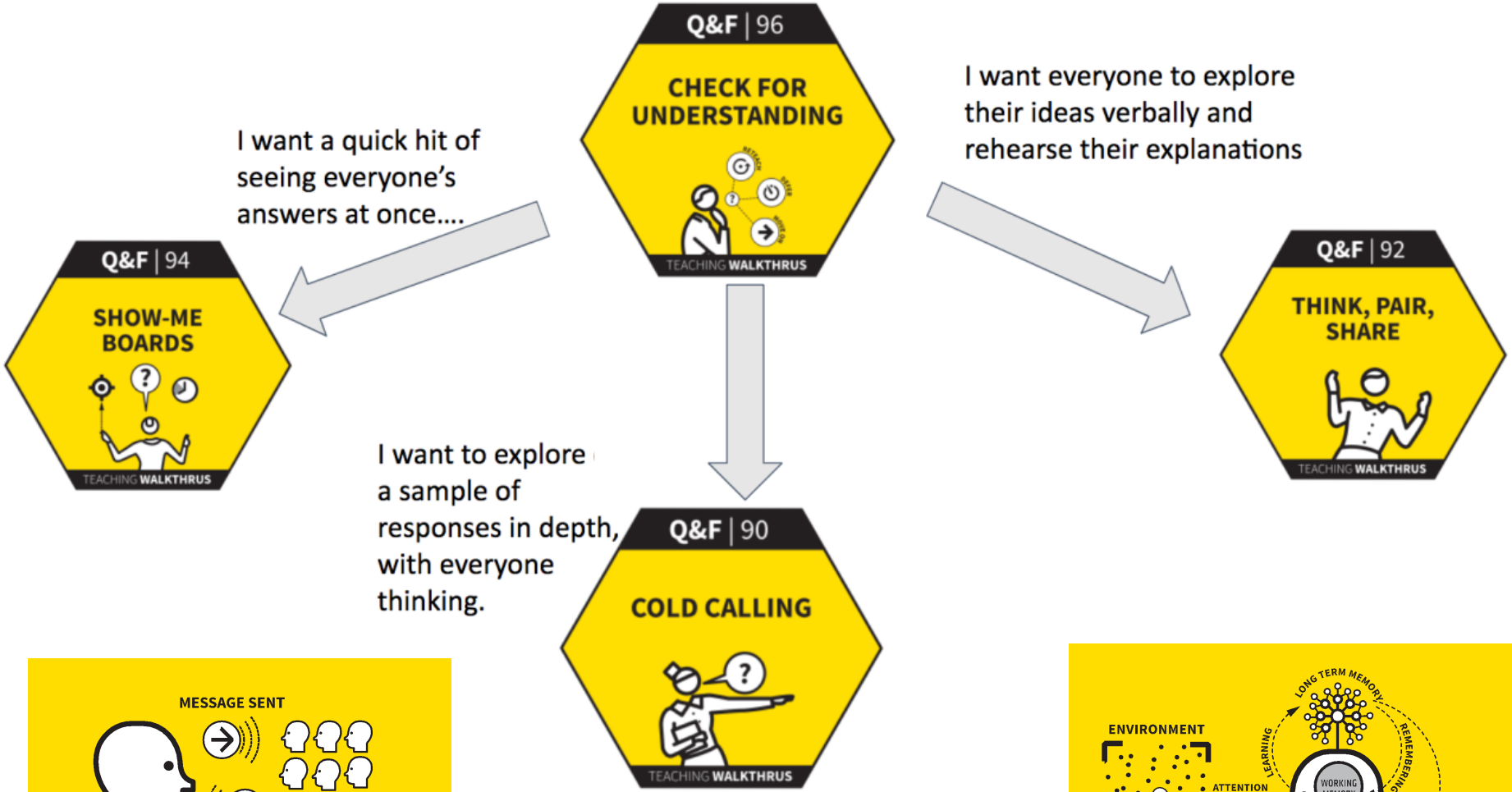
STUDENTS AS LEARNING RESOURCES



STUDENTS AS OWNERS OF THEIR LEARNING

Internal and external feedback loops

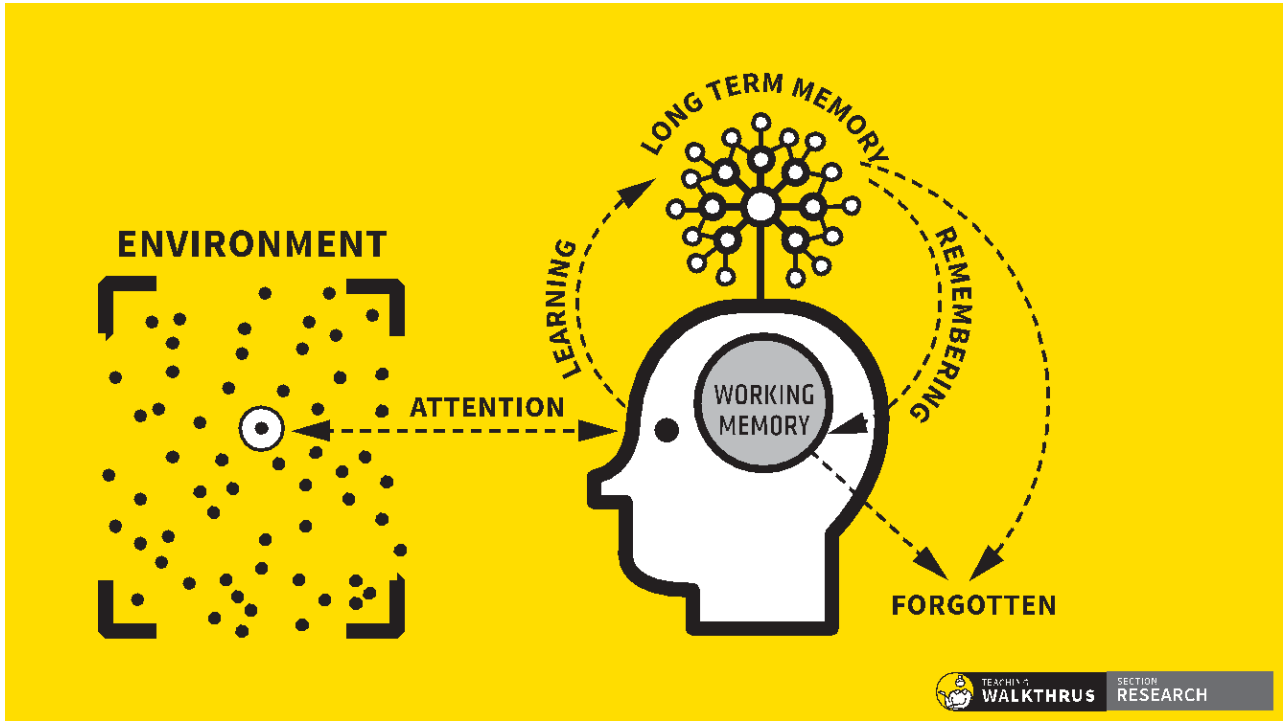



Q&F | 96
CHECK FOR UNDERSTANDING
TEACHING WALKTHRUS
I want a quick hit of seeing everyone's answers at once....
Q&F | 94
SHOW-ME BOARDS
TEACHING WALKTHRUS
I want everyone to explore their ideas verbally and rehearse their explanations
Q&F | 92
THINK, PAIR, SHARE
TEACHING WALKTHRUS
I want to explore a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

