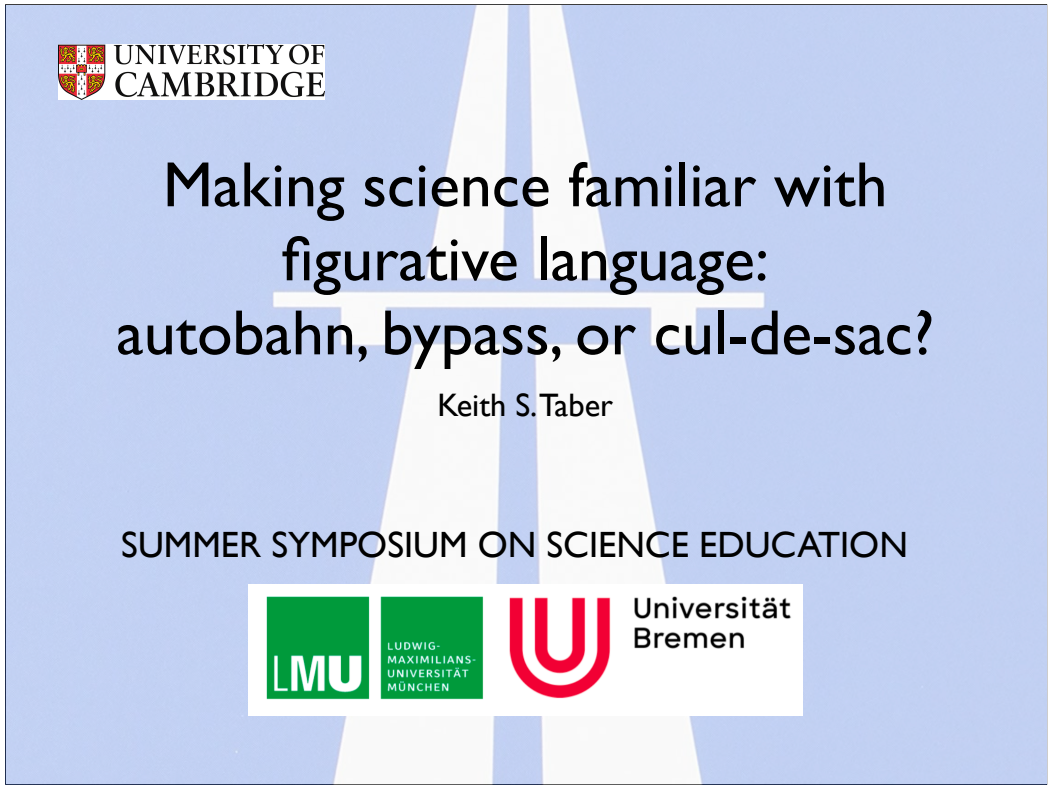


Taber, K. S. (2024) Making science familiar with figurative language:
autobahn, bypass, or cul-de-sac? Invited presentation: Summer Symposium on Science Education organised by Ludwig-Maximilians-Universität München / University of Bremen (online)

This presentation presents a simple model encompassing different forms of figurative language used in communicating science, and consider the requirements for using familiar comparisons to introduce science concepts.

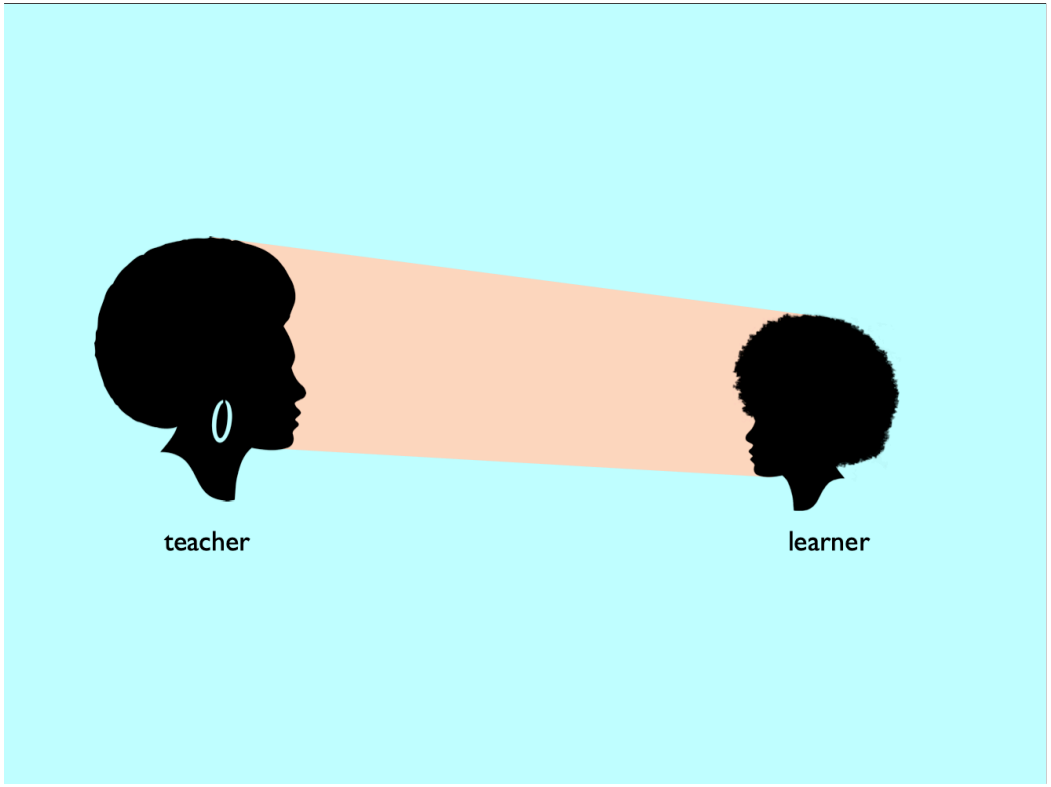
Plan of talk

Motivation: teaching as making the unfamiliar familiar

The teacher-learner system and the role of interpretation

Types of figurative language

Interpreting some examples

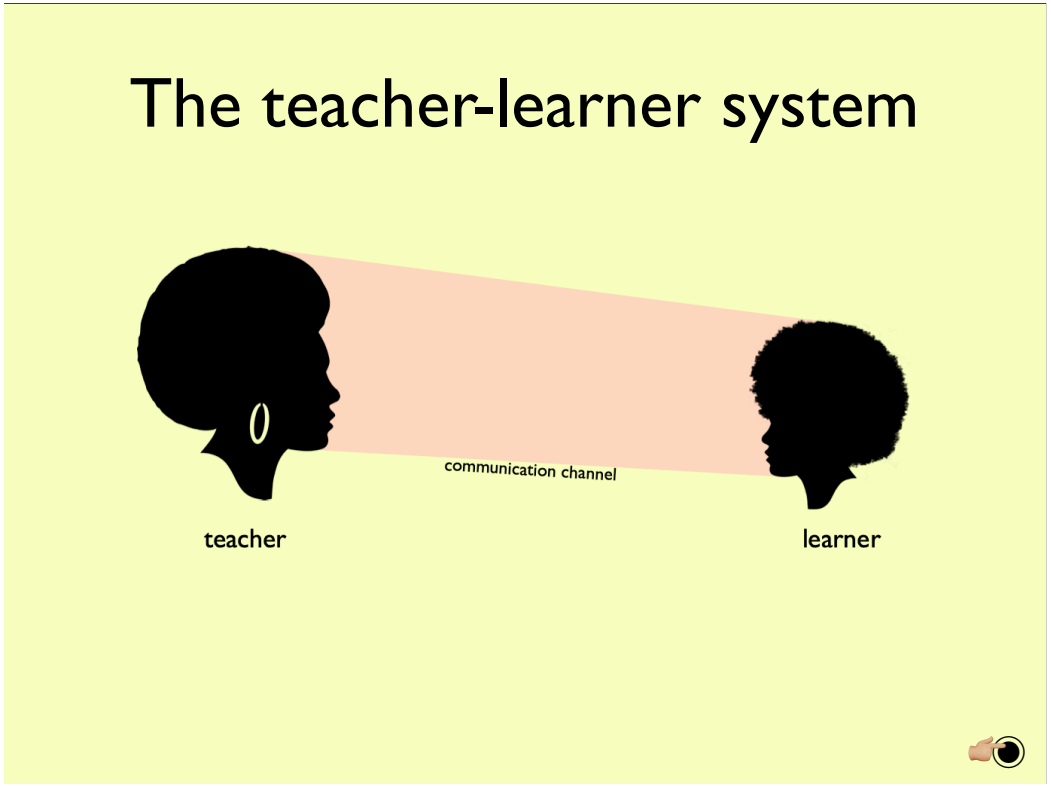


The focus is here is on teaching as requiring the learner to appreciate the teacher's meanings.

Motivation

Teaching is about making the unfamiliar familiar

by pointing, showing, modelling, gesturing, telling, narrating, simulating…



The communication channel may simple mean the learner watching and listening to a teacher in class (which requires a clear view, low level of background noise, etc)., but it could be via a video link etc.

A text…

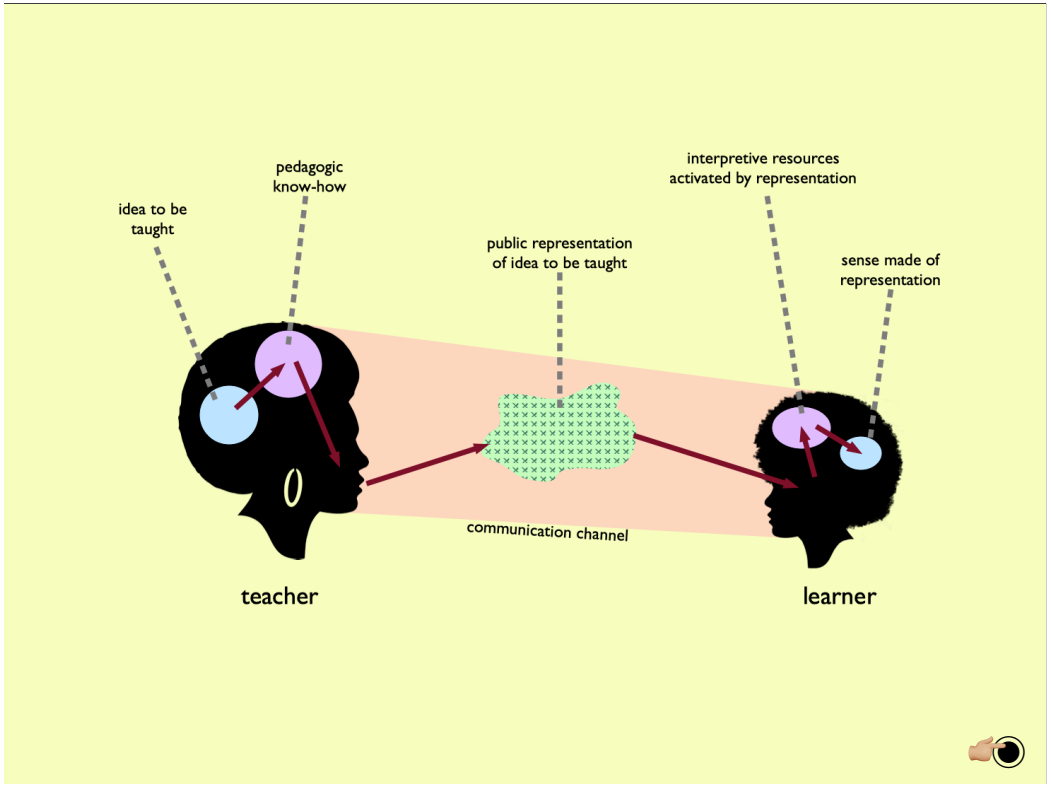
has no inherent meaning

may have an intended meaning

may have an interpreted meaning

(*may have multiple interpreted meanings*)

these need not be the same



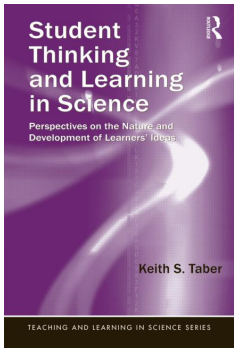
What is publicly available is not the teacher's ideas, but a representation of them (in speech drawing etc.) that the learner has to make sense of, drawing on the mental 'interepretive resources' they have available.

