Achieve

Report

What States Should Know About International Standards In Science: Highlights From Achieve's Analysis

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WHAT STATES SHOULD KNOW ABOUT INTERNATIONAL STANDARDS IN SCIENCE: HIGHLIGHTS FROM ACHIEVE'S ANALYSIS

In fall of 2009 the Carnegie Corporation of New York and the Institute for Advanced Study published *The Opportunity Equation,* making the case anew that the U.S. must quickly put in an action plan in place to raise student achievement in science and mathematics:

The nation's capacity to innovate for economic growth, and the ability of American workers to thrive in the global economy depend on a broad foundation of math and science learning, as do our hopes for preserving a vibrant democracy and the promise of social mobility for young people that lie at the heart of the American dream.[1] The report's conclusions are unambiguous: Moving forward our goal must be nothing short of ensuring all students have the opportunity to graduate STEM-capable (that is, having the option of choosing science, technology, engineering and mathematics careers).

In response to these concerns, the science education community, with the support of the Carnegie Foundation, is embarking on the development of a new conceptual framework for science education, led by the National Research Council (NRC) after which Achieve will lead the development of aligned Next Generation Science Standards. The National Research Council (NRC), Council of Chief State School Officers (CCSSO), National Governor's Association (NGA), American Association for the Advancement of Science (AAAS), the National Science Teachers Association (NSTA), and the Council of State Science Supervisors (CSSS) will be active in the development of the new standards.

One characteristic of the NRC framework and the Next Generation Science Standards is that they will take into account the science expectations of high performing countries. For some time, state and national leaders have called for U.S. standards to be internationally benchmarked spurred on, in part, by the consistently dismal news that U.S. students lag behind their peers in other nations on international science assessments and the lack of U.S. students attaining science, technology, engineering and math degrees at all postsecondary levels. These realities have implications for the United States' ability to lead the world in research and development and our future economic growth and stability. And for individuals and communities, being STEM capable is essential to making sense and understanding the world around us.

Achieve, through support from the Noyce Foundation, examined ten sets of international standards with the intent of informing the development of both the conceptual framework and Next Generation Science Standards. Achieve selected countries based on their strong performance on international assessments and/or their economic, political, or cultural importance to the United States.

State Implications

In 2007, the *No Child Left Behind* act required states to develop science standards and assessments. While many states already had science standards, most revised their science standards in the years leading up to the science assessment requirement. In doing so, they drew upon several documents to inform decisions regarding content and the philosophy of science education such as AAAS's *Benchmarks for Scientific Literacy* and the NRC's *National Science Education Standards*. Both of these documents, and others like them, focused on a scientific literate citizenry.

Policy making bodies such as state boards of education are more and more concerned with national and international alignment of proposed standards in all core subjects. Achieve's International Science

[1] The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy, Exec Sum, pg. vii. ©2009 by Carnegie Corporation of New York and Institute for Advanced Study.

Benchmarking report will serve as another resource for states to utilize as they engage their respective communities in discussions regarding science education. It will also serve as a companion document to the NRC's *Conceptual Framework for Science Education* and the subsequent Next Generation Science Standards whose development will be lead by Achieve.

In addition, this report supports the current initiatives states are engaged in with regard to STEM and their college- and career-ready policy agendas. States need resources that have the ability to communicate the need for students to be engaged in quality science and mathematics beyond what most students now receive. This report can serve as evidence that high performing countries expect high levels of rigor in science for all their students, regardless of post secondary destinations. As can be seen in the discussion below and more fully in the report, exemplar countries have students engage in content from Primary through Lower Secondary School that establishes a foundation for scientific literacy and success in additional courses of increasing rigor that properly prepare them for the demands of postsecondary education and careers. With this foundation, students are prepared to move into coursework in Upper Secondary School that supports their career or continuing education goals including preparation for STEM careers.

