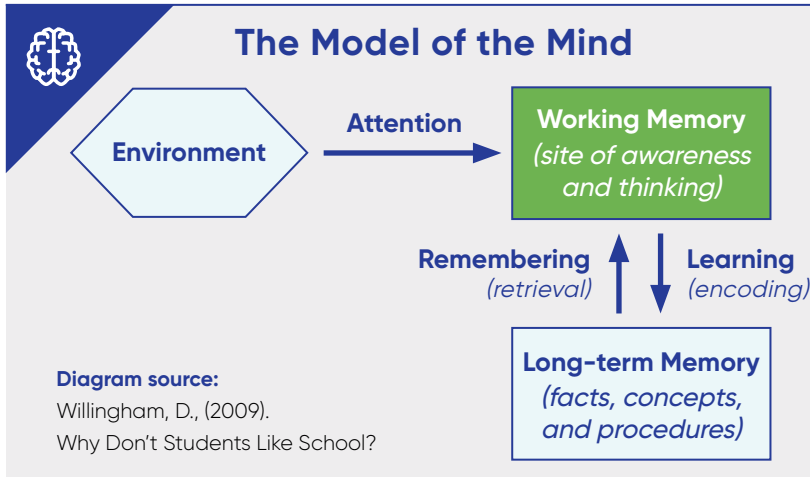




Using Examples and Non-Examples

This resource from DFI's [Learning by Scientific Design Network](#) provides practicing teacher-educators with an overview of a learning science-informed teacher action. To access additional materials, visit deansforimpact.org/resources

Teachers prompt students to connect (and distinguish) varied examples and contrasting non-examples



We need concrete examples and non-examples to refine our mental models of a concept in long-term memory.

Varied examples help a learner define the most important parts of a concept so they aren't fooled by distracting factors that might cause them to *under-generalize* about key ideas.

Non-examples help students attend to the boundaries of a concept and avoid *overgeneralizing* about key ideas.

Why does using examples and non-examples matter for students?

Because new learning builds on prior knowledge and how that knowledge is organized in long-term memory (as mental models called "schema"), learning gaps are exacerbated if we don't support students in developing nuanced schema about ideas. For students who may not encounter informal opportunities to learn about the concepts outside of school, these chances to refine schema are especially important.

Prompting students to articulate the connections and differences among examples helps them tune into the deep structure so they build accurate schema. By thinking deeply about the connections, students are more likely to store the ideas in durable ways they can draw on more easily in the future.

What does this look like in the classroom?



Varied Examples

Provide examples to draw student attention to the deep features of a concept

Varied examples (e.g., a sparrow, a penguin, and an emu are all birds) help students understand what a concept *is* (it's "deep features") and avoid surface misconceptions (e.g., birds must fly to be birds).



Contrasting Non-Examples

Provide non-examples to draw student attention to the boundaries of a concept

Contrasting non-examples help students define what a concept is *not*, particularly if non-examples share surface features with the concept (e.g. an airplane flies but is *not* a bird).



Prompts to Elaborate

Prompt students to explain connections and differences among examples and non-examples

When teachers prompt students on *how* and *why* an example and a non-example differ, or how examples are similar, students learn the concept more deeply.

Common pitfalls novice teachers fall into



Missing Pieces

Students do not have the components they need to build schema because a teacher has failed to provide examples, non-examples, or opportunities to make connections between the two.

- **Might look like:** A teacher says "Something is *soluble* in water if its molecules dissolve in it. So with that in mind, today we're exploring how we can conduct electric current through certain liquids..."
- **Try instead:** A teacher says "Something is *soluble* in water if its molecules dissolve in it. For example, salt is soluble in water, but oil is not. How might they be different in their composition to make that be true?"



Unplanned Examples

Teacher does not intentionally select examples and non-examples ahead of time and so comes up with something in the moment that may be confusing or misleading for students.

- **Might look like:** Students seem confused about the meaning of *soluble*. The teacher says, "You know... like salt is soluble but flour is insoluble." A student says, "But flour does kind of disappear in water and just makes it cloudy, what do you mean?"
- **Try instead:** The teacher has planned in advance and says "Think about salt and sand. If I stir a little bit of salt into a glass of water, it disappears and doesn't come back. If I add sand, once I stop stirring it all settles to the bottom. That's insoluble."



Familiarity Bias

Teacher selects only examples students are familiar with, so they don't have opportunities to broaden schema.

- **Might look like:** Teacher only gives examples from common household items like sugar, salt, or oil and vinegar.
- **Try instead:** Teacher augments household examples with discussion of how different medicines, most of which students haven't heard of, have different solubilities and are taken up at different rates in the body. Students get to see how medical science is influenced by the concept.



Treating All Examples as Equal

Teacher does not intervene to correct student-generated examples or non-examples that do not fit or are not relevant. Students miss out on feedback to help them correct developing schema.

- **Might look like:** A student says "Like big rocks! Those don't dissolve!" "Yep!" says the teacher and moves on.
- **Try instead:** The teacher says "Let's take a moment with that...what are rocks made of if they wear down over time? Sand and sediment...so rocks are insoluble, but it's not just because it's just too big for water to break down, it's because sand or gravel is a particle."