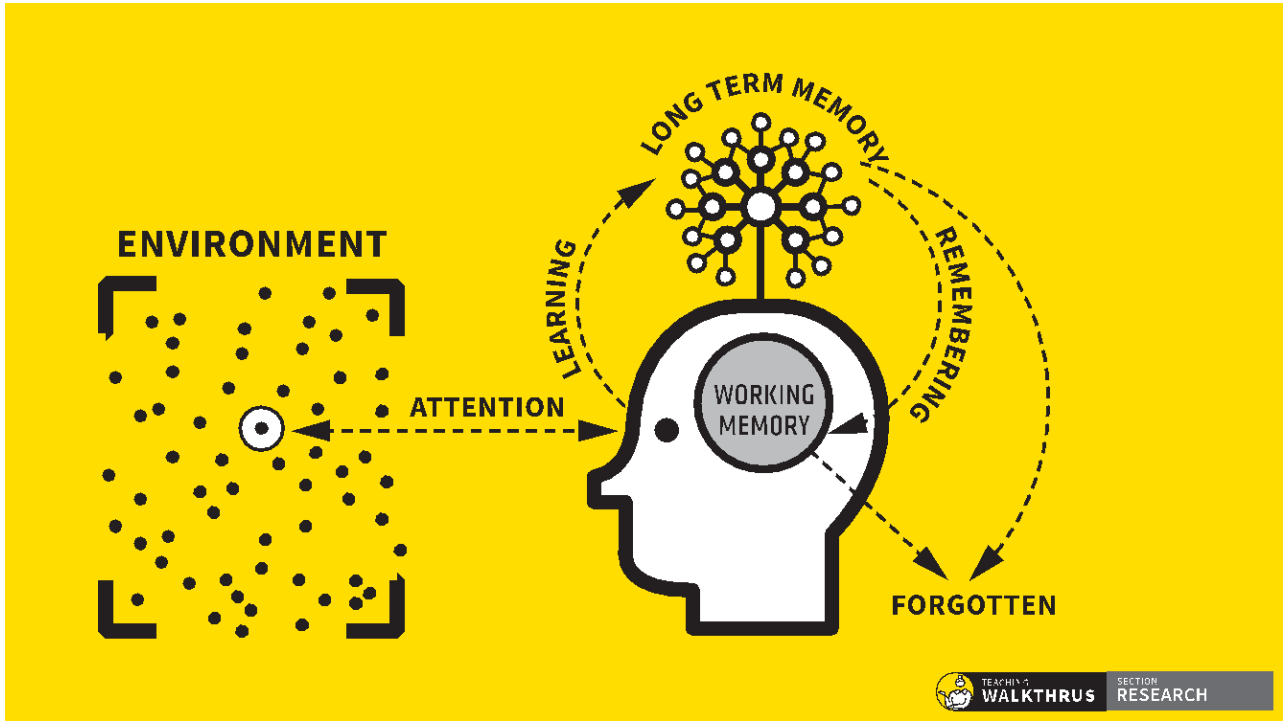
MESSAGE SENT
MESSAGE RECEIVED?