learning is

incremental

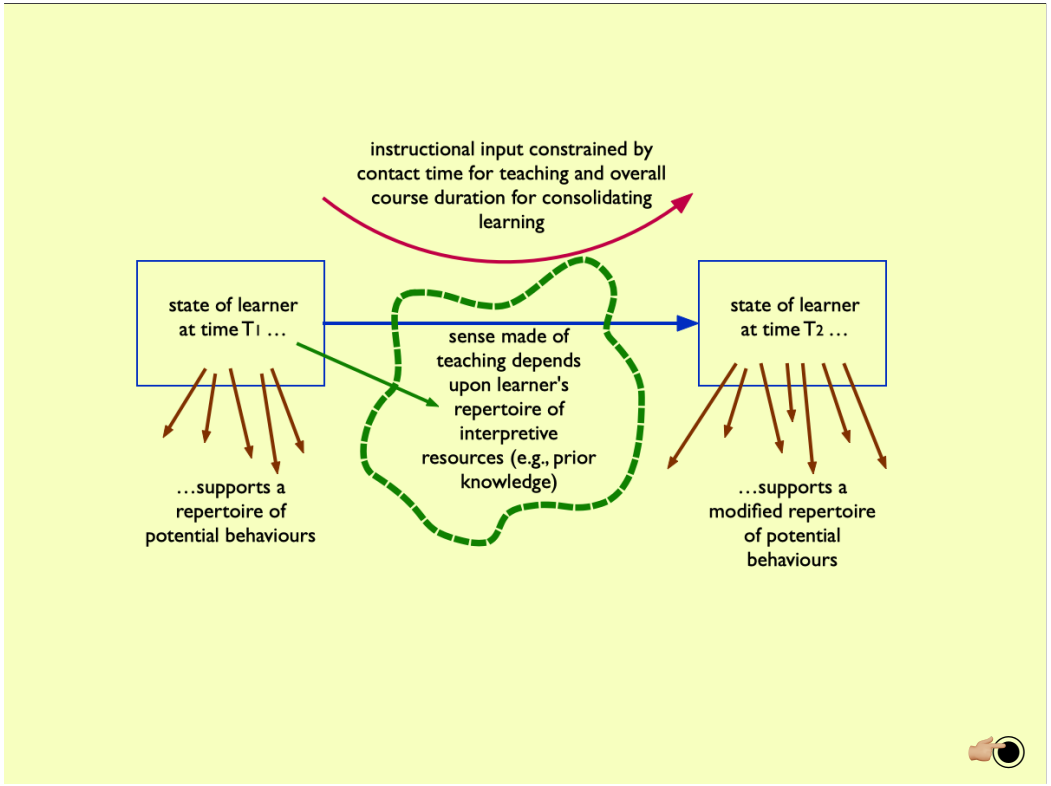
interpretive

iterative

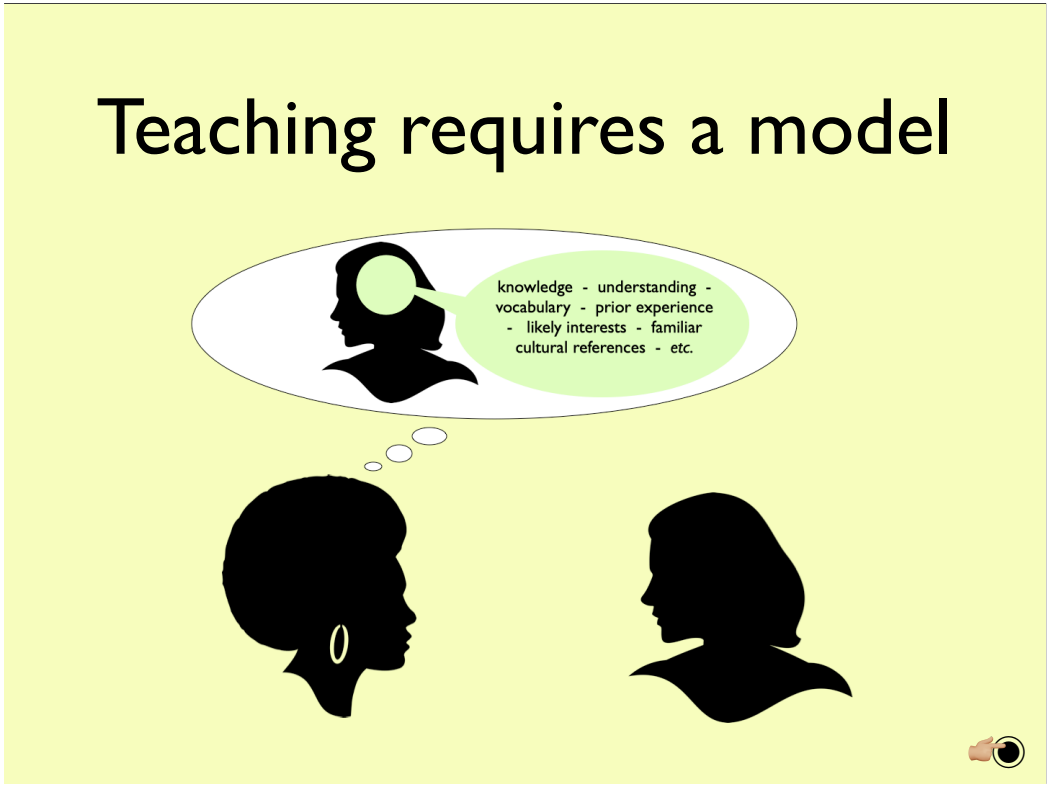


A Constructivist Perspective

Put simply, the constructivist perspective rejects the notion of the learner as computer-like device with an input channel that allows a large amount of data to be fed in, and a memory store that can keep neatly catalogued and discrete inputs for future reference. Instead the apparatus of human cognition is understood quite differently (and indeed more in keeping what research in cognitive psychology and the learning sciences suggest is really going on). Learning is seen as being iterative, interpretive, and incremental.

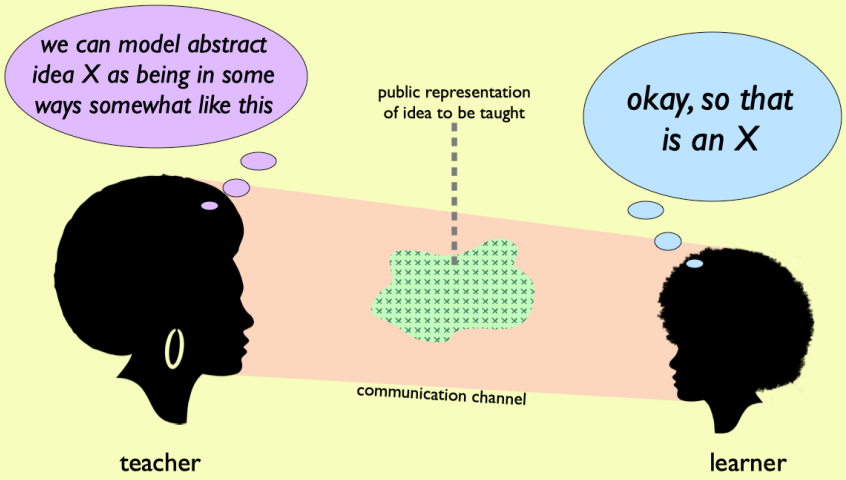


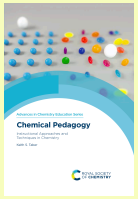
The learner's set of interpretive resources is developed by teaching - but also determines how that teaching is understood. (That is, misinterpretation can happen, leading to new misconceptions. Newly acquired interpretive resources can then themselves lead to misinterpreting subsequent teaching.)

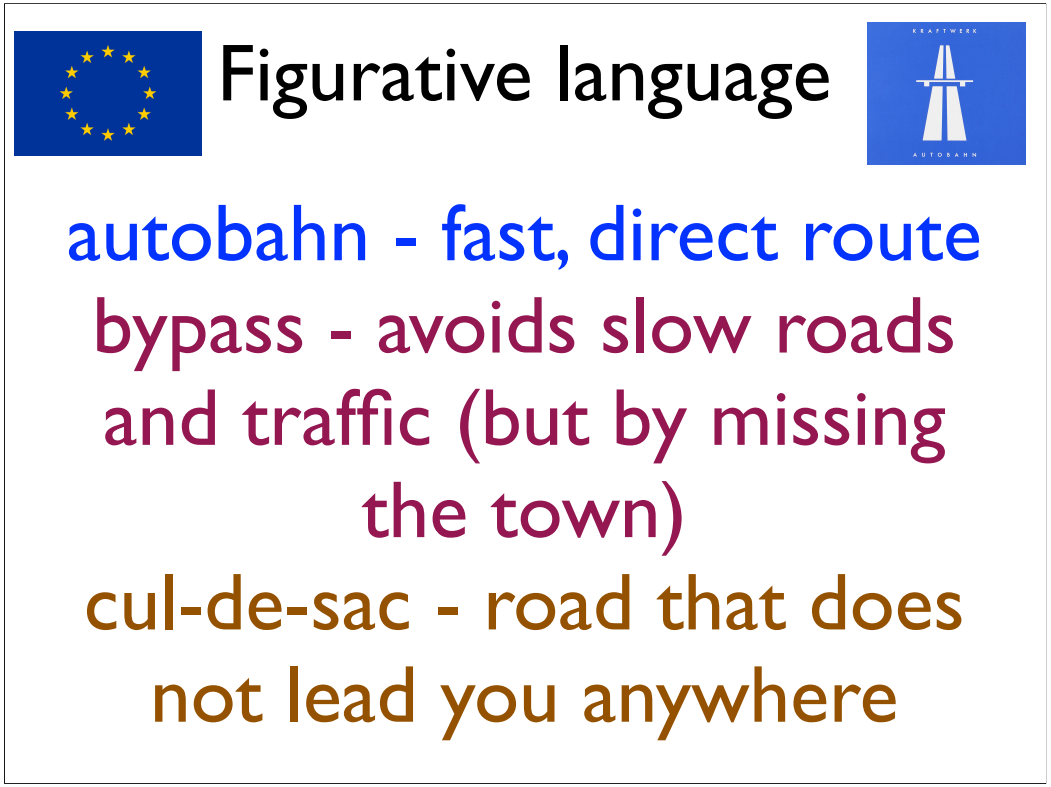


Effective teaching relies on the teacher having a mental model of the learner, so to represent ideas in ways the learner is ready to make sense of.

learners may lack *epistemological* sophistication

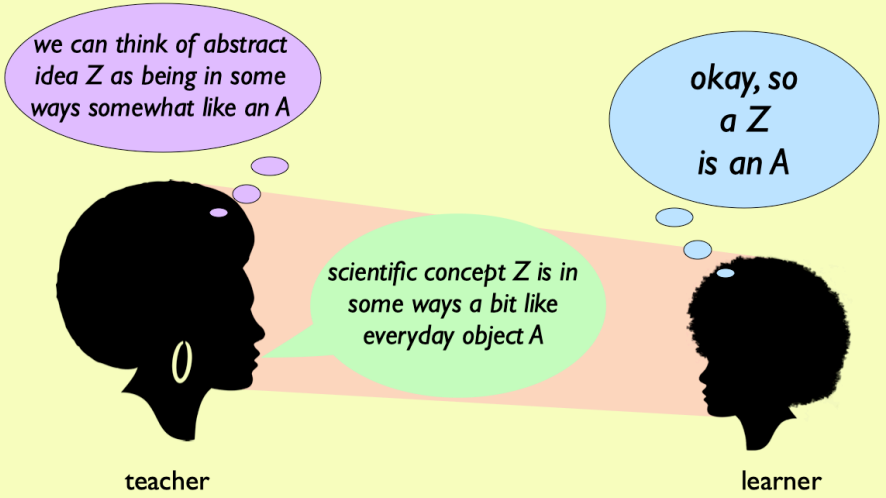




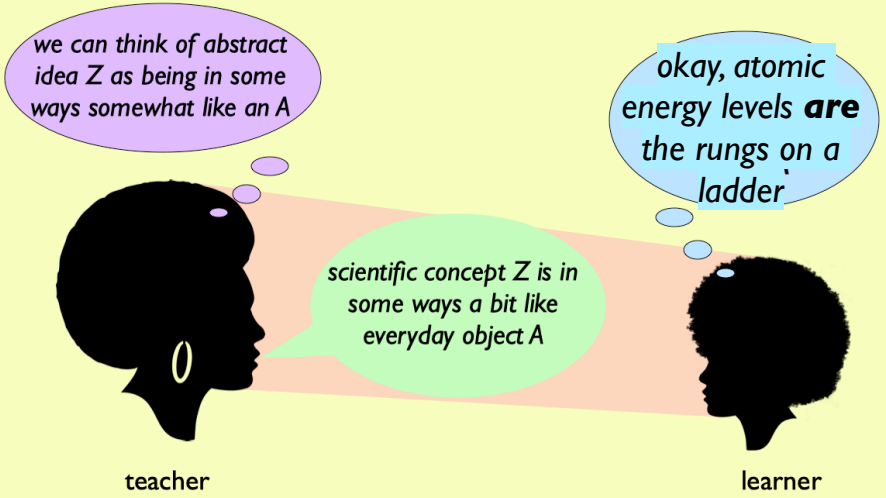


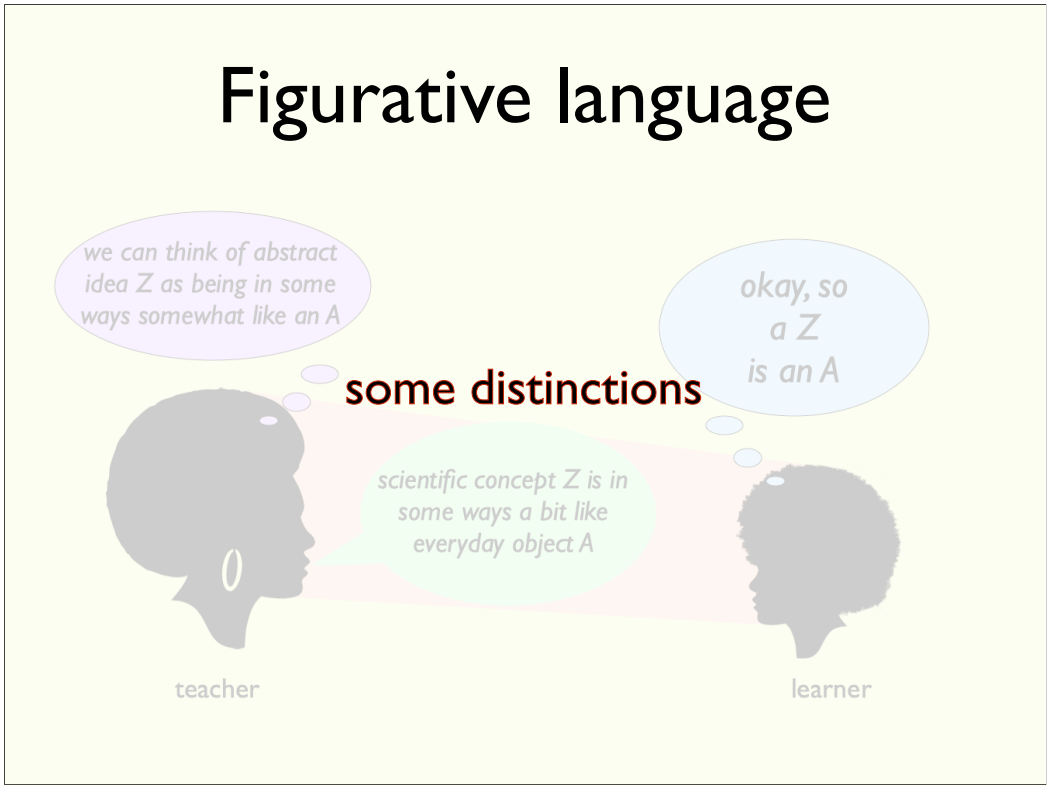
My title makes use of figurative language, offering metaphors for possible teaching-learning outcomes.

Figurative language



Figurative language





I am going to offer a simple model of types of figurative language used to communicate science.

Figurative language

simile

Starting with simile.

simile

…is like a…

…as a…

simile

…is, so to speak / in a manner of speaking / so to say, a…

…is a '…'…

…kind of…

…sort of…

simile

…is like a…

…-like…

…as a…

simile

…is, so to speak / in a manner of speaking / so to say, a…

…is a '…'…

…kind of…

…sort of…

simile

…is like a…

…as a…

…is, so to speak / in a manner of speaking / so to say, a…

…is a '…'…

…kind of…

…sort of…

…-like…

simile

"…hair-like…
wire-like…
vase-like…
urn-like…
necklace-like
…cushion-like
…wart-like…"

Figurative language

adjectives: tall, strong, flexible, labile, bright, powerful, indistinct, colourless…

simile

adjectivised nouns

nouns: membrane, lance…

"…hair-like…wire-like…vase-like…urn-like…necklace-like…cushion-like…wart-like…"

"…yellowish brown membranaceous lanceolate scales…"

Figurative language

adjectives: tall, strong, flexible, labile, bright, powerful, indistinct, colourless…

simile

adjectivised nouns

nouns: membrane, lance…

"…hair-like…wire-like…vase-like…urn-like…necklace-like…cushion-like…wart-like…"

membrane-like

"…yellowish brown membranaceous lanceolate scales…"

lance-like

Figurative language

"For example, the Vaucheria sessilis consists of one long branched cell; on the same side of it two swellings appear near to each other, one of which elongates, curls round like a horn, and is soon filled with snake-shaped filaments having long cilia at their thin end, with which they move rapidly both within the horn, and after they come out of it into the water."

