EDUCATION WEEK
Published Online: April 2, 2013
Published in Print: April 3, 2013, as **Assessing the Impact of New Science Standards**

COMMENTARY

3 Reasons to Like the New Science Standards

By Arthur H. Camins

New K-12 science **learning standards** soon will be released to the nation with great expectations. This is reason for both hope and concern.

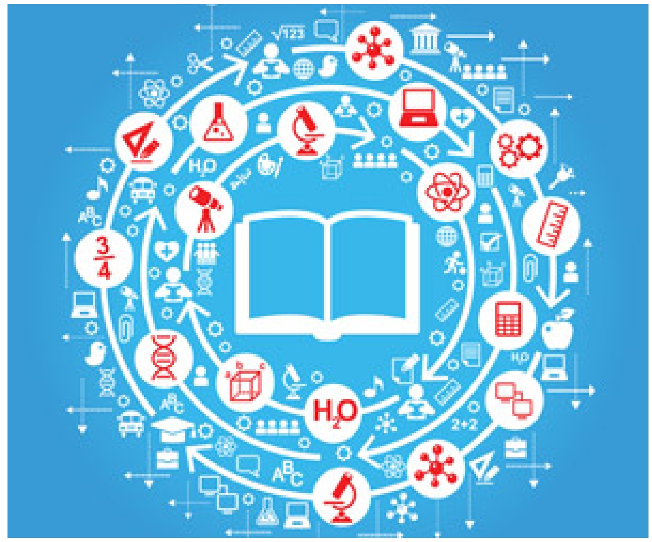
The National Research Council published **"A Framework for K-12 Science Education,"** a visionary document designed to guide development of specific standards for use by teachers, districts, states, curriculum developers, and researchers, in July 2011. Subsequently, the bipartisan organization Achieve was commissioned to draft the Next Generation Science Standards, or NGSS. Now, after two successive drafts and broad public and expert comment, the group is set to produce a final draft any day now. An impressive **26 states have contributed** to this effort. Taken together, the framework and science standards have the potential to generate a wave of improvement, but only if we prevent their promise from crashing on the rocky shores of high-stakes, all-purpose testing.

There are three reasons the framework and standards have the potential to generate great improvement.

First, based on the earlier drafts, they would promote scientific thinking, which is the bedrock of informed democratic participation. Already, there is a choir singing in behalf of improved science, technology, engineering, and mathematics, or STEM, learning. The lyrics of their songs are all about preparing students for the demands of 21st-century jobs and enhancing U.S. competitiveness in the global marketplace. These are vital goals.

However, there is a broader and equally compelling goal for the standards. Specifically, their existence will emphasize that scientific practice is about building, testing, debating, and revising explanations about the natural world through evidence-based reasoning. The new standards should elevate the importance of scientific practices and make clear that the way students should learn and demonstrate their understanding of science is through their ability to use these practices.

A central idea in science is that initial ideas, conjectures, and models should be made public and subject to verification and revision—with evidence as the arbiter. The prevalence of misrepresentation and illogic in the last election cycle and in public-policy decisionmaking, as well as the persistence of misinformation about critical issues such as climate change, suggest that schools have failed to inculcate evidence-based decisionmaking as a core value and skill. We are all the worse for that failure. The new science standards will offer one potential tool to help ease that failure.



—iStockphoto.com/VolodymyrGrinko

Second, the standards will elevate the importance of understanding the engineering design process. Why is it important for students to learn about engineering? Virtually everything we use to survive and thrive is engineered. Our food supply, clothing, housing, energy generation, health care, transportation, communication, education, and even leisure time are all engineered ... purposefully designed to solve problems with constraints and trade-offs in mind. Too often, the decisions that are made about each of these lack transparency and public scrutiny. Too often, such decisions optimize design features that are not in the best interest of the wider public good.

A broad understanding of engineering design and examination of the values that influence decisions should be an essential feature of every student's education.

> **"The new standards should elevate the importance of scientific practices."**

Third, the next-generation standards will push at the boundaries of learning in two significant ways. They will build toward the most durable features of schooling: long-term memory and knowledge transfer—the ability to retrieve and apply skills and concepts to novel situations. They do so by carefully sequencing learning from novice to more-sophisticated concepts across the K-12 spectrum and by setting the expectation that students will learn more deeply by using their knowledge to actively investigate real scientific questions and engineering problems in multiple and varied contexts. The facts of science, while interesting, are easily forgotten and become useless unless they can be marshaled and applied to phenomena and problems outside the classroom.

These new standards will challenge our current notions of when complex ideas can be introduced to students. For example, the standards drafts proposed introducing sophisticated ideas, such as properties of waves, in elementary school. They also challenge all students to represent, test, and revise their initial science and engineering models in more-conscious and systematic ways than ever before.

The framework and the pending science standards rest on solid research in the learning sciences, but will still need time and space for evidence-based testing and revision. To reach their potential, we will need finely tuned assessments that provide strong actionable evidence for multiple purposes, including informing teachers' day-to-day instructional decisions, school and district instructional-materials purchases, and professional-development plans. States will need evidence to assess whether support systems are effective. Instructional-materials developers and researchers will need independent evidence to probe the effectiveness of curricular designs and nuances of student learning. The standards-writers will need information to inform whether they should make adjustments in their product. No single test format will serve all of these varied constituencies well.

Consequential testing, especially in its cheap, easily scored format, will undermine all of these purposes. Myriad unfortunate examples in medical research, finance, and education should make us step back from the pressure for quick results at the risk of compromising integrity. If anything, pressure should promote learning from what is new and bold rather than fearing the missteps and failures that accompany new knowledge.

With the Common Core State Standards for English/language arts and mathematics completed, assessment development well under way, and testing already in place in at least one state, there are already several lessons to be learned. First, resistance to the common core is growing in part because the very idea of reaching agreement as a nation about goals for learning has become linked to high-stakes assessments. Second, there is growing resentment of a heavy federal hand in forcing theoretically voluntary standards on states through the promise of Race to the Top rewards in tough economic times. Finally, there is a perception of a conflict of interest because the same corporate entities that sell textbooks and district data systems also have a role in test development. We need to step back from the brink and avoid all of these pitfalls with the science standards.

Currently, states have tests designed to assess previous standards iterations. As long as these assessments are in place for accountability, they will command greater attention than the new standards, inhibiting generative work on their implementation. Therefore, states that adopt the next-generation science standards should place a moratorium on the use of their statewide science tests. However, in order to maintain momentum, federal and state authorities should provide grants to states, districts, curriculum developers, and researchers to develop long-term, comprehensive science and engineering learning, assessment, and improvement plans, as the National Research Council has recommended. By all means, we should assess the impact of the new science and engineering standards on learning. Every teacher should have high-quality, curriculum-embedded assessment tools to gauge the learning of every student. Substantial research has demonstrated that such formative, just-in-time assessment is a more powerful driver of improvement than late-arriving standardized tests. Alternatively, research and overall program assessment can be accomplished with sampling, targeted case studies, and other analytic strategies. Decisions about high-stakes assessment of science and engineering will determine whether the new standards generate a wave of improvement or just another ripple in the pond.

Arthur H. Camins is the director of the Center for Innovation in Engineering and Science Education at Stevens Institute of Technology, in Hoboken, N.J.

Vol. 32, Issue 27, Pages 22-23, 25