The Washington State Board of Education

Governance | Accountability | Achievement | Oversight | Career & College Readiness

Title:	**Next Generation Science Standards—Adoption Considerations**
As Related To:	☐ Goal One: Effective and accountable P-13 governance. ☐ Goal Two: Comprehensive statewide K-12 accountability. ☐ Goal Three: Closing achievement gap. ☐ Goal Four: Strategic oversight of the K-12 system. ☒ Goal Five: Career and college readiness for all students. ☐ Other
Relevant To Board Roles:	☐ Policy Leadership ☒ System Oversight ☐ Advocacy ☐ Communication ☐ Convening and Facilitating
Policy Considerations / Key Questions:	Should the State Board of Education adopt a motion recommending the adoption of the Next Generation Science Standards? Key questions identified by the Board for consideration of the standards are: • Are these the right standards for Washington? • Will these standards help prepare our STEM workforce?
Possible Board Action:	☐ Review ☒ Adopt ☐ Approve ☐ Other
Materials Included in Packet:	☒ Memo ☐ Graphs / Graphics ☒ Third-Party Materials ☐ PowerPoint
Synopsis:	The SBE will engage in a panel discussion with representatives of science educators and employers. The panelists are: Ms. Sandi Everlove, Chief Learning Officer, Washington STEM Dr. Dana Riley Black, Director of the Center for Inquiry Science, Institute for Systems Biology Ms. Midge Yergen, Teacher, West Valley Junior High School, and Past President, Washington Science Teachers Association Mr. Jeff Estes, Division Director, Science and Engineering Education, Pacific Northwest National Laboratory The role of the SBE is to provide consultation to the Superintendent of Public Instruction, who will consider adoption of the standards for the state.

NEXT GENERATION SCIENCE STANDARDS—ADOPTION CONSIDERATIONS

Policy Consideration

At the July 10-11, 2013, Board meeting, the State Board of Education (SBE) will engage in a panel discussion with representatives of science employers and educators concerning the Next Generation Science Standards (NGSS). Key questions for the discussion identified at the May 2013 Board meeting are:

- Are these the right standards for Washington?
- Will these standards help prepare our science, technology and engineering workforce?

RCW 28A.655.068 authorizes the Superintendent of Public Instruction to adopt the multi-state consortium science standards (NGSS) in consultation with the SBE.

The SBE will consider adopting a motion recommending the Next Generation Science Standards be adopted by the Superintendent of Public Instruction.

Background

SBE Members were informed about preparation for the NGSS at the March 14-15, 2012 Board meeting, and received an update on implementing Common Core State Standard and NGSS assessments at the May 8-9, 2013 meeting. At the May 8-9, 2013 meeting, Office of Superintendent of Public Instruction (OSPI) staff provided a brief update on the development and completion of the NGSS and engaged in a discussion of adoption considerations. The NGSS were released in final form in April 2013.

The Next Generation Science Standards were created through a joint effort of the National Research Council, the National Science Teachers Association, and the American Association for the Advancement of Science, and Achieve, Inc. The first phase of the process to produce the standards was the development of a Framework for K-12 Science Education by the National Research Council. The second phase was the development of the standards themselves, managed by Achieve, Inc. As one of 26 Lead State Partners, Washington actively participated in the development and review of the standards. Representatives from Lead State Partners provided guidance to writing the standards, gathered and delivered feedback from state-level committees, and came together to address common issues and challenges. The Lead State Partners also agree to commit staff time to the initiative and, upon completion, give serious consideration to adopting the Next Generation Science Standards.

The NGSS underwent a Bias and Sensitivity Process, to verify that the standards contain no unnecessarily difficult language and avoid bias and stereotypes. In addition, OSPI conducted an analysis to compare the NGSS with the 2009 Washington State K-12 Science Standards.

In June 2013, the Fordham Institute released a report of an evaluation of the NGSS compared to state standards (*Final Evolution of the Next Generation Science Standards*, Paul Gross, Douglas Buttrey, Ursula Goodenough, Noretta Koertge , Lawrence S. Lerner, Martha

Schwartz, Richard Schwartz, June 13, 2013: http://www.edexcellence.net/publications/final-evaluation-of-NGSS.html. The first section of the foreword of the report is included in this packet).