Figurative language

"They appear in large expansions of red, golden yellow, grey or white, on barren heaths, under plantations, and on the stems of aged trees; while others of them often hang from the branches like long shaggy grey hair, and many form forests of miniature bushes on the northern plains."

Figurative language

"The order Caliciei consists of horizontal lichens, with generally an ill-developed crust; the discs, which are at first covered by a veil, are contained in a stalked, or more rarely sessile, excipulum, looking like little flat headed pins stuck into the crust; the veil at length vanishes, and exposes a pulverulent mass of spores, which adhere so loosely in the Calicium inquinans, that they soil the finger if touched; in other cases they come out of their ascus like little necklaces."

Figurative language

"This is the youthful state of the Marchantia polymorpha, but after a time green points appear from under little reddish scales on the surface, and these are developed into stalks an inch or less in height, which terminate differently, some in lobed shields, others in spoked whorls, like a carriage wheel without the rim"

Figurative language

Mary Somerville (1869). *On Molecular and Microscopic Science*

these types of similes are descriptive and generally clear

but they *rely on shared cultural references*

Figurative language

"The fertile fronds, in certain groups, differ in form from the sterile, generally by the greater or less contraction of their parts. In most ferns the full-grown fronds are flat, that is, with all their parts lying in one plane; but, during their vernation, that is, when they first rise from the stem, they are circinate or curled inwards, like a crosier"

Some examples.

A document with many more examples – ***Creative Comparisons: Making Science Familiar through Language***. *An illustrative catalogue of figurative comparisons and analogies for science concepts* – can be downloaded from: https://science-education-research.com/downloads/publications/2025/Taber-Science-Comparisons.pdf

Figurative language

simile

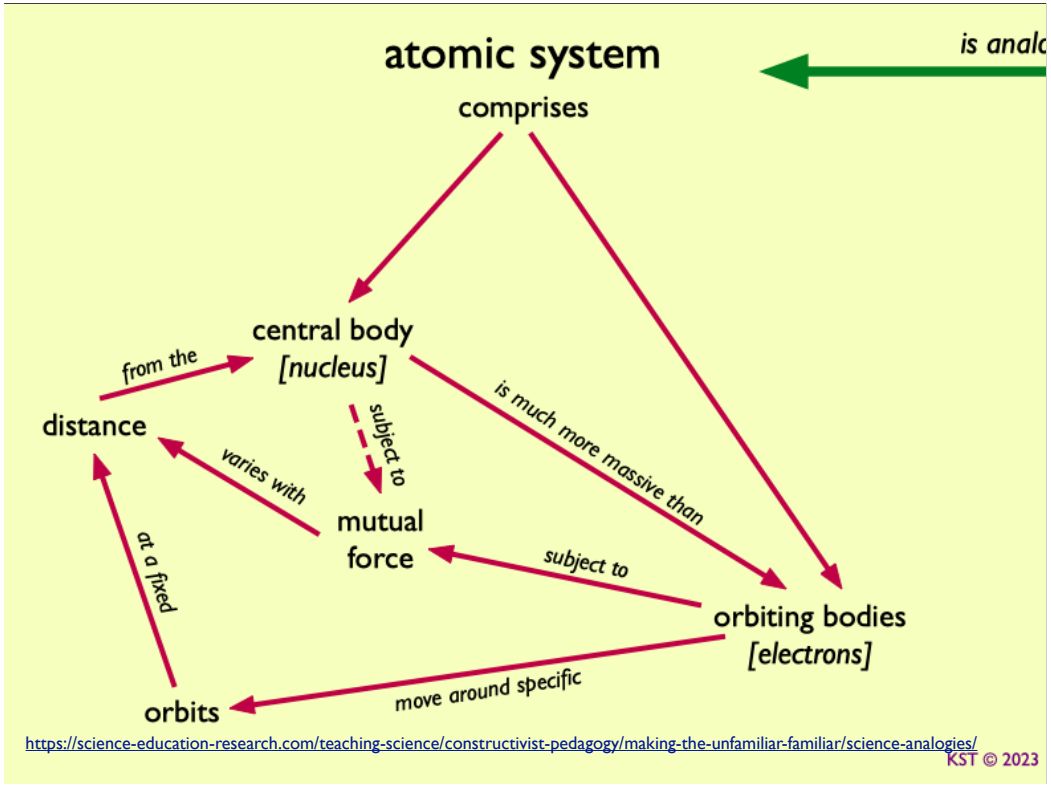
adjectivised nouns

analogy

analogy

An analogy is a comparison between two things that shows how they are in some sense structurally similar. The analogue (the thing that something of interest is said to be like) is said to map onto the target (the thing of focal interest).

Analogy goes beyond simile.


atomic system
is analo
comprises
central body
[nucleus]
from the
distance
subject to
is much more massive than
varies with
mutual
force
subject to
orbiting bodies
[electrons]
at a fixed
move around specific
orbits
https://science-education-research.com/teaching-science/constructivist-pedagogy/making-the-unfamiliar-familiar/science-analogies/
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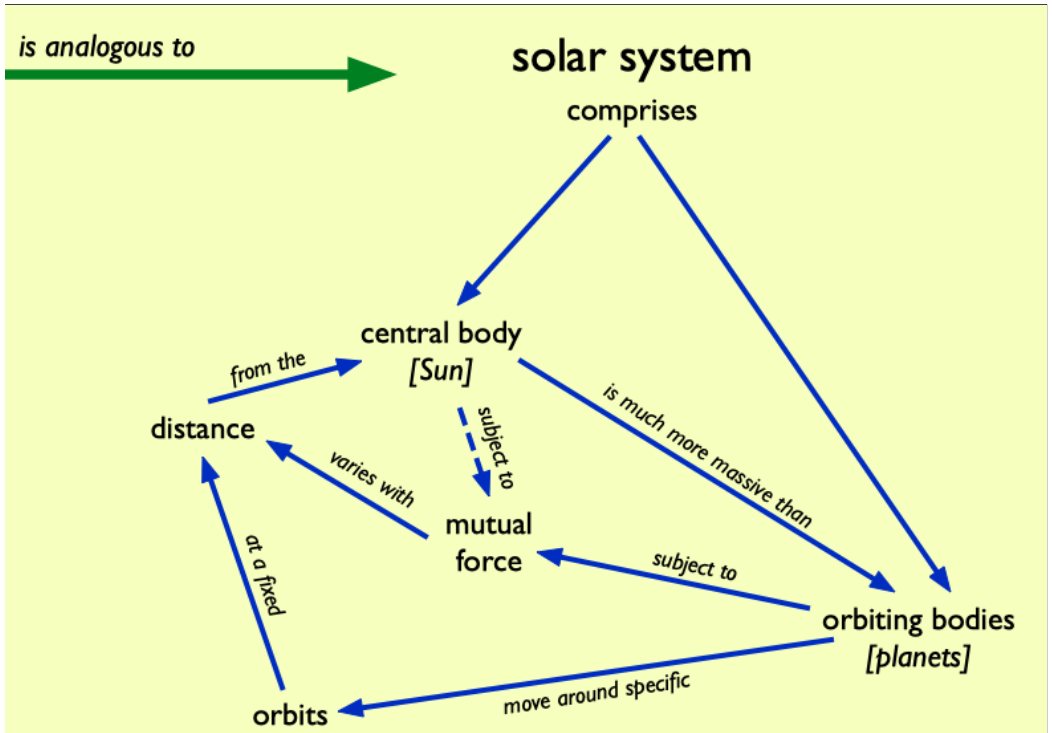
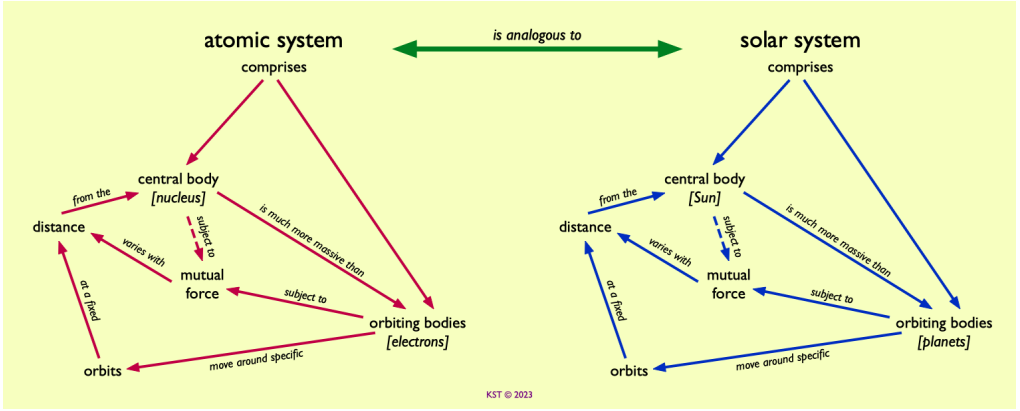


https://science-education-research.com/teaching-science/constructivist-pedagogy/making-the-unfamiliar-familiar/science-analogies/

analogy

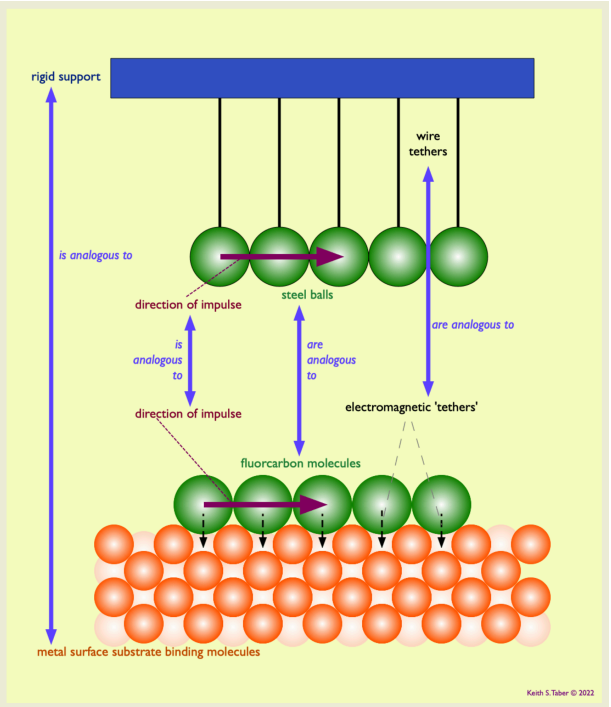


analogy

https://science-education-research.com/teaching-science/constructivist-pedagogy/making-the-unfamiliar-familiar/science-analogies/

"Scientists in Canada have succeeded in setting off a chain of reactions in which fluorine atoms are passed between molecules tethered to a copper surface. The sequence can be repeated in alternating directions, *mimicking* the to-and-fro motions of a Newton's cradle."

Chemistry World

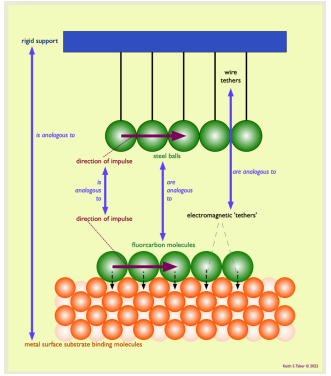


https://science-education-research.com/a-molecular-newtons-cradle/

"Scientists in Canada have succeeded in setting off a chain of reactions in which fluorine atoms are passed between molecules tethered to a copper surface. The sequence can be repeated in alternating directions, mimicking the to-and-fro motions of a Newton's cradle."

Chemistry World

"What was more, each CF_3 had been flipped in the process, so **the Newton's cradle** as a whole was a mirror image of how it had begun, giving the potential for a reverse swing. Unlike a desk Newton's cradle, it did not swing back on its own accord, but another electron impulse could be used to set it off."



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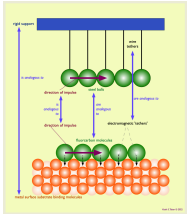
significant 'negative analogy' feature!



https://science-education-research.com/a-molecular-newtons-cradle/

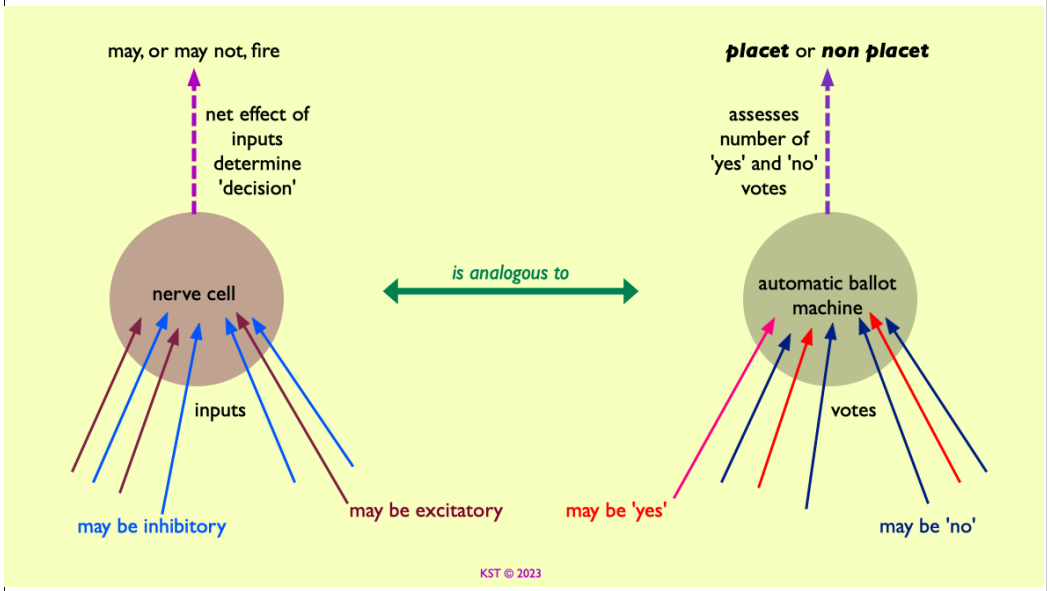
"…most nerve cells receive inputs, in the form of  neurotransmitters, from many different cells, so the 'decision' about whether or not the cell should fire depends on the net effect of all the different inputs, some of which will be excitatory, and some inhibitory, with the pattern of input perhaps varying all the time.

So any single nerve cell acts like an [sic] tiny automatic ballot machine, assessing the number of 'yes' and 'no' votes entering it at any one time and either firing or not firing depending on which type of vote predominates at any one time.

…Nerve cells receive electrochemical signals from other cells, and each signal represents a 'yes' or a 'no' vote in an election to determine whether the cell should fire."

Vital Principles: The molecular mechanisms of life.