The Report

All of the countries selected require their students to learn science from Primary through Lower Secondary, which ends at either grade 9 (three countries) or grade 10 (seven countries). In Upper Secondary, countries expect students to pursue further science study by taking courses in Biology, Chemistry, Physics and/or (where available) Earth and Space Science. The way in which countries structured their standards prompted researchers to think about findings from three perspectives:

1. PRIMARY AND LOWER SECONDARY SCIENCE: *What knowledge and skills do countries expect all students to learn in primary through lower secondary grades prior to taking discipline-specific high school courses in science?*
2. UPPER SECONDARY SCIENCE: *What knowledge and skills do countries expect students to learn in upper secondary courses in Biology, Chemistry, Physics, and Earth and Space Science that prepare them for postsecondary study in science, engineering and technology?*
3. EXEMPLARS: *What are exemplary features of the standards reviewed in this study that should be considered by developers of the Next Generation Science Standards in the United States? What are common shortcomings – and how might they be overcome?*

Achieve's report is limited by its focus on standards. It does not take into account the broader country context, i.e., how the education system functions as a whole and differences in economic, social, and cultural norms. Other limitations were a dearth of information on student course-taking patterns and pathways, and the availability of adequate English translations.

Achieve's analysis has both a quantitative and qualitative component. The quantitative analysis revealed the specific content and performance expectations the ten high-performing countries have established for each science discipline for Primary through Lower Secondary and for Upper Secondary (subject-specific courses). The qualitative examination complemented the quantitative analysis by identifying noteworthy practices and also weaknesses among the countries' standards. The table below shows the countries selected for the study and how their standards were analyzed.

Country	Preliminary Qualitative Review	In-Depth Qualitative Review		Quantitative Analysis
		Biology, Chemistry & Physics	Earth and Space Science	
Canada [Ontario]	✓	✓	✓	✓
Chinese Taipei	✓		✓	✓
England	✓	✓		✓
Finland	✓			✓
Hong Kong	✓	✓		✓
Hungary	✓			✓
Ireland	✓			✓
Japan	✓	✓	✓	✓
Singapore	✓	✓		✓
South Korea	✓			✓

Major Findings of the International Benchmarking Report

The overall goal of Achieve's report on international standards is to inform the development of the NRC's conceptual framework and the subsequent development of the Next Generation Science Standards. Through a quantitative analysis of international standards, Achieve's reviewers discovered four key findings.

Finding #1 - All countries require participation in integrated science instruction through Lower Secondary and seven of 10 countries continue that instruction through Grade 10, providing a strong foundation in scientific literacy.

Finding #2 –Physical science content standards (physics and chemistry content taken together) received far more attention in lower primary through lower secondary. Other countries dedicate the greatest proportion of their standards to biology and physics content and the least to earth and space science.

Finding #3 – Other countries' standards focus life science instruction strongly on human biology, and relationships among living things in a way that highlights the personal and social significance of life science for students and citizens. However, in the U.S., virtually all states also have a requirement for health and physical education from lower primary to lower secondary which could explain the difference in focus.

Finding #4 – Cross-cutting content common to all of the sciences such as the nature of science, nature of technology and engineering receives considerable attention. Inquiry skills in Primary are stressed more than in Lower Secondary. However, advanced inquiry skills receive increasing attention in Lower Secondary.

Exemplary Features

Achieve reviewers qualitatively reviewed five of the ten countries' (Canada, England, Hong Kong, Japan, and Singapore) standards documents to determine exemplary features. Achieve's reviewers submitted six exemplary features for the NRC's Conceptual Framework for Science Education committee to consider, they are:

Feature #1 – Standards based around "unifying ideas" for Primary through Lower Secondary seem to confer more benefits than a discipline-based structure. Achieve's reviewers found that developing standards around unifying ideas provided greater coherence and focus within the standards. In addition, this structure provides a more focused perspective in development by providing a method to determine what content should be included.

Feature #2 – Providing multiple examples of performance in content and performance standards makes expectations for student performances specific and transparent. Achieve's reviewers found Canada's use of multiple examples within their standards an excellent method to communicate the level of rigor expected from students. Multiple examples help learners connect concepts with applications in the real world, help them to explain everyday phenomena, and enhance the clarity and accessibility of standards. Incorporating multiple examples (rather than relying on a single example) is important because multiple examples show a range of applications, rather than a single point that can quickly become a limiting factor.

Feature #3 – Making meaningful connections to assessment helps to focus attention on the ultimate goal of raising student achievement. Achieve found three countries, Canada, England, and Hong Kong; make a special effort to show how their standards and assessments are aligned. While the approaches vary considerably, all three countries make solid links between the content they expect students to learn and how that learning will be evaluated.