The Fordham's evaluation gives the NGSS a grade of "C", and scored the 2009 Washington State K-12 Science Standards approximately equivalent to the NGSS in quality. Twenty-six states were graded lower than a "C." Twelve, including Washington, were graded a "C," and 13 states were graded higher than the NGSS. The foreword to the report is included in this packet, and summarizes the findings of the report. The shortcomings the reviewers found with the NGSS include 1) missing or implied content; 2) the possibility of limiting what is taught and learned because of stated limits on what should be assessed ("assessment boundaries"); and, 3) failure to include essential math content. In addition, the report describes the NGSS as wrongly prioritizing the practice of science over science content.

The National Science Teachers Association responded to the Fordham report with a statement by Dr. David L. Evans, NSTA Executive Director (included in this packet and available here: http://www.nsta.org/about/pressroom.aspx?id=59989) that supports the balance of practice and content presented in the NGSS, and argues that the Fordham report is based on the personal opinions of the reviewers and is not research-based.

Additional considerations the SBE may discuss include:

- Advantages to students of adopting multi-state science standards, including portability.
- Advantage to the state in adopting multi-state science standards, including common development of science assessments, economies of scale in curricula development and resources, and comparability of assessment results.
- The level of commitment and capacity by the state and districts to fully implement new science standards.
- The interplay of the standards and graduation requirements; currently 2 credits of science are required but 3 credits have been approved by the SBE—can the standards be met with 2 credits of high school science?

Resources

The final Next Generation Science Standards:
http://www.nextgenscience.org/next-generation-science-standards

TVW video of House Education Committee Work Session April 11, 2013, update on the Next Generation Science Standards:
http://tvw.org/index.php?option=com_tvwplayer&eventID=2013041051

The PowerPoint presentation for the above video may be found here:
http://app.leg.wa.gov/m/cmd/Handler.ashx?MethodName=getdocumentcontent&documentId=qeWOag55PvI&att=false

A Framework for K-12 Science Education: Looking Toward the Future of Science Education:
http://www.nae.edu/Publications/Bridge/69735/69747.aspx

Fordham Institute report on the Next Generation Science Standards, *Final Evolution of the Next Generation Science Standards*, Paul Gross, Douglas Buttrey, Ursula Goodenough,

Noretta Koertge , Lawrence S. Lerner, Martha Schwartz, Richard Schwartz, June 13, 2013: http://www.edexcellence.net/publications/final-evaluation-of-NGSS.html

The Fordham Institute previously released evaluations of state science standards in 2012, http://www.edexcellence.net/publications/the-state-of-state-science-standards-2012.html; in 2005, http://www.edexcellence.net/publications/sosscience05.html; and, 1998, http://www.edexcellence.net/publications/stsciencestnds.html. The 2012 evaluation was discussed by the SBE at the March, 2012 meeting.

Action

SBE may adopt a resolution recommending the adoption of the Next Generation Science Standards.

Next Generation Science Standards Panelist Bios

Dana Riley Black

Since 2005, Dr. Dana Riley Black has held the appointment of Director for the Center for Inquiry Science at the Institute for Systems Biology. Riley Black is an educator whose interests include professional development for teachers and administrators as applied to systemic science education reform, and correspondingly, strategies that enable the scientific community to engage with and support K-12 science education. Through securing and managing grants from federal, state and corporate organizations, she currently partners with and supports school districts across the Puget Sound region in their efforts to implement research-based science education reform.

Riley Black has a Bachelor of Science degree from the University of Washington and a M.Ed. in Science Education and a Ph.D. in Educational Leadership and Curriculum Studies from Miami University. Through graduate school she worked for the Principal Investigator of Ohio´s NSF-funded Statewide Systemic Initiative, Project Discovery – a systemic initiative supporting middle school mathematics and science teachers across the state of Ohio. During her post-graduate appointment at the Harvard-Smithsonian Center for Astrophysics, Riley Black developed physical science curriculum and televised professional development experiences for teachers of mathematics and science. Before joining the Institute for Systems Biology, she worked for five years at the University of Washington, establishing its K-12 Institute for Mathematics and Science Education – this work served to coordinate the university´s Mathematics and Science outreach efforts with regional systemic reform efforts.