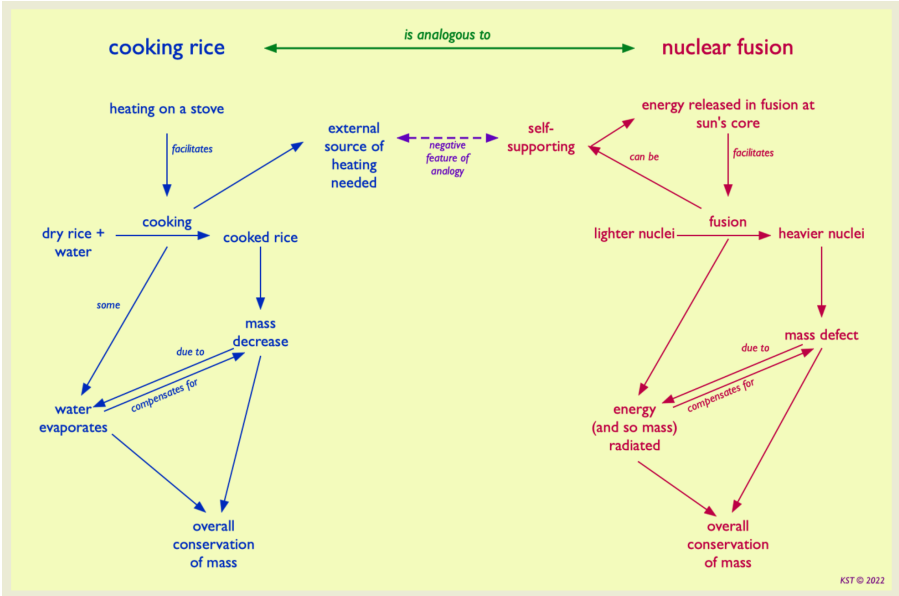
https://science-education-research.com/making-molecular-mechanisms-familiar/



Vital Principles: The molecular mechanisms of life.

https://science-education-research.com/making-molecular-mechanisms-familiar/

a teaching analogy for explaining why mass defect does not contradict conservation of mass



https://science-education-research.com/the-complicated-social-lives-of-stars/

a teaching simile for explaining why mass defect does not contradict conservation of mass

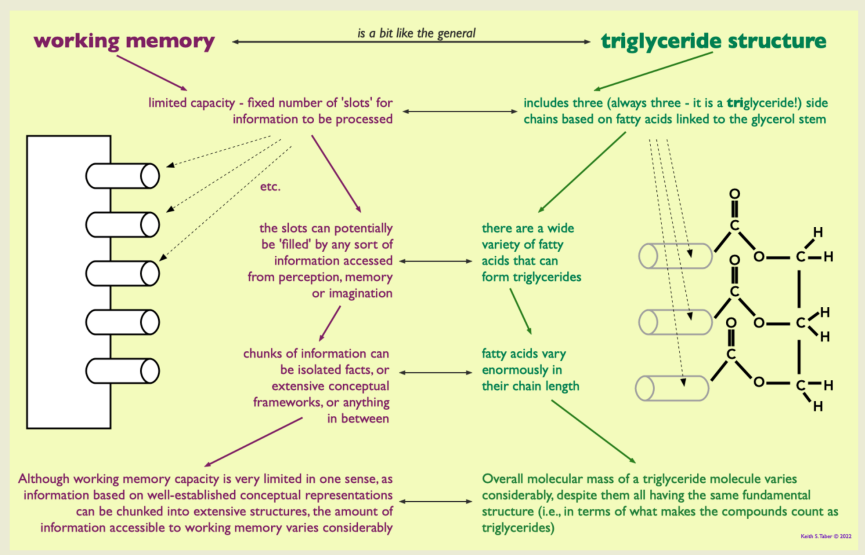
mass - energy is like pounds X euros?

pounds - pence

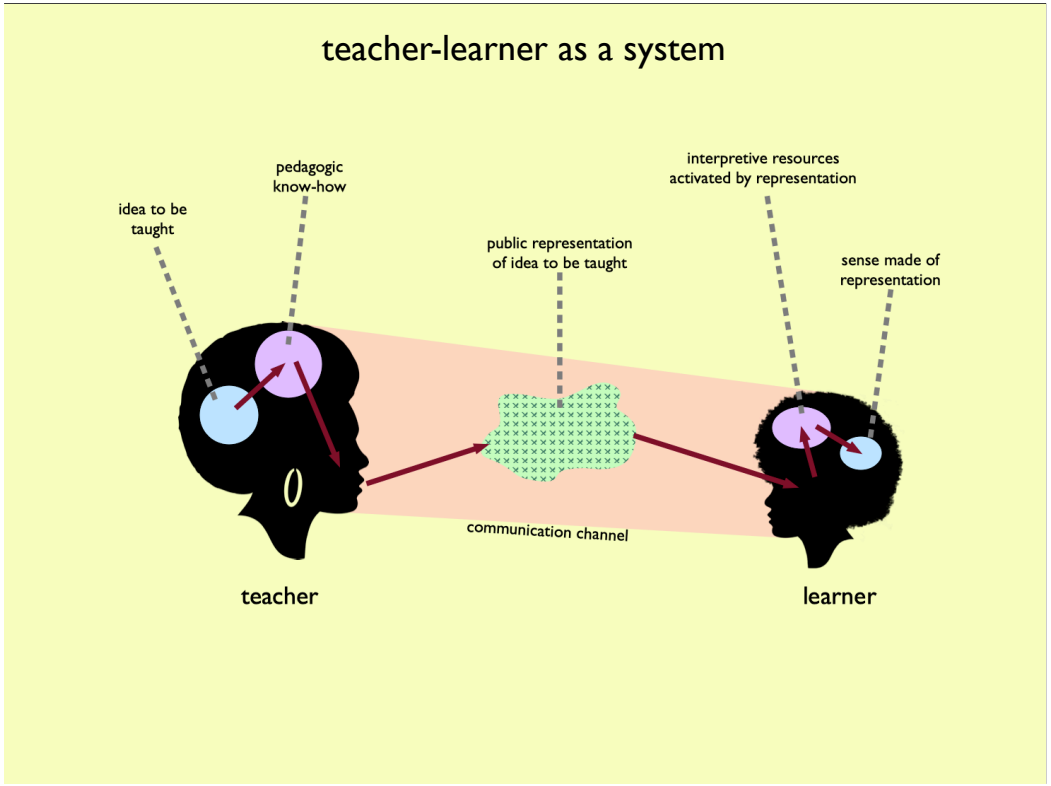
(or euros - cents)

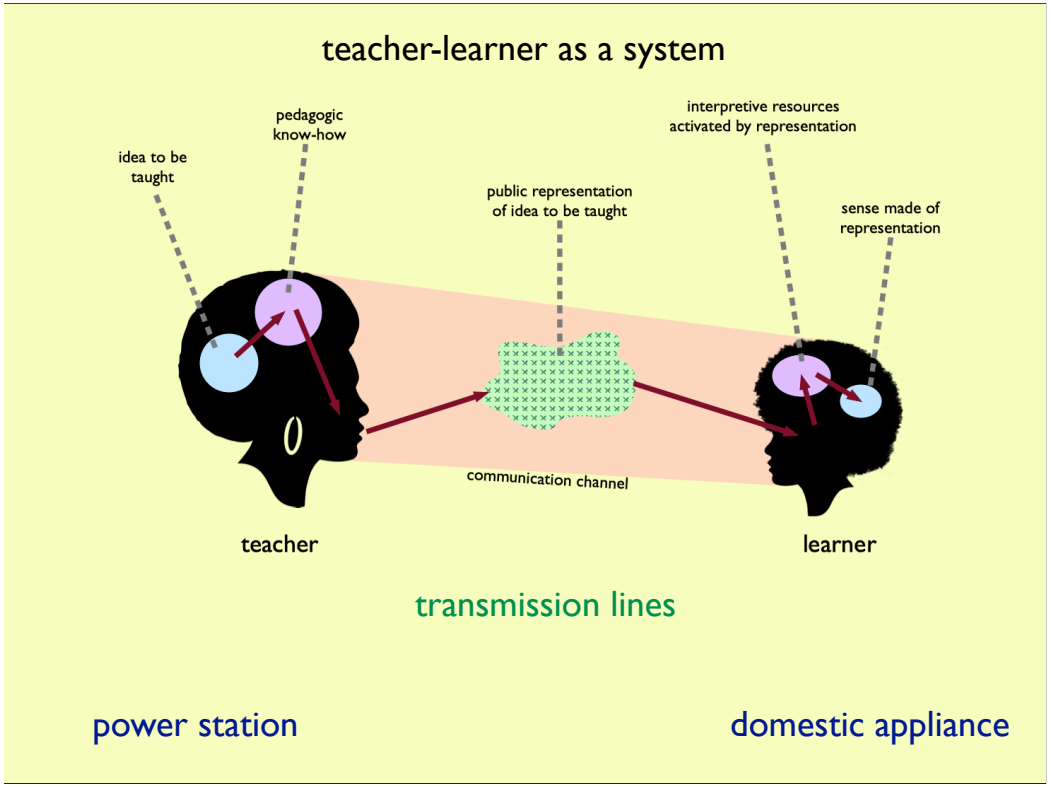
https://science-education-research.com/the-complicated-social-lives-of-stars/

an analogy for explaining how chunking allows experts to hold more information in mind than novices with the same working memory capacity

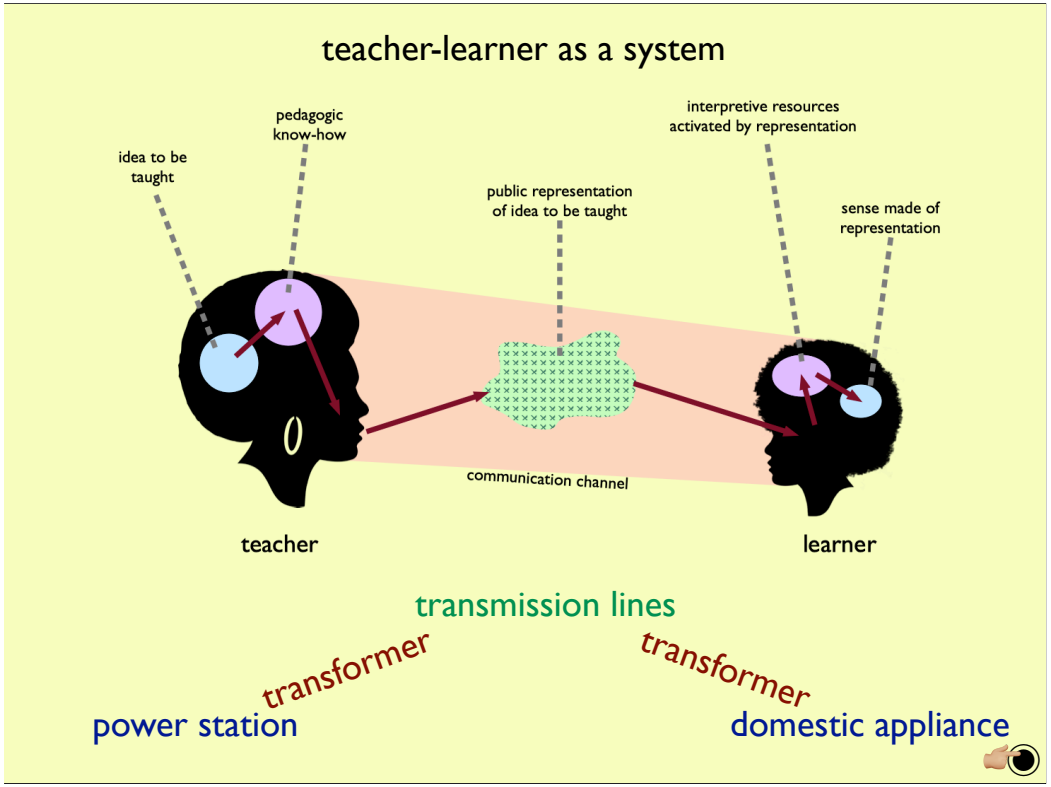


https://science-education-research.com/how-fat-is-your-memory/


teacher-learner as a system
idea to be taught
pedagogic know-how
public representation of idea to be taught
interpretive resources activated by representation
sense made of representation
communication channel
teacher
learner



To offer an analogy…



Analogy discussed in Taber, K. S. (2024). Chemical Pedagogy. Instructional Approaches and Teaching Techniques in Chemistry. Royal Society of Chemistry.

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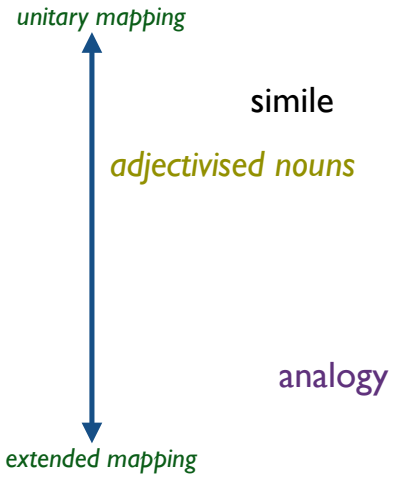
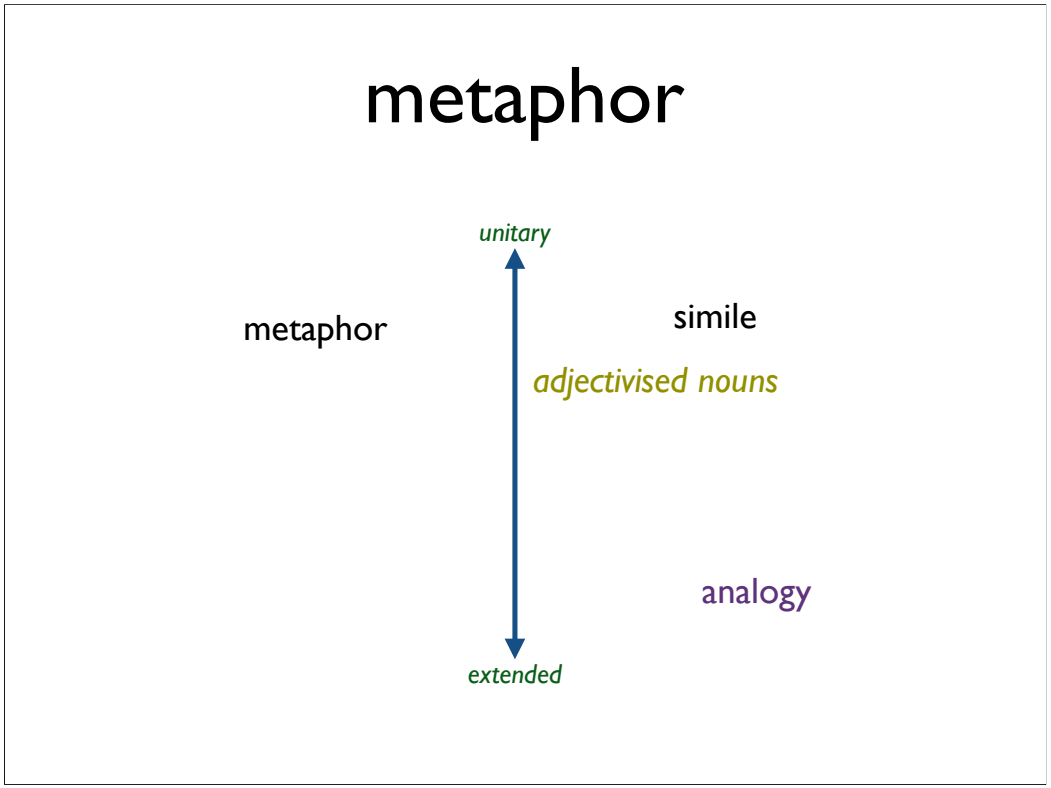
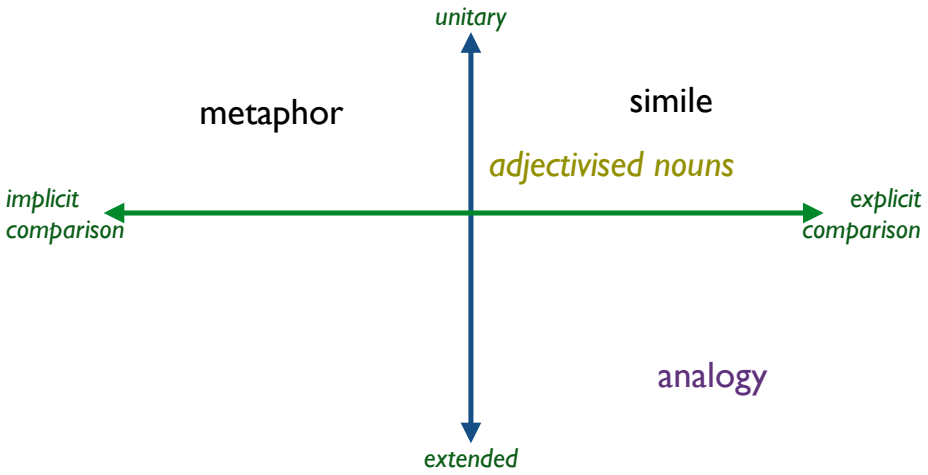
Figurative language





