

Tips for Engaging Students in Scientific Thinking

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"I hate science. We never DO anything!" We often hear this lament from students, and if their science classes amount to lectures, textbooks, and worksheets, who can blame them? While the students are discouraged, their teachers are frustrated: "I just do not know how to get my students excited about science." The good news is that both teachers and students want science to be authentic, challenging, and engaging. The bad news is that many teachers struggle to make that desire a reality.

One of the things that we find most exciting about the [Next Generation Science Standards](#) (NGSS) is the way they attempt to address this challenge of how to engage students in true scientific thinking. For example, the core ideas in the NGSS include, for the first time, engineering, technology, and the applications of science on the same short list with physical, earth, space, and life sciences. These grade-specific core ideas are bound together by the two other dimensions that make up the NGSS: crosscutting concepts and science and engineering practices. The crosscutting concepts (seven overarching concepts, including cause and effect, systems and system models, and structure and function) "provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically based view of the world" (Achieve, 2013, Dimension 2). More important from the perspective of involving students in the work of science and engineering are the practices. These eight practices—which include asking questions and defining problems, analyzing and interpreting data, and engaging in argument from evidence—are the behaviors that drive the inquiry and design processes. To think like a scientist or an engineer is to use these eight practices.

So students, teachers, and the new standards are all in agreement—we need to actively engage students in the disciplines of science and engineering. But how? Here are some quick tips:

- **Get their attention.** You can't engage anyone if you don't prime the engine for serious learning. A good hook at the beginning of lessons and units will stimulate curiosity, activate prior knowledge, and establish a purpose for learning. For example,

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- Why do some trees stay green all year while others change colors?
- How can today's scientists draw conclusions about what life was like millions of years ago?
- **Use vocabulary to fuel thinking and learning.** Don't just ask students to memorize important terms; instead, try an inductive learning activity. Give students all of the key terms they'll be learning, mixed together with some familiar terms from the unit to come. Let them work in teams to define unknown words, place all the terms into related groups, and give each group a descriptive label. Then, ask students to use their groups to make three or four hypotheses about what they will learn in the unit (e.g., "I hypothesize that different kinds of cells have different kinds of functions"). As the unit progresses, have students collect evidence that supports or refutes their hypotheses and refine their thinking accordingly.
- **Up the controversy.** Challenge students to take positions on real scientific debates. How should dinosaurs be classified? Can genetic research go too far? Is human activity the primary cause for global warming? Of course, students always need to back their positions with evidence.
- **Make it authentic.** Ask students to defend their positions or present their ideas to an authentic audience, whether in person or using technology (e.g., Skype).
- **Invent and innovate.** Tap into the engineering aspect of science by having students create or improve on a model or design that explains their position or theory. Can they design a new and improved plant or animal to meet specific criteria? Can they design their own scientifically sound experiment to test a hypothesis?

When teachers put the emphasis on engagement and critical thinking in these ways, students become actively involved in the real work of science and engineering. Instead of experiencing frustration, we can have teachers who say, "My kids were so excited in science class today that they did not want to stop working!" Best of all, we will hear our students exclaim, "Today we did the neatest thing in science! I learned so much!"

Reference

Achieve. (2013). *Next generation science standards: Three dimensions*. Retrieved from www.nextgenscience.org/three-dimensions

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