Jeff Estes

Jeffrey Estes is the Division Director, Science & Engineering Education, at the Pacific Northwest National Laboratory (PNNL), a U.S. Department of Energy (DOE) National Laboratory that is proudly operated by Battelle Memorial Institute. PNNL's mission is to transform the world through courageous discovery and innovation.

Science & Engineering Education at PNNL brings to bear the resources of a DOE National Laboratory to advance science, technology, engineering and mathematics (STEM) education; recruit and prepare a talented workforce; and keep the U.S. at the forefront of innovation.

Estes is responsible for strategy execution and evaluation of the Laboratory's efforts to 1) strengthen and advance STEM education in Washington State, 2) improve the Laboratory's work-based learning and outreach efforts, 3) deliver against the workforce development expectations of the U.S. Department of Energy-Office of Science and 4) connect PNNL to regional and national STEM education initiatives that are part of an emerging effort by Battelle-affiliated laboratories to catalyze sustainable improvements in STEM education.

Science & Engineering Education initiatives at PNNL *plant* the seeds of wonder, inquiry, problem solving and critical thinking; *cultivate* rich learning environments that catalyze improvements in STEM education; and *harvest* the next generation of scientists and engineers through intern and fellowship programs.

Sandi Everlove

Sandi Everlove is the Chief Learning Officer at Washington STEM. In this role, Sandi leads efforts to generate and share knowledge of innovation in STEM teaching and learning. In addition to working with funded partners to document insights and lessons learned, Sandi identifies and promotes promising practices from around the state, the nation, and internationally.

Prior to joining Washington STEM, Sandi founded TeachFirst where she led the development of innovative multimedia and face-to-face tools and resources to support teacher learning. This included producing hundreds of online videos that demonstrated research-based instructional strategies, facilitator guides, discussion protocols, leadership resources, and student shadow protocols.

A passionate advocate for children, Sandi brings on the ground experiences to her work in STEM education. She is an award-winning high school chemistry teacher with Seattle Public Schools and received the Washington State Golden Apple Award in 1998. Through a U.S. Department of Education grant, she wrote and piloted a number of innovative science courses including an award-winning high school science ethics class. Her efforts extend internationally including creating and leading professional development courses for teachers in Guatemala.

Sandi co-founded the Lake Washington Girls Middle School, the first nonprofit, secular all girls' middle school in Washington state. She has also served on the Mount Baker, Martin Luther King, Jr. scholarship committee for over 20 years.

Midge Yergen

Midge Yergen is a 35 year veteran secondary science educator. She currently teachers STEM/CTE Human Health Sciences at West Valley Junior High in Yakima, Washington where the STEM/CTE program was recognized as a 2012-2013 Washington State Lighthouse School. She also teaches in the district's Gifted and Talented program. Midge was a 1995 recipient of the Presidential Award for Secondary Science Teaching and serves as the Co-Coordinator of the Presidential Awards for Excellence in Mathematics and Science Teaching program in Washington State. Midge is the current Past President of the Washington Science Teachers Association and served 3 years as President of WSTA. She has been a member of the WSTA board of directors since the 1980's. She has provided science and assessment professional development opportunities throughout our state, region and nation. Midge also continues to serve as one of the original members of the Washington Science Assessment Leadership Team (SALT) at OSPI.

Partnership for Learning
EDUCATION FOUNDATION of THE WASHINGTON ROUNDTABLE

WASHINGTON ROUNDTABLE

June 27, 2013

State Board of Education
600 Washington Street SE
Olympia, WA 98504

Dear Members of the State Board of Education:

The members of the Washington Roundtable and Partnership for Learning, representing major private sector employers throughout Washington state, applaud your commitment to the success of every Washington student. There is still much to be done to ensure every student graduates prepared for college and the world of work – but, your decision to adopt and implement the Common Core State Standards in math and English language arts and your commitment to adopt the Next Generation Science Standards are steps in the right direction.