Feature #4 – Organization and format has an enormous effect on the clarity and accessibility of a country's standards. Achieve found Canada, Singapore, and Hong Kong have user-friendly standards, and their approaches are similar. England's standards are structured differently but are also accessible. Great care was taken on the part of these countries to ensure they were clear and communicated the level of rigor and intent of the standards.

Feature #5 – Developing students' ability to use inquiry, engineering design, and modeling supports student participation in structured projects that nurture scientific habits of mind and stimulates student interest. Developing students' capacity to understand, design and apply physical, conceptual, and mathematical models is a key ability. Achieve found that Canada's parallel development of inquiry and design stands out as a quality example. It makes fundamental connections between conducting investigations in the natural world and problem solving in the designed world. It describes a progression of performances from beginning to proficient in four key areas for both inquiry and design: Initiating and Planning; Performing, and Recording; Analyzing and Interpreting; Communicating.

Feature #6 – All student populations should have accessibility to science and guidance should be provided to support this philosophy. Achieve's reviewers found countries who had clearly made accessibility of science to all populations a priority. For instance, England includes guidelines for teaching science to all students that are an important part of a standards document. Hong Kong also includes curriculum adaptations for a diversity of learners including accelerated learners.

Quantitative Analysis

To conduct the quantitative analysis, Achieve adapted a coding system, initially developed by Michigan State University for use in its Third International Science Study (TIMSS 1995), to identify general patterns in the content and performances that the ten countries emphasize at each level of schooling. The quantitative analysis allowed Achieve to examine the expectations through lower secondary separate and apart from the additional content and performance expectations included in the upper secondary courses that signal what it means to be prepared for postsecondary work in each discipline.

The chart below lists the major content areas and the kind and level of performance countries included in their standards.

CONTENT	PERFORMANCE
• Biology • Chemistry • Physics • Earth/Space Science • Cross-Cutting and Interdisciplinary Content	• **Cognitive Demand** o *Knowing* o *Applying* o *Reasoning* • **Inquiry Skills** o *Basic* o *Advanced*

In looking across countries, we find somewhat different emphases In Primary and Lower Secondary than we typically see in U.S. standards. For example, the countries in Achieve's study tend to:

- Emphasize physical science (physics and chemistry content taken together). This emphasis on the physical sciences is not shared by most states and is also not shared to the same degree by the NAEP 2009 Science Assessment Framework;
- Dedicate the greatest proportion of their standards to biology and physics content and the least to earth and space science. Again, the attention given to physics is not typical of U.S. national and state standards.
- Focus life science instruction strongly on human biology, and relationships among living things in a way that highlights the personal and social significance of life science for students and citizens;
- Devote considerable attention to cross-cutting content common to all of the sciences–especially the *nature of science, nature of technology and engineering*, *interactions of science, technology and society*, and *sustainability*.
- Stress inquiry skills in Primary more than in Lower Secondary, but give increasing attention to advanced inquiry skills in Lower Secondary;
- Place a premium on the cognitive level of *knowing*, but place increasing emphasis on *applying, and reasoning* in Lower Secondary.

Among the key findings from this analysis for Upper Secondary courses are that other countries on average:

- Place unexpected emphasis on organic chemistry and the mathematics of chemical reactions;
- Give priority in physics to Newton's laws of motion, electrical phenomena, energy and physical/chemical changes, and cross-cutting concepts in *science, technology and society*, but little attention to engineering concepts;

- Include cross-cutting topics that do not belong exclusively to a specific discipline in all subject-specific courses. This is especially true of earth and space science.
- Devote slightly less than 20 percent of performances on average to inquiry skills;
- Place more stress on *knowing* than in Primary and Lower Secondary, likely reflecting the tension between covering content and developing proficiency in higher-order thinking skills.

Qualitative Analysis

In the qualitative analysis, Achieve first surveyed the ten countries' standards and supporting documents, examining their structure, organization, and other features in search of exemplary characteristics worthy of emulation. Based on these preliminary findings, content experts conducted a more in-depth analysis of the five most promising international standards, using an established set of criteria Achieve has developed for the evaluation of academic standards. The criteria include coherence, focus, rigor, progression, specificity, clarity and accessibility. Examining the five countries' standards on the basis of these criteria helped reveal comparative strengths and weaknesses, as well as noteworthy features.