Then there are metaphors (which fall short of simile).

Figurative language



Figurative language

"The order Caliciei consists of horizontal lichens, with generally an ill-developed crust; the discs, which are at first covered by a veil, are contained in a stalked, or more rarely sessile, excipulum, looking like little flat headed pins stuck into the crust; the veil at length vanishes, and exposes a pulverulent mass of spores, which adhere so loosely in the Calicium inquinans, that they soil the finger if touched; in other cases they come out of their ascus like little necklaces."

(Not 'something like a veil', but 'a veil').

‘birth’ of metaphor?

Figurative language

"For example, the Vaucheria sessilis consists of one long branched cell; on the same side of it two swellings appear near to each other, one of which elongates, curls round like a horn, and is soon filled with snake-shaped filaments having long cilia at their thin end, with which they move rapidly both within the horn, and after they come out of it into the water."

A simile, that slips into metaphor.

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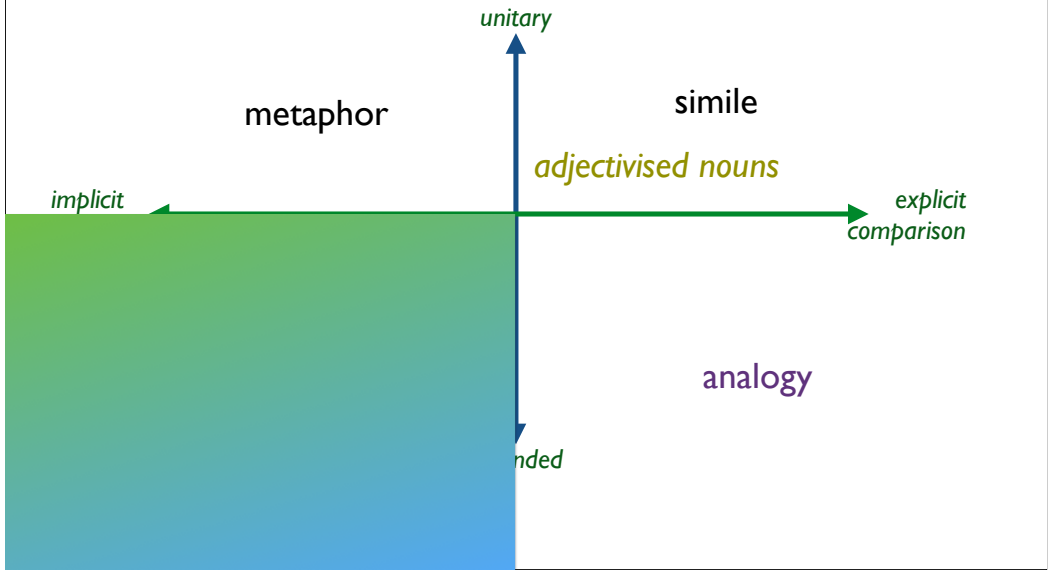
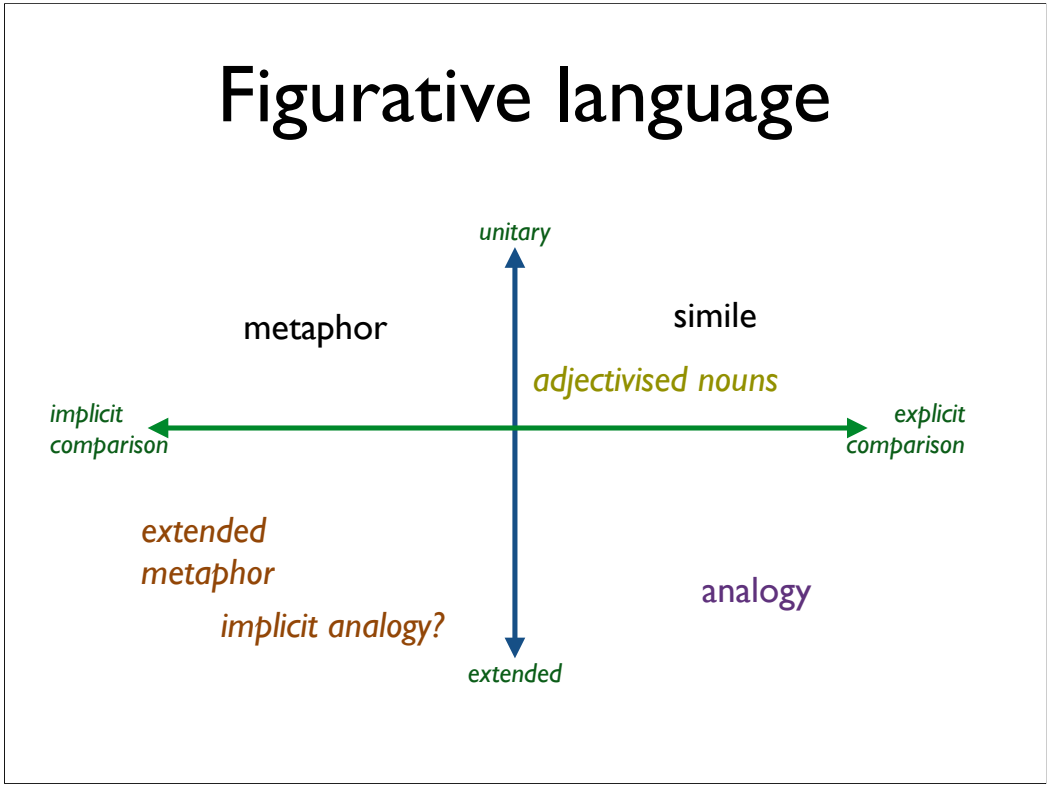
Figurative language





Extended metaphor goes beyond a simple metaphor.

An implicit analogy is a simile partially explained, but without the full mapping of an analogy.

extended metaphor

"At the core of nuclear physics lies a tug of war between two of the four fundamental forces: on one side, the strong nuclear force acts to hold the nucleus together by binding the protons to the neutrons; on the other, electromagnetism acts to blow it apart by repelling the positively charged protons. The strong nuclear force is the strongest force in nature, and in the lighter, smaller nuclei it easily wins out, making nuclear fusion of these elements highly exothermic.

The strongest of the forces it may be, but the strong nuclear force only acts over very short distances. The range of the electromagnetic force is infinite, however, despite its strength decaying with distance. As nuclei get larger, therefore, the battle between the two gets more even, and eventually electromagnetism begins to win."

Chemistry World

implicit analogy

"At the core of nuclear physics lies a tug of war between two of the four fundamental forces: on one side, the strong nuclear force acts to hold the nucleus together by binding the protons to the neutrons; on the other, electromagnetism acts to blow it apart by repelling the positively charged protons. The strong nuclear force is the strongest force in nature, and in the lighter, smaller nuclei it easily wins out, making nuclear fusion of these elements highly exothermic.

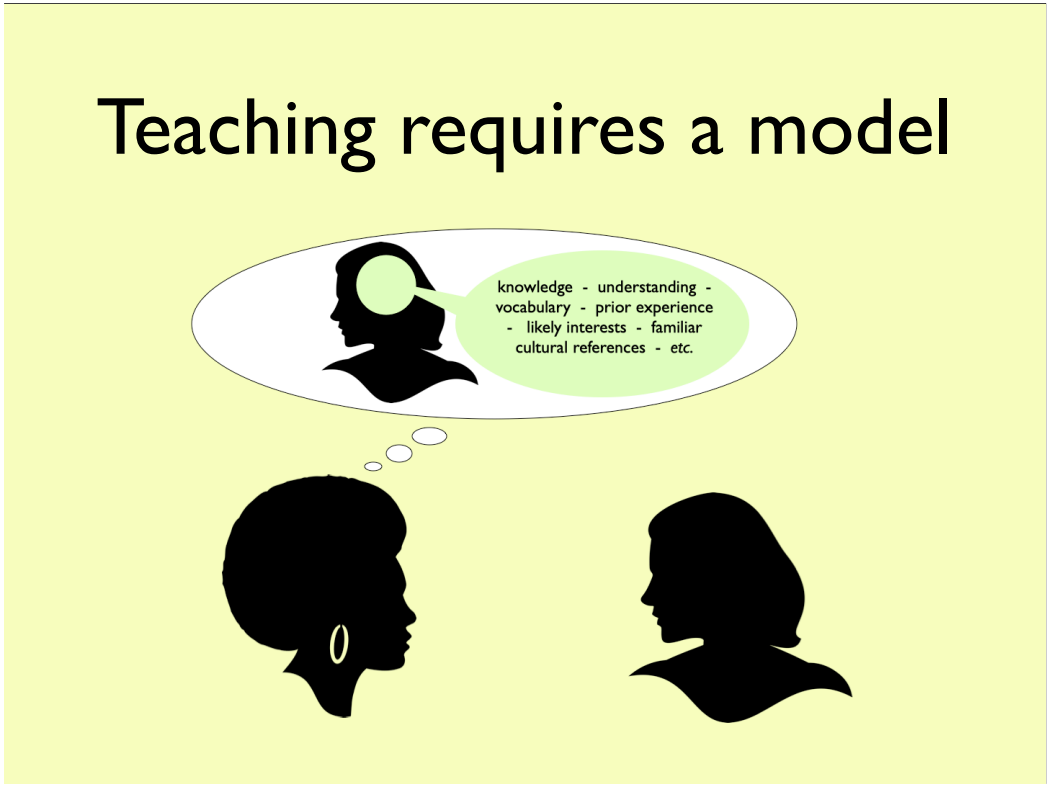
The strongest of the forces it may be but the strong nuclear force only acts over very short distances. The range of the electromagnetic force is infinite, however, despite its strength decaying with distance. As nuclei get larger, therefore, the battle between the two gets more even, and eventually electromagnetism begins to tell."

author assumes we will read this as a comparison not an identity

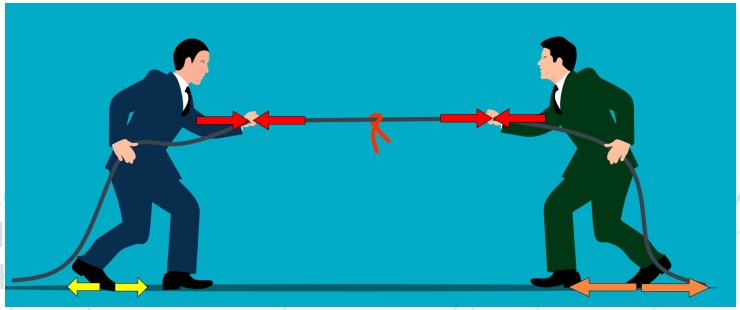
author assumes we know what a tug of war is

author assumes we can map the force sources onto the teams

author assumes we know what happens when one side is winning, and how this maps onto the description of the atomic case



Remember, the teacher needs to have a mental model of the learner to decide on potentially fertile comparisons the learner will be familiar with, and the level of treatment suitable.



In a tug of war, both teams pull on the rope with equal force -

when the rope is stationary

and when the rope is moving to one side

Will readers appreciate this?

Does this over-complicate the analogy?

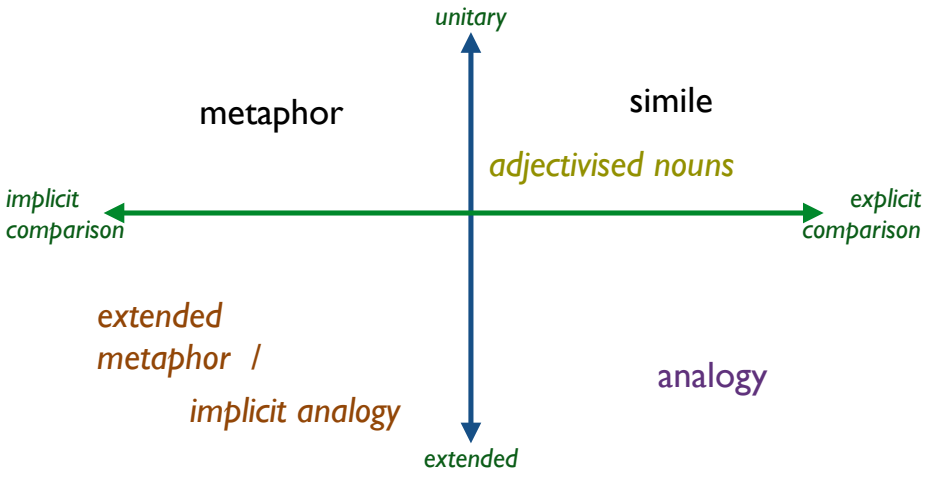
implicit analogy?