LONG TERM MEMORY
ENVIRONMENT
LEARNING
REMEMBERING
ATTENTION
WORKING MEMORY
FORGOTTEN

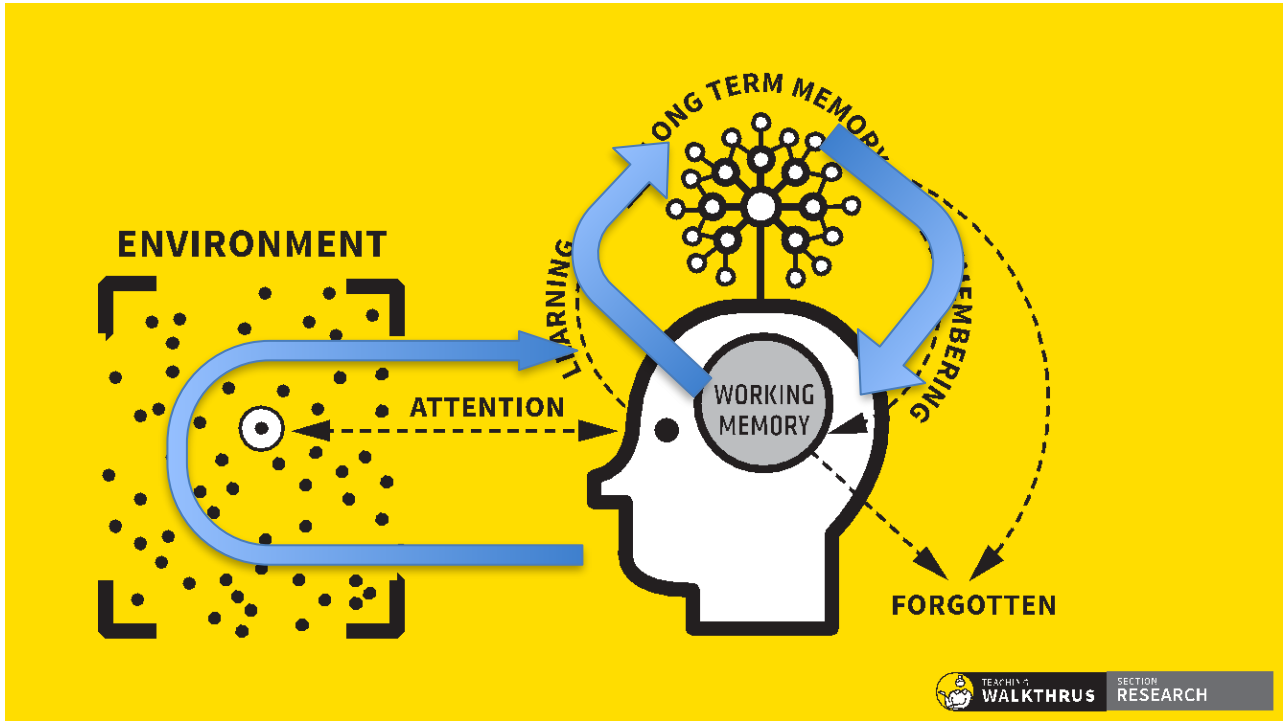
Cold calling, Think-Pair-Share



Collaboration and group work



Creativity in composition



Decision making, evaluation of outcomes, schema building based on the effect of our choices. Fluency with component elements.

‘Evidence-informed wisdom’

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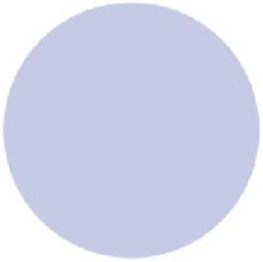
A HISTORY OF THE ATOM: THEORIES AND MODELS

How have our ideas about atoms changed over the years? This graphic looks at atomic models and how they developed.

SOLID SPHERE MODEL



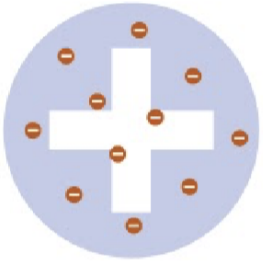
JOHN DALTON

1803

Dalton drew upon the Ancient Greek idea of atoms (the word 'atom' comes from the Greek '*atomos*' meaning indivisible). His theory stated that atoms are indivisible, those of a given element are identical, and compounds are combinations of different types of atoms.

- ⊕ RECOGNISED ATOMS OF A PARTICULAR ELEMENT DIFFER FROM OTHER ELEMENTS
- ⊖ ATOMS AREN'T INDIVISIBLE - THEY'RE COMPOSED FROM SUBATOMIC PARTICLES

PLUM PUDDING MODEL



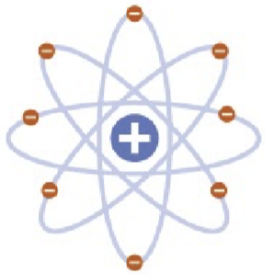
J.J. THOMSON

1904

Thomson discovered electrons (which he called 'corpuscles') in atoms in 1897, for which he won a Nobel Prize. He subsequently produced the 'plum pudding' model of the atom. It shows the atom as composed of electrons scattered throughout a spherical cloud of positive charge.

- ⊕ RECOGNISED ELECTRONS AS COMPONENTS OF ATOMS
- ⊖ NO NUCLEUS; DIDN'T EXPLAIN LATER EXPERIMENTAL OBSERVATIONS

NUCLEAR MODEL



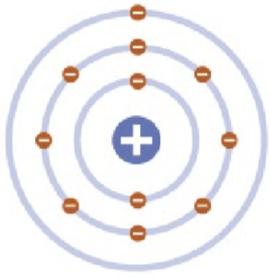
ERNEST RUTHERFORD

1911

Rutherford fired positively charged alpha particles at a thin sheet of gold foil. Most passed through with little deflection, but some deflected at large angles. This was only possible if the atom was mostly empty space, with the positive charge concentrated in the centre: the nucleus.

- ⊕ REALISED POSITIVE CHARGE WAS LOCALISED IN THE NUCLEUS OF AN ATOM
- ⊖ DID NOT EXPLAIN WHY ELECTRONS REMAIN IN ORBIT AROUND THE NUCLEUS

PLANETARY MODEL



NIELS BOHR

1913

Bohr modified Rutherford's model of the atom by stating that electrons moved around the nucleus in orbits of fixed sizes and energies. Electron energy in this model was quantised; electrons could not occupy values of energy between the fixed energy levels.