It is important to note that countries organize their Primary and Lower Secondary standards in different ways. Achieve found that two countries, Canada and South Korea, have detailed grade-level standards for grades 1-10; one country, Japan, has a blended approach with grade-level standards in the Primary grades and grade spans in the Lower Secondary grades; the remaining seven countries organize their standards in grade spans. Notably, two of the ten countries included in this study, Japan and Singapore, delay the start of science instruction until grade 3.

An obvious difference between the countries analyzed and most states is that seven of the ten countries analyzed require participation in an integrated science program – life, physical, earth science, and cross-cutting content through grade 10 before they initiate discipline-based courses. Thus, students in these seven countries have two years of integrated science instruction in high school. The additional year allows time for students to build a stronger foundation in scientific literacy before enrolling in more rigorous, discipline-specific courses at the Upper Secondary level that support their college and career interests.

No one country's set of standards emerged from the analysis as being an overall exemplar, but a number of features, described below, stood out as being particularly effective (detailed examples are discussed in the full report).

- STANDARDS ARCHITECTURE - Basing standards, either on key concepts in the major fields of life, physical, and earth sciences or on foundational themes (big ideas), is structurally sound. Singapore and Canada structure their standards on themes common to all of the sciences, though their approaches differ somewhat in execution.
    - Singapore has four themes—Diversity, Systems, Energy, and Interaction that are common to both Primary and Lower Secondary. (Cycles appear only in Primary, replaced by Measurement and Science and Technology in Lower Secondary, while Systems is expanded at Lower Secondary to include Models.)
    - Canada structures its K-8 Science and Technology Standards on the basis of six themes: Matter; Energy; Systems and Interactions; Structure and Function; Sustainability and Stewardship; and Change and Continuity. Both countries overlap in their selection of Systems, Energy, and Interactions as crossover ideas.

A conceptual framework based on cross-cutting themes seems especially powerful for Primary through Lower Secondary grades. Themes provide a matrix for developing a strong story line that can help teachers and students make sense of seemingly disconnected content within and across years of instruction and impart an underlying coherence to the curriculum. Importantly, a theme-based approach provides a filter for selecting among the many core concepts that could potentially be included in a set of standards.

The NRC's Conceptual Framework for Science is being developed around core ideas and the Next Generation Science Standards will be aligned to the framework. States will be able to use the core ideas as a means to develop instructional materials and statewide assessments that focus on the core ideas. Providing teachers and curriculum developers with matrices that show the relationships within science content could be a powerful tool for teachers. In addition, matrices for elementary teachers showing relationships between science content and practice with the content in the Common Core State Standards (CCSS) in English language arts and mathematics could boost a more integrated and robust approach to elementary instruction.

- LINKING PERFORMANCES TO CONTENT - Linking performance expectations (what students can do to show they have learned the related content) directly with content statements helps make the required level of rigor transparent.
    - Consider Singapore's Primary (Grades 3-4) standard: *Identify the different parts of a typical plant cell and animal cell and relate the parts to the functions. – Parts of plant cell: cell wall, cell membrane, cytoplasm, nucleus of chloroplasts; – Parts of an animal cell: cell membrane, cytoplasm, nucleus.* The related skill that students are expected to demonstrate is *to compare a typical plant and animal cell*.
    - In Hong Kong's Upper Secondary Biology we find: *Explain why sample size, random sampling, replicates and repeat procedures are important in scientific investigations (e.g., field studies)*.
    - And in Hong Kong's Upper Secondary Chemistry we find: *Suggest and perform experiments to compare the strength of acids or alkalis.*

  Linking performance to content is particularly important in signaling the level of cognitive demand expected in support of rigor. It is relatively easy to show alignment of content; it is quite a different challenge to show alignment of performance, especially to demonstrate that higher-order thinking skills are being called for. States can support their teachers by showing examples of this alignment through instructional tasks, rubrics, and model large-scale assessment items.

- CONNECTING ASSESSMENTS TO STANDARDS - Providing links between the content students are to learn and how the learning will be evaluated calls attention to the ultimate goal of raising student achievement. Canada, England, and Hong Kong take different approaches but all three countries make solid links between the content they expect students to learn and how that learning will be evaluated.
    - England's Attainment Targets provide rubrics for teachers to assign performance levels based on students' understanding of content and inquiry skills.
    - Hong Kong calls its standards for secondary schools *Curriculum and Assessment Guides* and the discussion of assessment permeates the entire document. The

guides provide a wide range of assessment objectives that are aligned to the specific content of biology, chemistry and physics.