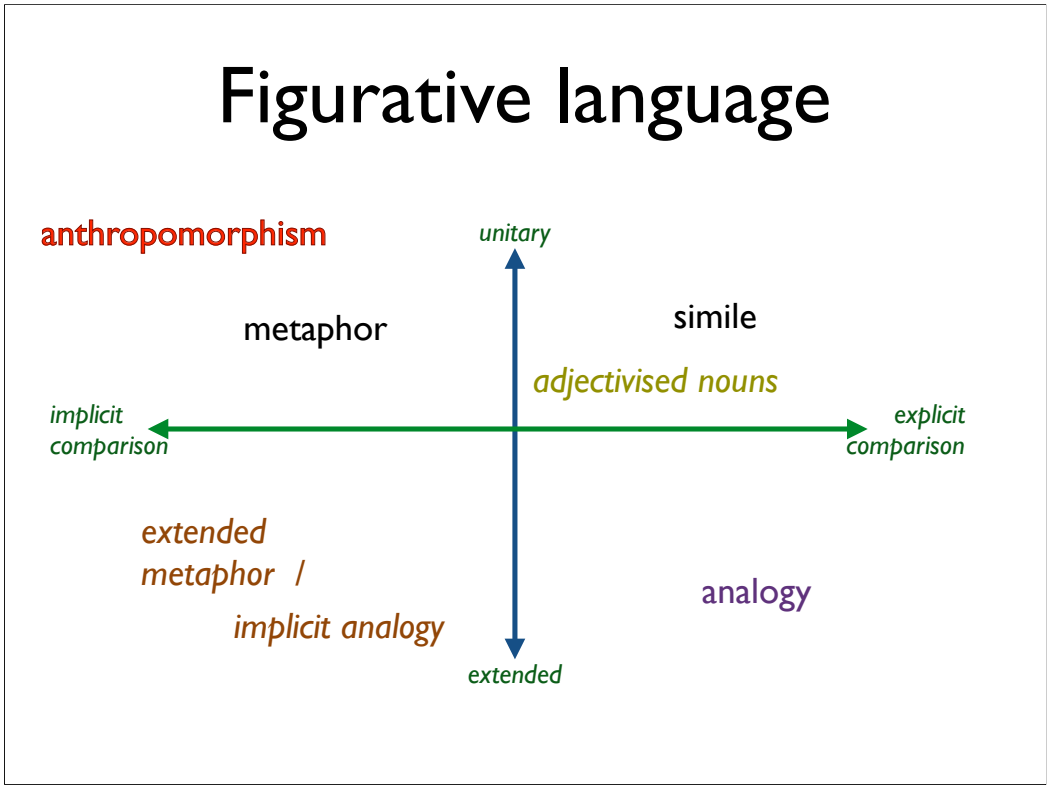
offering a comparison,

and then developing the analogue,

but leaving the audience to work out the rest of the mapping to the target

Figurative language





Then there are those particular types of metaphors that are anthropomorphic.

anthropomorphism

metaphors that are anthropomorphic use figurative language suggesting a non-human object has the kind of perceptions, conceptions, emotions, drives, *etc.* that a human does:

the non-human object could be a mouse, a tree, a bacterium, a virus, a rock, a cloud, an atom, a proton, etc.

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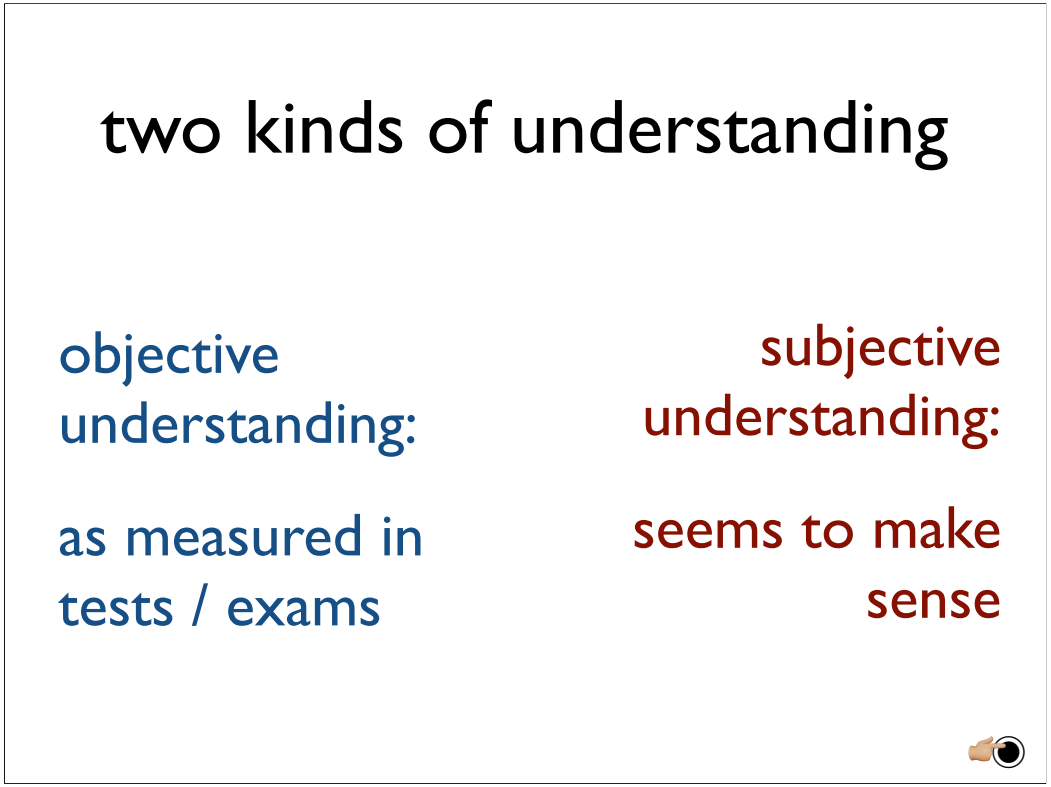
the non-human object could be a mouse, a tree, a bacterium, a virus, a rock, a cloud, an atom, a proton, etc.

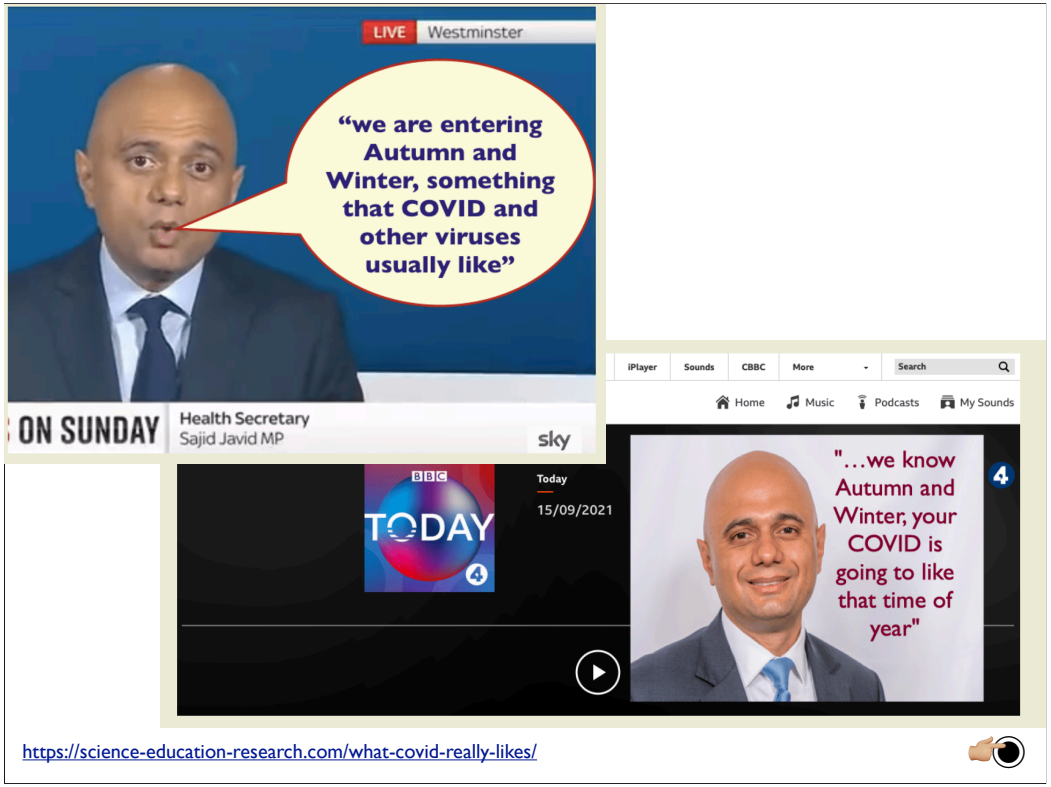
a kind of pseudo-explanation?

https://science-education-research.com/learners-concepts-and-thinking/pseudoexplanations/

Anthropomorphism may be intended as metaphor, but can be misunderstood as offering a kind of explanation (and perhaps one that would be acceptable in a science exam?)



Anthropomorphism may be very effective at giving learners the impression that they understand the science - but does not reflect the scientific principles and mechanisms at work.



I wonder if he really believed this - or what he just trying to get across an important point?

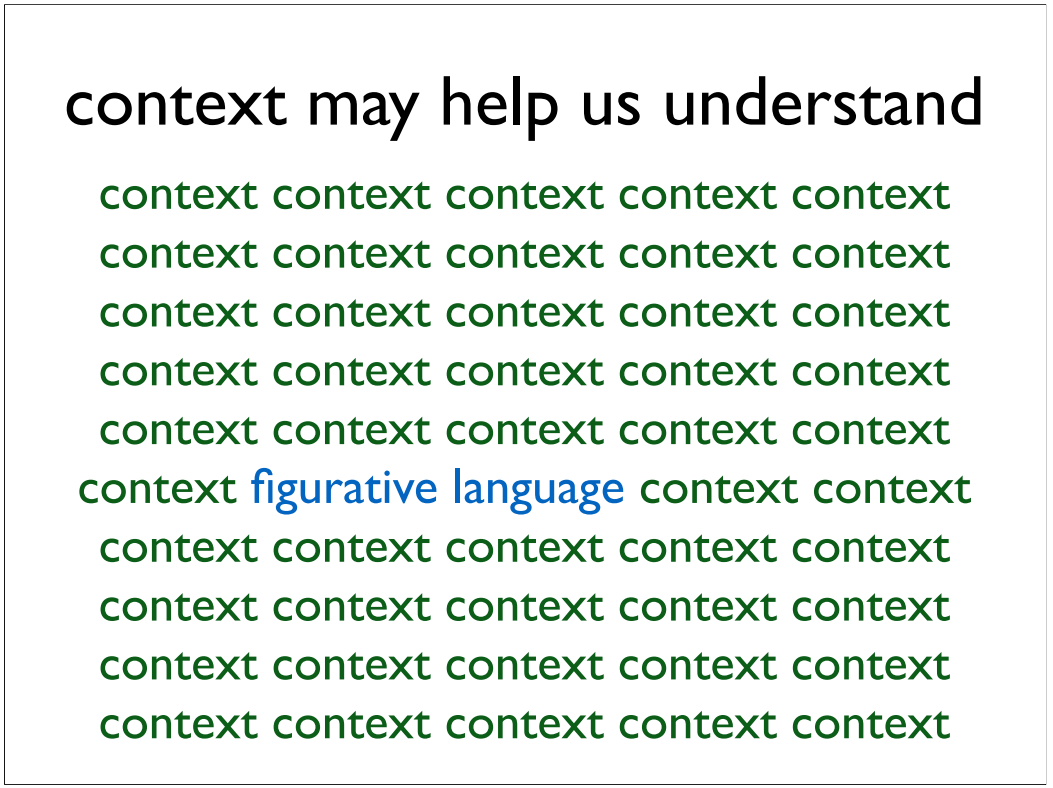
"The virus thinks, whatever the SNP may think, the virus thinks this is all one country, and that's the reality."

Ex-**Prime Minister** Boris Johnson gives evidence to the independent public inquiry set up to examine the UK's response to and impact of the Covid-19 pandemic…

and claims that **the virus knows** about British political geography

Surely, he did not mean this?

(The virus does not respect borders, because it knows nothing about them, not because it takes a position on Scottish independence!)



We often need to read figurative language in terms of the surrounding context.

context may help us understand

e.g.,

how can molecules pledge their allegiance to a theoretical system?

"Specifically, Boltzmann and Maxwell pictured a volume of gas as an enormous number of tiny, hard masses speeding about and colliding with each other in mostly empty space. These atoms [sic] pleaded allegiance to the Newtonian laws of mechanics: they had velocities and directions, carried momentum and kinetic energy, bounced off one another in predictable ways, and so on."

The Dream Universe: How fundamental physics lost its way

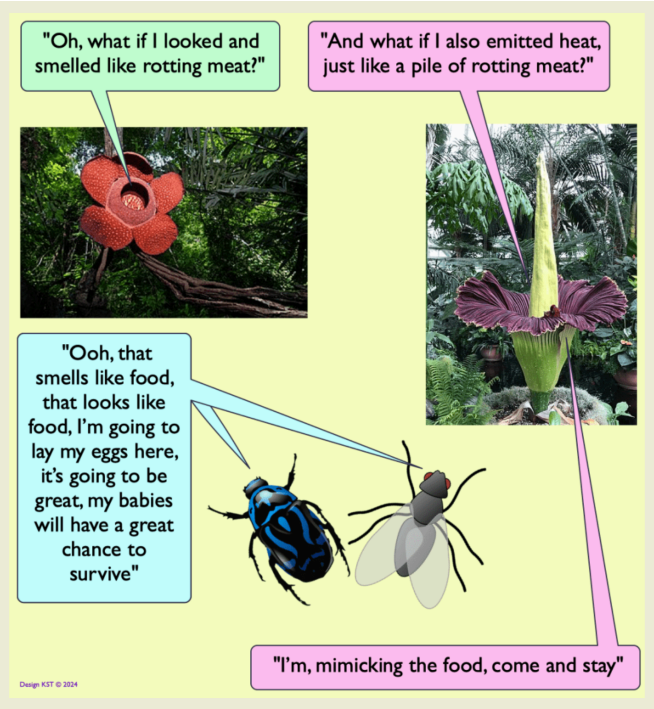
"Specifically, Boltzmann and Maxwell pictured a volume of gas as an enormous number of tiny, hard masses speeding about and colliding with each other in mostly empty space. These atoms [sic] pleaded allegiance to the Newtonian laws of mechanics: they had velocities and directions, carried momentum and kinetic energy, bounced off one another in predictable ways, and so on."