- ⊕ PROPOSED STABLE ELECTRON ORBITS; EXPLAINED THE EMISSION SPECTRA OF SOME ELEMENTS
- ⊖ MOVING ELECTRONS SHOULD EMIT ENERGY AND COLLAPSE INTO THE NUCLEUS; MODEL DID NOT WORK WELL FOR HEAVIER ATOMS

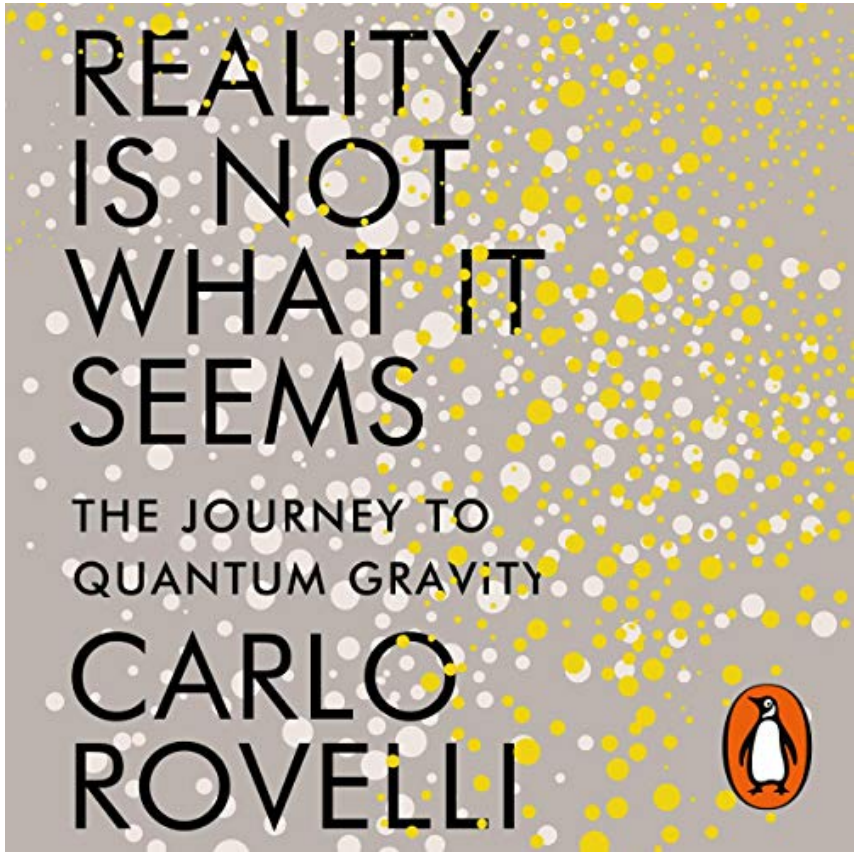
QUANTUM MODEL

ERWIN SCHRÖDINGER

1926

Schrödinger stated that electrons do not move in set paths around the nucleus, but in waves. It is impossible to know the exact location of the electrons; instead, we have 'clouds of probability' called orbitals, in which we are more likely to find an electron.

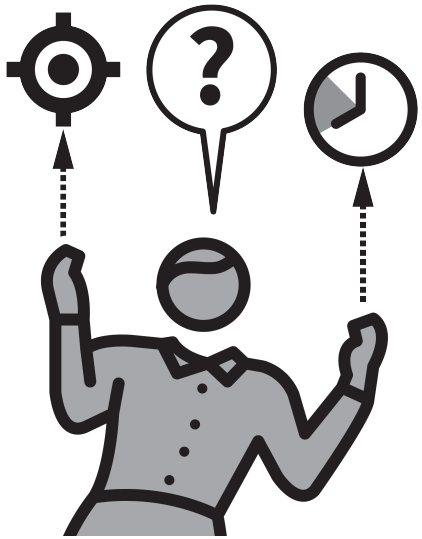
- ⊕ SHOWS ELECTRONS DON'T MOVE AROUND THE NUCLEUS IN ORBITS, BUT IN CLOUDS WHERE THEIR POSITION IS UNCERTAIN
- ⊕ STILL WIDELY ACCEPTED AS THE MOST ACCURATE MODEL OF THE ATOM



- If we are certain of nothing, how can we possibly rely on what science tells us? The answer is simple:
- Science is not reliable because it provides certainty. It is reliable because it provides us with the best answers we have at present….
- It is precisely its openness, the fact that it constantly calls current knowledge into question, which guarantees that the answers it offers are the best so far available.

- *Reality is not what it seems. The journey to quantum gravity. Carlo Rovelli 2017*

Thank you!



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