- Ontario takes assessment guidelines to another level in designing a set of assessment tasks and scoring rubrics, and importantly, publishing related samples of actual student work that illustrate what level of performance is sufficient to attain the various levels of proficiency.

Several states are engaged in a similar type of work. Standards and assessment staff should work collaboratively to develop clear relationships between standards and assessments. The products of this collaboration should be posted in a place that teachers can access and utilize. When the work is done separately and posted or disseminated separately it can lead to confusion or mistrust. Taking on the philosophy of connecting the assessments to standards can go a long way in improving instruction and building relationships between districts, teachers, and the state education agency.

- USE OF MULTIPLE EXAMPLES - Including multiple illustrations helps learners see how core concepts explain phenomena in the natural world and how science, technology and engineering relate to everyday life. Multiple examples demonstrate the application of a concept in a range of contexts and discourage recall of a single case.
  - Consider Canada's Grade 5 standard regarding physical and chemical changes: *Describe physical changes in matter as changes that are reversible (e.g., a melted ice cube can be re-frozen; a bottle of frozen water can be thawed to a liquid state again; water vapor that has condensed on a cold window can evaporate into a vaporous state again; water from a puddle that has evaporated will fall to the ground as rain);* and *Describe chemical changes in matter that are irreversible (e.g., when the chrome on a bicycle rusts, it can never go back to being chrome; when an egg is boiled it can never go back to being a raw egg.)*
  - *And its Grade 5 standard regarding developing investigation skills: Measure and compare, quantitatively and qualitatively, the force required to move a load (e.g., to lift a book, to open a drawer) using different mechanical systems (e.g., different pulley systems, a lever, a gear system), and describe the relationship between the force required and the distance over which the force moves.*

  Canada also uses sample issues to ground standards related to science, technology and society, avoiding overly broad standards that are very difficult to assess. For example,
  - *Assess the impact on local and global water systems of a scientific discovery or technological innovation (e.g., enhancing the efficiency of naturally occurring bacteria that consume hydrocarbons from oil spills and convert them to carbon dioxide and water; development of desalination techniques to provide fresh water from sea water.)*

    ---Sample issues: (a) Bioremediation (e.g., the use of microorganisms to clean up contaminated soil or water) can eliminate contamination in many environments with a speed and thoroughness much greater than traditional methods and at significantly lower costs. However, it is effective on a limited number of contaminants; in some cases, the time involved is relatively long; and considerable knowledge and experience are needed to design and implement a successful bioremediation program. (b) Desalination is a method that allows sea water to be made into fresh water. The cost to do this is declining, while extracting water from

rivers and lakes is becoming more expensive as well as ecologically harmful, and groundwater in many locations is depleted. However, not every area that needs a supply of fresh water is on the coastline.

Multiple examples are also a great resource for teachers; especially teachers who may be weak in a particular area or those teaching out-of-field. By providing these kind of examples states offer all teachers support. Teachers who are proficient in their content area can use these when time is short. Teachers who are struggling with content have quality examples at hand to incorporate in their lessons.

- INCLUSION OF INQUIRY AND DESIGN PROCESSES - Developing both inquiry and design processes supports student participation in structured projects that nurture scientific habits of mind and stimulates student interest. Canada consistently relates core concepts to developing either investigation and communication skills or technological problem–solving skills, often including sample problems and/or guiding questions. Consider Canada's grade 8 standard:
  - *Use technological problem-solving skills to investigate a system (e.g., an optical system, a mechanical system, an electrical system) that performs a function or meets a need.)*

    ---Sample problem: Create a device that will carry a snack from one place to another. Describe the function of each component part, and examine the effects of making a change to one or more components.

    ---Sample guiding questions: What purpose or need does your device fulfill? When you tested your device, which component or components worked as intended? Which did not? Why do you think the problem occurred? Predict what will happen if you remove or change the size or direction of one or more of the components.
  - In addition, Canada's standards for grades 1-8 include a separate, but parallel matrix for *Scientific Inquiry/Research Skills* and for *Technological Problem-Solving Skills* that describe a full continuum of stages of proficiency. These matrices chart the extent of student learning from *beginning* to *exploring* to *emerging* to *competent* in four key areas: 1) Initiating and Planning; 2) Performing and Recording; 3) Analyzing and Interpreting, and 4) Communication, common to Inquiry and Technological Problem-Solving Skills.