The Dream Universe: How fundamental physics lost its way

anthropomorphism

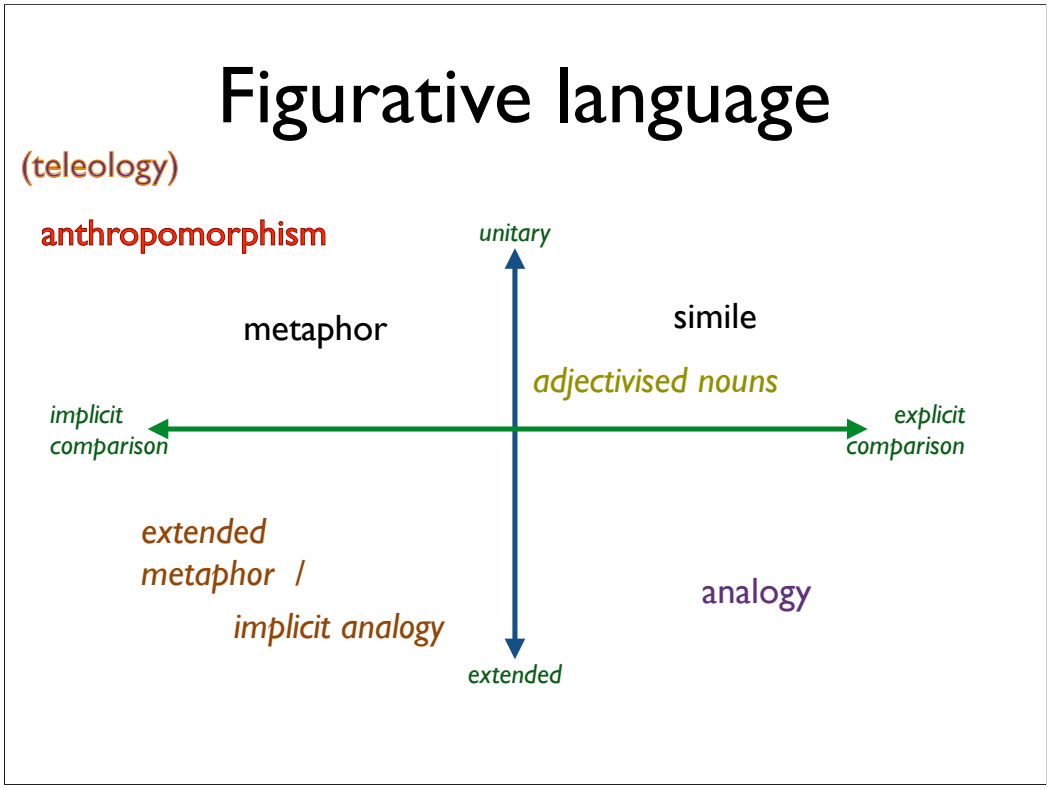
Based on conversation on a BBC Radio 4 programme/podcast:

‘Mysterious Plants’



https://science-education-research.com/and-then-the-plant-said/

A document with many more examples – ***Creative Comparisons: Making Science Familiar through Language***. *An illustrative catalogue of figurative comparisons and analogies for science concepts* – can be downloaded from: https://science-education-research.com/downloads/publications/2025/Taber-Science-Comparisons.pdf



Then there is teleology, which suggests something happens to meet some end or purpose.

teleology

explanation in terms of a purpose

"Eyes are not **designed** for picking out individual colours, but **for using colour to distinguish shapes and objects**."

"the mutations are located around the spike protein, and this is indicative of the fact that **the mutations are there to escape antibodies** generated from vaccination or from previous infection…"

"**Nature's plan** for dispersal and and reproduction of the cocklebur plant is for the seed burs to become attached to passing birds and [sic] animals."

https://science-education-research.com/public-science/examples-of-teleology/

As with anthropomorphism, teleology can seem to be offering an explanation when it is really just another of describing what has been discovered.

Your task!

The challenge - please think about these questions:

What does this mean - what is the excerpt *intended* to tell a reader/listener?

How do I know that?

> What particular interpretive resources did I used to make sense of the excerpt?

How readily would a student / school pupil / member of the public appreciate the intended meaning?

So, here is a wide range of examples of the use of figurative language in communicating science. Do you understand the intended meanings? Would your students? What needs to be already known/understood to make good sense of the quote?

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"A black hole is a region of space where you have just crammed so much stuff into a such a small space, that gravity kind of goes into **overdrive**, it grabs onto everything, and it won't let go, and that includes light, so even if a light beam goes into a black hole it just kind of gets sucked in and stays there."

"The ultimate waste disposal unit, stuff gets sucked in and can't escape."

BBC Inside Science

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"The Kupffer cells hang around like **spiders** on the walls of the blood vessels waiting to catch any red blood cells which have passed their best before date (typically 120 days)."

Immune: How your body defends and protects you.

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"TNF (tumour necrosis factor) superfamily-mediated cell death involves a receptor (from the THN superfamily) on the surface of the infected cell, which is like **a magic key** capable of **unlocking** death when **turned** by the right **hand**."

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but not the left hand?

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"Every time a cell undergoes mitosis, it loses a little of what is called the telomere, the protective surface on the chromosome, capping the end of each D.N.A. strand. In a process often likened to the **gradual fraying of a shoelace**, the telomere gets a little shorter with every division, until eventually it can no longer guard the D.N.A. effectively, and the cell loses its ability to undergo mitosis and becomes senescent (inert)."

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"… rare elements and heavy atoms, as trace elements play an important role for life; with their very special qualities they are, in a manner of speaking, the **'spice'** in the **soup** of life."

The Anthropic Principle: Man as the focal point of nature.

making the unfamiliar familiar

other domain ➔ science

one scientific field ➔ another scientific field

science ➔ other domain

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"Cixi…learnt quickly and skilfully how to essentially operate amongst the various characters at court…and also understanding how the family relationship between different parts of the royal family operated. So she learnt the ropes, you know, the kind of **the circuit board** of the Qing court, quickly and effectively"

BBC In Our Time

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"The mathematicians proudly claimed that striving for unambiguous definitions was one of the 'specific traits of the mathematical style of thinking', and they insisted that a mathematician in linguistics 'plays the role of a litmus test: if a definition satisfied the mathematician, then if must satisfy everyone'."

From Newspeak to Cyberspeak: A history of Soviet cybernetics

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"Like a **Tibetan prayer-wheel**, Selection Theory murmurs untiringly: 'Everything is useful.' But as to what actually happened and which lines evolution has actually followed, selection theory says nothing, for the evolution is the product of 'chance', and therein obeys no 'law'."

Problems of Life: An evaluation of modern biological thought

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"The genome is **the stuff of B movies**, like **a graveyard filled with ghosts**. Bits and pieces of ancient viral fragments lie everywhere-by some estimates, 8 percent of our genome is composed of dead viruses, more that a hundred thousand of them at last count. Some of these fossil viruses have kept a function, to make proteins useful in pregnancy, memory, and countless other activities discovered in the past five years. Others sit like **corpses** where they attached to the genome only to be extinguished and decay."

Some Assembly Required: Decoding four billion years of life, from ancient fossils to DNA

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"The technique was crude: they mushed fly bodies into a paste, isolated their DNA, put the mixture in a gel, and added their gene with a dye. The idea was that the gene would act like **molecular flypaper** and attach to every gene with a similar sequence."

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puns in science?

"de Sitter was a skilled mathematical astronomer, and his interest in problems of gravitation pulled him into Einstein's orbit."

"the concept of stress has profitably been exported from physics to psychology and sociology. But, unless carefully performed, such an exploration of technical ideas may result in shear confusion"

"Soon Ghiorso was convinced that Stockholm was 'completely wrong'. Nobelium, he and Seaborg joked in private, was nobelievium."

https://science-education-research.com/public-science/science-puns/

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"What makes the gamma-ray burst … is **feeding** a newly-formed black hole matter at an extremely high rate…The process that gives rise to the production of this neutron-rich material is actually outflows from the disc that's **feeding** the black hole."

Prof. Brian Metzger (Department of Physics and Columbia Astrophysics Laboratory, Columbia University)

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"When the universe started, essentially all that came out of the big bang in chemical terms was hydrogen, helium and a tiny little bit of lithium. And all the [other] chemical elements that are in the universe have formed since that time, in various processes, in normal stars; in supernovae explosions of stars; some possibly in the **murder** of neutron stars."

Mike Edmunds (Emeritus Professor of Astrophysics at Cardiff University and President of the Royal Astronomical Society)

understanding in context

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e.g.,

$$\frac{10^{53}\text{kg}}{10^{9}} = 10^{44}\text{kg}$$

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"Not all stars are the same – there's a whole **zoo** of them, determined by their mass and the stage they're at in their life cycle."

Astrobiology:The Search for Life Elsewhere in the Universe

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would a zoo separate out specimens by life stage?

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dead
metaphor?

Astrobiology:The Search for Life Elsewhere in the Universe

dead metaphors?

stars are born, start young, live,
sometimes living alone but sometimes not,
sometimes have complicated lives,
have lifetimes, reach the end of their lives, and die,
so, becoming dead, eventually long dead;
and, indeed, there are generations of stars
with life cycles

https://science-education-research.com/the-passing-of-stars/

figurative language…

…can be used to communicate dubious science

just as much as canonical science

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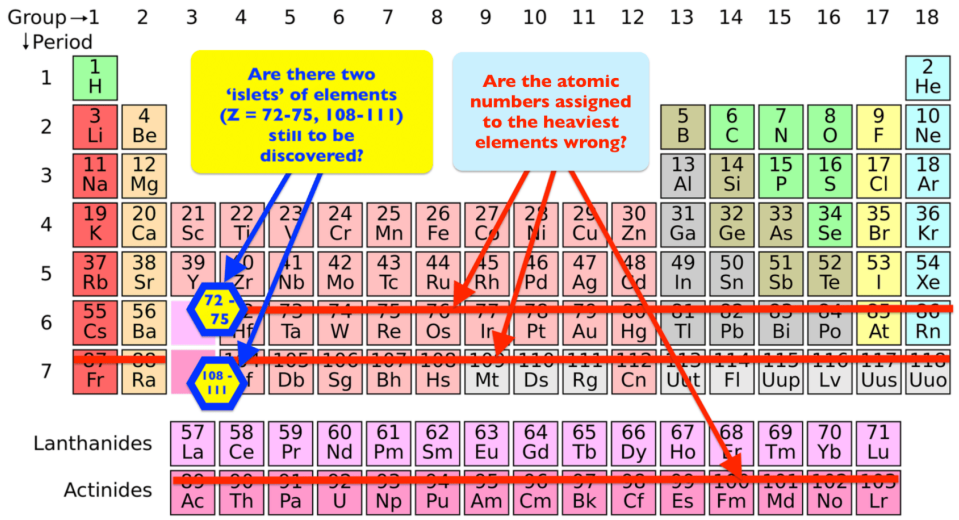
"Our nuclear charge is located on the surface, since the number of protons and the number of neutrons in the nucleus are such that protons and neutrons should be in the outer layer of the nucleus, and only neutrons inside, that is, a shell forms on the surface of the nucleus. In addition, protons must be repelled, and also attracted by an electronic **fur coat.**"

Journal of Chemistry: Education Research and Practice

is NOT: Chemistry Education Research and Practice



https://science-education-research.com/move-over-mendeleev-here-comes-the-new-mendel/

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"…the beauty of click chemistry…and bioorthogonal chemistry which is a **cousin** of click chemistry, these reactions have the special quality that they are so incredibly selective that the two reacting **partners** just **ignore** all the other functional groups even on really large molecules and even on large objects like human cells for example… they **find each other**, but also like they might like bounce around each other until the right two functional groups **find each other**, right, and they'll **click**, and all the rest of the stuff on the molecule just, you know, just **along for the ride**."

Carolyn R. Bertozzi (Professor of Chemistry at Stanford)

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"atoms…**look for** others to bond with, in ways that will complete them (aww). In this, atoms are really no different from the people they ultimately create, **looking** for others to form connections with for a **happier** and, perhaps, **easier life**. …Sometimes there is a true **meeting of minds**, in the form of an electron being shared; others happen when one atom **gives up an electron for the sake of another**; still more are the product of the electrical charges created as electrons are **traded**."

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"Any NK cell that finds itself shaking hands with a ULBP receptor knows it has found a stressed-out cell. The same is true if the NK cell extends its receptors to the cell only to find it omits parts of the secret-handshake expected from a normal cell."

https://science-education-research.com/reference/pseudo-explanations/natural-killer-cells-know-about-stress/

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"Normally the [Bose-Einstein] condensate would be totally opaque, but the first laser creates a sort of **ladder** through the condensate that the second light beam can **claw** its way along – at vastly reduced speeds."

Light Years: The extraordinary story of mankind' fascination with light

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"What ground is there to accept the principle of lawfulness: might it not be just the carrot that keeps science going?

… the search for law – the marrow of scientific research…the principle of lawfulness, as usually understood, is far from being hollow and there is no advantage to emptying it….

And no science lover could sensibly reject this protective and programmatic hypothesis, because to kill the principle of lawfulness would be a worse crime than killing the golden egg hen: it is not just a piece of knowledge but a motor of knowledge."

Mario Bunge

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"But by the 1970s, nuclear power was a pariah…

Climate change had been there all along: skies had been warming, glaciers melting and seas slowly rising for decades. Until the 1980s, few humans had regarded the beast as a serious threat. No longer. But the only force that was truly able to combat it – according to the movie – was largely regarded as a pariah, beset by a cultural hysteresis that associated it with bombs and meltdowns."

Film review in *Physics World*

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"These are more specialised bees that once they were vegetarian for a really long time and they actually decided to change their ways, there's all of this meat in the forest, why not take advantage?…

so potentially this specialised group of bees realised that, and maybe there's enough competition on the flowers that they decided to switch…"

BBC Science in Action

https://science-education-research.com/of-opportunistic-viruses-and-meat-eating-bees/

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"…the common clothes moth is what is called synanthropic, it actually depends entirely on man, so you don't find it in the wild"

"yeah, so there must have been a point when they were feeding on something else, and they thought 'actually, here's a better life, clothes'…"

BBC Inside Science

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"it's the gravity of dark matter that likes to kind of bring everything together"

Professor Catherine Heymans (Professor of Astrophysics at the University of Edinburgh, Astronomer Royal for Scotland)

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"you see a little drop of water, a tiny drop. And the atoms [sic, molecules] attract each other, they like to be next to each other. They want as many partners as they can get. Now the guys that are at the surface have only partners on one side here, in the air on the other side, so they're trying to get in. And you can imagine…this teeming people, all moving very fast, all trying to have as many partners as possible and the guys at the edge are very unhappy and nervous and they keep pounding in, trying to get in, and that makes it a tight ball instead of a flat, **and that's** what, you know, **surface tension**. When you realise when you see how sometimes a water drop sits like this on a table then you start to imagine why it's like that because everybody is trying to get into the water"

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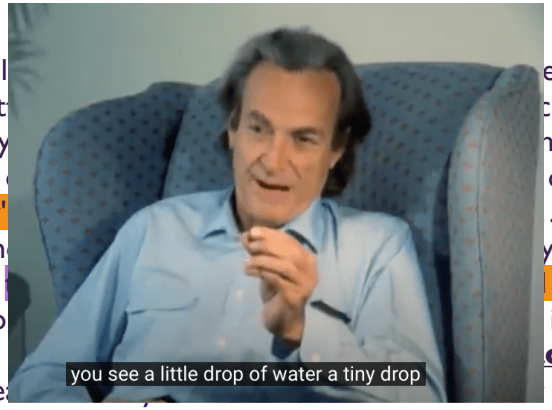
"you see a l 

e atoms [sic, molecules] at ch other. They want as many hat are at the surface have on the other side, so they' .this teeming people, all m y partners as possible and nervous and they keep po it a tight ball instead of a **ce tension**. When you re drop sits like this on a table then you start to imagine why it's like that because everybody is trying to get into the water"

https://science-education-research.com/surface-tension-is-due-to-everybody-trying-to-get-into-the-water/

What does this mean - what is the excerpt *intended* to tell a reader/listener?

