With the advent of the Next Generation Science Standards, educators and curriculum developers need to know which materials are really aligned to the new standards.

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In February 2014, a year after the release of the Next Generation Science Standards (NGSS), state leaders and national partners in the development of the standards met to consider strategies for implementing this ambitious new vision for science education. Among other key aspects of implementation—from professional development to assessment to advocacy—the role of curriculum and instructional materials was a major focus. States and school districts seeking to implement the new standards wanted to know which materials are aligned to the standards and support the standards’ three-dimensional learning approach.

The answer from the standards’ developers was short but not sweet: You won’t find much now, and it’s going to take time. Our work here at Project 2061, a long-term science literacy initiative of the American Association for the Advancement of Science (AAAS), suggests that we shouldn’t be too surprised at this cautious response.

Because AAAS is a partner in the development of the new standards, we’re committed to their success, but we’re realistic about the challenges that lie ahead. These standards are different in some important ways from previous standards, and those differences are likely to have major implications.

What’s New?
Two major differences between the new standards and previous ones are likely to affect the design and use of textbooks and other curriculum materials.

Three-Dimensional Learning
The Next Generation Science Standards differ from earlier standards in their focus on having students understand and demonstrate their science knowledge by using it, just as professional scientists and engineers apply their knowledge to investigate and innovate. Students will engage in science and engineering practices and use disciplinary core ideas and crosscutting concepts to make sense of new information, explain phenomena in the world around them, solve problems, and make informed decisions. The working together of these three elements is called three-dimensional learning. Each of the three dimensions is important in its own right and contributes to learning in the other two dimensions.
The disciplinary core ideas are central to earth, life, and physical science and explain a host of phenomena in the natural and designed world.

The crosscutting concepts (such as patterns and cause and effect) serve as intellectual tools for connecting important ideas across all science disciplines. For example, finding patterns in data enables us to make predictions about new phenomena.

The science and engineering practices build on what earlier science standards called inquiry or science process skills to engage students in asking questions or refining problems; investigating and analyzing data; developing and using models; constructing evidence-based explanations and arguments; and obtaining, evaluating, and communicating information.

Research shows that learning improves when science content learning and science inquiry work together, rather than being separated, as is common in classrooms and curriculums today (National Research Council [NRC], 2007, 2012).

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Engaging in science and engineering practices helps students learn science content, and learning the content helps students engage in the practices. Leave one out, and students may not develop proficiency in the other.

The new standards also challenge educators to integrate these three dimensions of learning coherently. Core ideas, crosscutting concepts, and science and engineering practices must build on one another within and across lessons and units and across grade bands. Coherence requires that materials take into account essential science ideas, common student misconceptions, and basic ideas to build on (Roseman, Linn, & Koppal, 2008).

As a starting point for thinking about coherence, educators and publishers can look to the standards themselves, which provide sample learning progressions at each grade band, as well as a matrix illustrating the practices students are expected to master. Another important resource is the AAAS Atlas of Science Literacy (www.project2061.org/publications/atlas), which maps the development of nearly 100 big ideas and skills in science, mathematics, and technology from kindergarten through high school and summarizes the research on students’ conceptual difficulties for each.

These can be useful tools, but curriculum developers will need classroom data to select phenomena-based activities for students, refine the sequencing of student experiences into a coherent content storyline, and provide the instructional scaffolding necessary for ensuring student learning.

Performance Expectations
To support three-dimensional learning, the standards are structured
as performance expectations that require students to demonstrate their knowledge of the three dimensions (NRC, 2012). This is a departure from earlier standards, which typically presented learning goals as knowledge or skill statements (for example, "students should know that . . ." or "students should be able to . . ."). The standards make it clear that performance expectations should not be construed as curriculum. Rather, they're intended to specify what students should know and be able to do for assessment purposes.

For example, an 8th grade performance expectation for life sciences

In the Grip of the Old
Although this increased emphasis on the interplay of science content and science practices is a move in the right direction, changing what actually happens in the classroom won't be easy. A national survey (Banilower et al., 2013) found that a teacher explaining an idea to the whole class was still the most frequent activity in science classrooms, with about 90 percent of the classes including it as part of their most recent lesson. Hands-on activities (which are more likely to be aligned to the science practices) were reported for only 39 percent of the high school classes and

Clearly, the quality of the curriculum materials that are developed to support the new standards will be crucial to the standards' success.

Help Is on the Way
Given these two major differences between the old and new standards, and given the importance of the textbook to classroom instruction, what does alignment to the new standards look like? Curriculum materials will have to do much more than simply cover a set of specified ideas and skills. Some developers and publishers are attempting to modify their materials, whereas others are merely making claims of alignment. To date, however, there has been little guidance on what it means to align to the new standards or to support students in achieving the performance expectations.

However, with the release of the Educators Evaluating the Quality of Instructional Products (EQP) rubric (NGSS Lead States, 2014), science educators and curriculum developers and publishers now have a set of criteria they can use to assess materials, lessons, and units. (To download the rubric, go to www.nextgenscience.org/resources.) Drawing on criteria developed by Project 2061, the rubric can be used to examine the alignment of material to the Next Generation Science Standards, the quality of the instructional support provided, and the extent to which the material provides support for monitoring students' progress.

It should be noted that the rubric's criteria have not yet been calibrated to indicate the level at which materials do or don't meet each individual criterion. According to the NGSS website, additional resources are being developed for use with the rubric, including scoring guides, a professional

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development guide, and criteria for textbook and curriculum developers.

Curriculum research and development groups, including our own here at AAAS, have begun to apply the criteria to different curriculum materials. We’re currently using the EQuIP rubric to analyze a six-week unit designed to give 8th grade students a solid foundation in chemistry and biochemistry as preparation for high school biology (AAAS/BSCS, 2014). So far, our analysis indicates that the unit is well aligned to several core disciplinary ideas in physical and life science and to the crosscutting concepts of matter conservation and patterns. Moreover, it coherently builds toward a set of performance expectations at the middle school level.

As others apply this tool and report on their results, the rubric should evolve to better meet the needs of educators who are evaluating materials and of curriculum developers who are designing or modifying materials.

Supply and Demand

With 11 states and the District of Columbia—about 26 percent of the U.S. student population—already committed to the new science standards and more states likely to come on board, the Next Generation Science Standards are in a position to exert significant influence on the design and use of science curriculum materials. By providing a common set of criteria for judging curriculum materials in the context of the new standards, the EQuIP rubric can help the science education community build consensus on what well-aligned materials should look like and what evidence developers and publishers should provide to support their claims of alignment.

On the supply side, developers and publishers need to take responsibility for understanding and taking seriously the changes called for in the standards and for providing educators with valid evidence for their claims of alignment. On the demand side, teachers need to take responsibility for understanding the standards and for becoming more critical consumers of publishers’ claims.

References


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