Just as in the previous category, struggling teachers need additional support in the area of implementing quality inquiry and design tasks. States can support these teachers, as well as strong teachers in need of more material, by developing exemplars, models, or providing a platform for teachers to share their own materials. Of particular importance is explaining the key areas and indicators of those areas for new and struggling teachers.

- MODELING - Building, applying, and refining models based on evidence is a central pursuit of modern science. Developing students' capacity to understand, design and apply physical, conceptual, and mathematical models is a key ability that should be interwoven in the standards. Canada's standards include a strong modeling component developed across the grades, often linked with inquiry and design. Consider the following Grade 7 standard:
  - *Design, construct and use physical models to investigate the effects of various forces on structures (e.g., the struts of a roof experience compression forces from shingles; the support cables of a suspension bridge are in tension; a twisted ruler has torsion*

forces; the pin that holds the two parts of a scissors together has sheer forces acting on it.)

In order to avoid contrived, mundane and non-productive modeling activities, states could provide exemplars that include how key components of modeling mesh with core concepts, provide guidance in implementation, and scoring rubrics that allow teachers to identify quality.

- ADDRESSING THE NEEDS OF ALL LEARNERS - Paying attention to the full spectrum of science learners from struggling students to those with exceptional ability sends the message that learning science is for all students.
    - England's standards contain a section on Inclusion that specifically addresses students with special educational needs, including but not limited to students with disabilities and those who are learning English as an additional language.
    - Hong Kong expects teachers to adapt the curriculum *to suit students of different needs, interests, abilities, experiences, and learning style,* and also addresses the need to accommodate students of exceptional ability by including specific extensions in the content standards for higher-ability students*.*

All states have grappled with this issue. These countries provide some examples of how states could provide leadership to districts and teachers on how to differentiate instruction. In particular, high ability learners need to be given more public support. Low performing students tend to receive more overt support, but these countries clearly show the need to meet the needs of all students.

Shortcomings

Other countries' standards have much to recommend them. However, Achieve's analysis inevitably revealed shortcomings, which are also instructive. These findings present opportunities for the developers of the NRC conceptual framework and Next Generation Science Standards to forge ahead building on the strengths of other countries' standards, avoiding their weaknesses, and spring-boarding to a new platform that will guide 21st century science learning. Based on Achieve's findings in this study, areas that require special attention in constructing new standards are as follows:

- INCLUSION OF MATHEMATICS: Mathematics is the bedrock of science and the integration of mathematics is a hallmark of rigorous science standards. To develop students' ability to think in quantitative terms, math applications need to be incorporated throughout the grades.
- EVIDENCE-BASED INQUIRY: Advances in science stem from constructing testable, evidence-based explanations, models, and predictions. Calls for students to back up explanations with evidence should be a consistent thread.
- ENGINEERING/TECHNOLOGICAL DESIGN PROCESSES: Today's world is largely and increasingly shaped and controlled through engineering and technology, but this is an area that tends to be on the periphery of other countries' science standards. Helping students understanding similarities and differences between science and engineering goals and practices will expand and deepen their knowledge of both the natural and the designed world and how they interact.
- CHEMISTRY FOUNDATION FOR MODERN BIOLOGY: Modern biology is focused on molecular biology and genetics, which are rooted in chemistry. Students thus need a solid grounding in chemistry, provided either in Lower Secondary or incorporated into Upper Secondary Biology expectations, so they are able to understand – not simply memorize – new and important life science content.

- LEARNING PROGRESSIONS: The articulation of learning progressions for key disciplinary and cross-cutting concepts is an expanding area of research. If students are to develop depth of understanding of core concepts, developers of new standards will need to tease-out the pre-requisite knowledge and skills, to provide a conceptual basis for understanding.

Conditions are right for the United States to take the lead internationally in forging a new conceptual framework for science, and Next Generation Science Standards. The NRC framework and aligned science standards will create a fresh vision for science education and new directions for teaching, learning, and assessment that could contribute significantly to improving student understanding and achievement. Seizing the opportunity that this moment presents will bring us a step closer to moving the United States into the vanguard of international science education reform.