How do I know that?

What particular interpretive resources did I used to make sense of the excerpt?

How readily would a student / school pupil / member of the public appreciate the intended meaning?

"It comes from plate tectonics. So, essentially the earth has one objective, it has had one objective for four and half billion years, and that's to cool down. We're a big lump of rock floating in space, and it's got all this primordial energy, so we are going right back here, there's all this primordial energy from the the material coming together, and it's trying to cool down."

Dr James Hammond (Reader in Geophysics at Birkbeck, University of London)

What does this mean - what is the excerpt *intended* to tell a reader/listener?

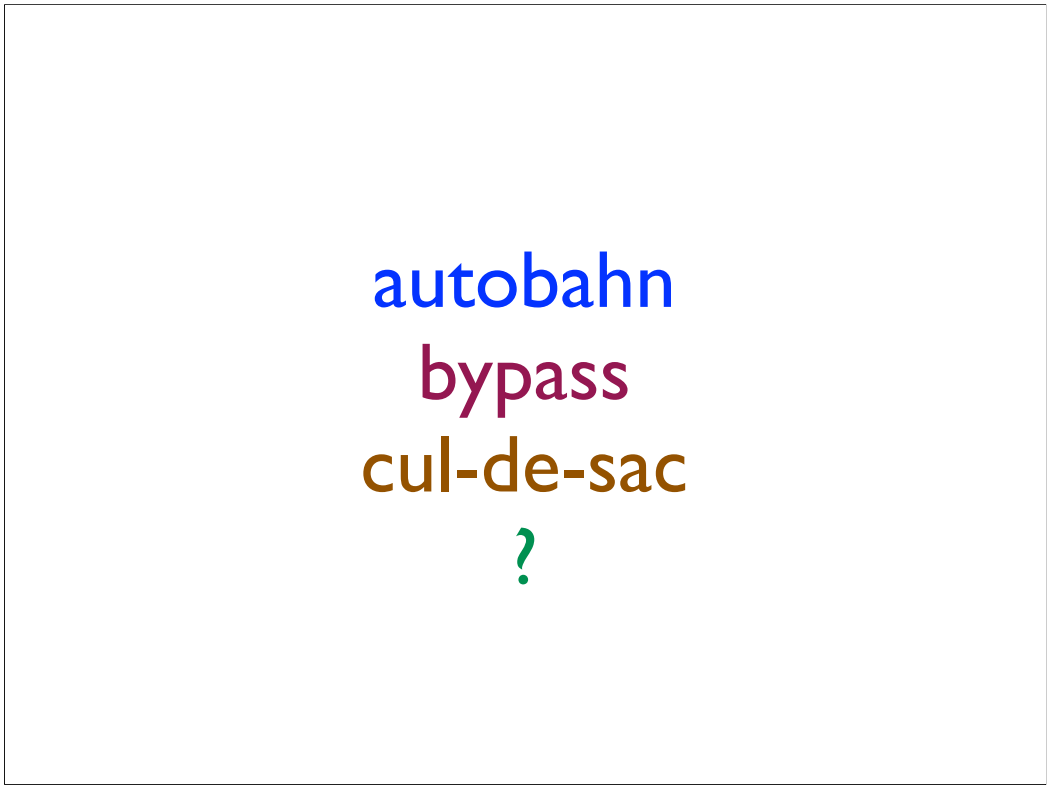
How do I know that?

What particular interpretive resources did I used to make sense of the excerpt?

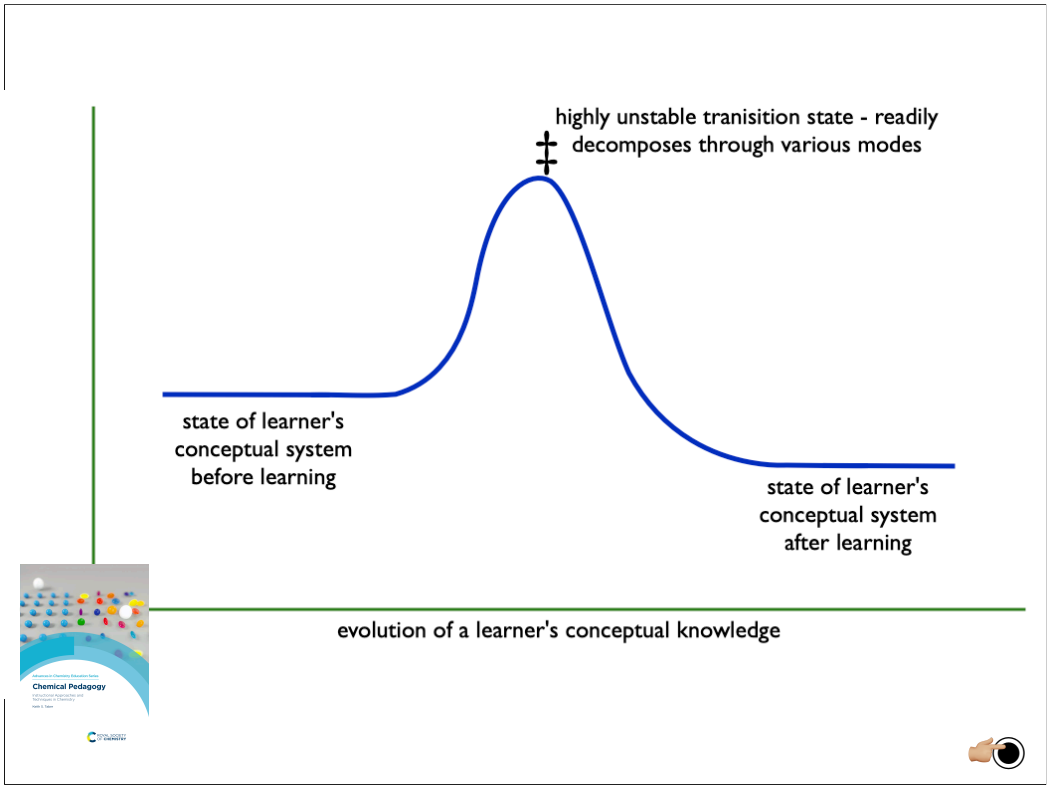
How readily would a student / school pupil / member of the public appreciate the intended meaning?

"…earth's biogeochemical cycles where there is no waste, everything is repurposed and recycled at different timescales. And I always think of the example of phosphorus in nature. Phosphorus is an element which that's really important for the biosphere, but it is really scarce in rocks, and so the biosphere has learned to recycle it ferociously."

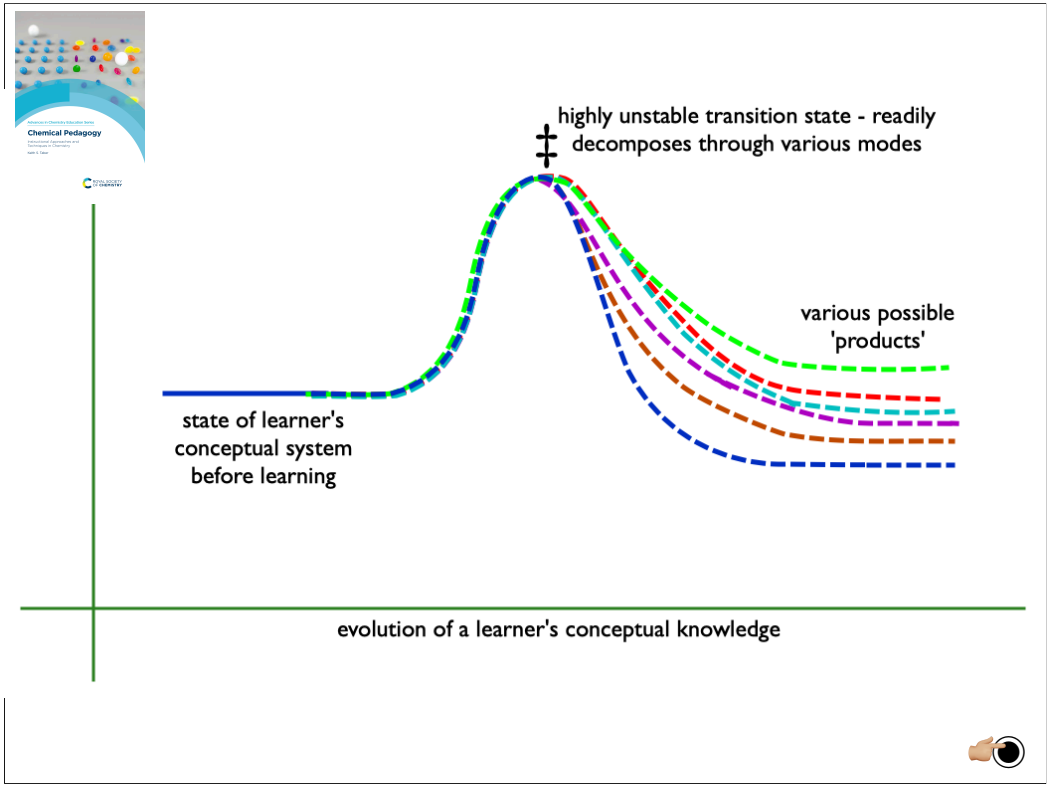
Prof. Marcia Bjornerud (Professor of Geology and Environmental Studies, Lawrence University)

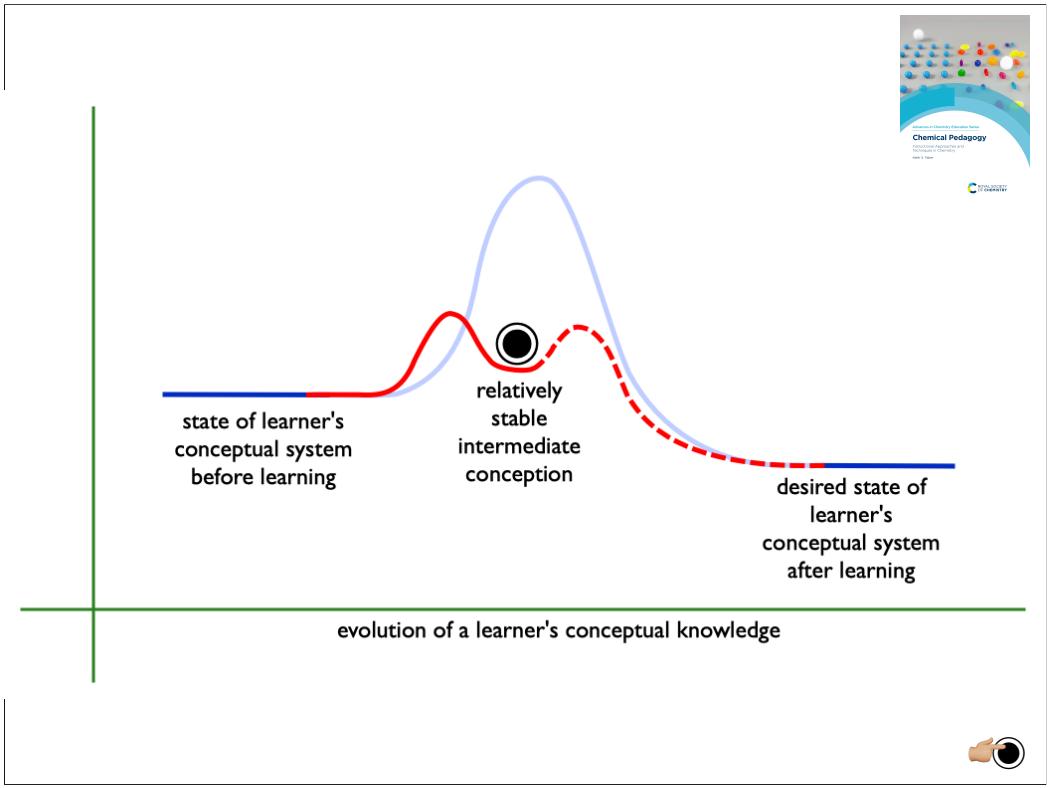


Are these examples autobahns getting meaning across quickly;
bypasses that might lead to learners missing the scientific principle;
or cul-de-sacs which lead the learner nowhere: so nothing valuable is learned?
(And that question needs to be asked with a particular group of learner, or strictly even a specific learner, in mind.)



Another analogy (explained in detail in Taber, K. S. (2024). Chemical Pedagogy. Instructional Approaches and Teaching Techniques in Chemistry. Royal Society of Chemistry.)


highly unstable transition state - readily decomposes through various modes
various possible 'products'
state of learner's conceptual system before learning
evolution of a learner's conceptual knowledge



When used well, comparisons with what is already familiar may help the learning process - like a catalyst (but there is much to go wrong). Catalysts tend to be selective: you need to use the right catalyst for a particular reaction.

The teacher (or other science communicator) needs tools to help ‘make the unfamiliar familiar’

Figurative language has a key role to play

But it also risks learners motoring past our intended destination because their interpretation of a figure of speech was not what we intended

And it risks the representation being taken for the target, and the learner getting stuck with the metaphor or anthropomorphic explanation

The teacher (or other science communicator) needs tools to help ‘make the unfamiliar familiar’

Figurative language has a key role to play

But it also risks learners motoring past our intended destination because their interpretation of a figure of speech was not what we intended

so, always be explicit that one is using a figure of speech, and in fully mapping across

And it risks the representation being taken for the target, and the learner getting stuck with the metaphor or anthropomorphic explanation

so, always move the learners on as soon as possible, so that what is intended as a transition state does not become a long-lived intermediate

Some key points for teaching.

"… more research is needed…"

objective understanding:

as measured in tests / exams

subjective understanding:

seems to make sense

This document contains an edited set of the slides presented, with some brief explanatory notes.

A document with many more examples – ***Creative Comparisons: Making Science Familiar through Language***. *An illustrative catalogue of figurative comparisons and analogies for science concepts* – can be downloaded from:
https://science-education-research.com/downloads/publications/2025/Taber-Science-Comparisons.pdf