Washington students no longer compete with their peers across the classroom or county line—they compete with students from across the globe. This means that every single student must be held to high standards and receive the same rigorous preparation. And it's a fact that a global knowledge economy indeed means we are expecting more people than ever before to learn, know and apply more than they ever have before – both to secure and contribute to gainful employment but importantly to participate in a democratic society increasingly reliant on technology and high levels of literacy. The Common Core standards represent a commitment to high standards and rigorous preparation.

Because the set of standards provides a *framework* for what students should know at each grade level, local schools and teachers – in 295 school districts and more than 2,000 individual schools – will continue to have control over instructional resources and other local decisions such as how the standards are taught. Local educators will determine the methods and materials that best meet the needs of their students, making sure every student understands the material well and every student is achieving the new, more rigorous and comprehensive standards.

Washington students cannot afford to be left out of this national movement. Our state's youth need a strong foundation in math and English in order to compete in fast-growing, continuously evolving information-based fields. By 2014, seventy-seven percent of new Washington state job openings, which

pay enough to support a small family, will be held by workers who possess education or training beyond high school.

Meanwhile it is important for districts and the state's Office of the Superintendent of Public Instruction (OSPI) to continue to provide teachers and principals with information; training; and aligned materials, resources, and formative and summative assessments. This is a big change in the way students learn, and the way teachers deliver instruction, and is one that will take time to see results.

We believe that timely implementation of Common Core State Standards in English and mathematics, and timely adoption of the Next Generation Science Standards, will together help Washington students compete for the quality jobs our state has to offer and become participants in our state's democracy. We urge you to keep Washington on course!

Respectfully,

Steve Mullin
President
Washington Roundtable

Jana Carlisle
Executive Director
Partnership for Learning

Cc: Randy Dorn, State Superintendent; Office of the Superintendent of Public Instruction
Cc: Alan Burke; Deputy State Superintendent; Office of the Superintendent of Public Instruction
Cc: Ben Rarick, Executive Director; State Board of Education

Foreword

Chester E. Finn, Jr. and Kathleen Porter-Magee

Let us start with the bottom line: We know this Fordham report will be controversial, if only because so many have invested much time, treasure, and energy in the development of the Next Generation Science Standards (NGSS) and they urgently want these standards to be embraced throughout American K–12 education. We respect them, acknowledge their hard work, and honor their intentions.

Having carefully reviewed the standards, however, using substantially the same criteria as we previously applied to state science standards—criteria that focus primarily on the content, rigor, and clarity of K–12 expectations for this key subject—our considered judgment is that NGSS deserves a C.

Before you gasp or grump or lash out, let us remind you that, only a year ago, twenty-six state science standards received grades of D or F from our reviewers, while twelve also earned Cs. Just thirteen jurisdictions—one in four—had standards worthy of honors grades. Only seven earned grades in the A range. (You can see which in the table below.)

As is widely understood, weak standards are not the only—or the most worrisome—problem facing science education in the United States in 2013. Achievement in this field has been dismal. The most recent appraisals by the National Assessment of Educational Progress (NAEP, 2009) found barely one-third of fourth graders at or above the "proficient" level in science, followed by a mere 30 percent in eighth grade and an embarrassing 21 percent at the end of high school. Other studies have shown that just 30 percent of U.S. high school graduates are prepared for college-level work in science.[1]

By international standards, our performance in science is even worse. According to results from the most recent PISA assessment (released in 2010), fifteen-year-olds in the United States ranked twenty-third out of sixty-five countries. On the 2007 TIMSS science assessment, U.S. eighth graders overall ranked eleventh out of forty-eight nations, with only 10 percent of American students scoring at or above the TIMSS "advanced" level.

In short: American science education at the K–12 level needs a radical upgrade. And in our estimation, such an upgrade begins with dramatic improvements in the *expectations* that drive curriculum, teaching, learning, and assessment in this crucial realm. Evaluated against our criteria (spelled out in Appendix A), NGSS earned a higher score than the standards currently in place in twenty-six states (and they are clearly superior to the standards of at least sixteen of those states).[2] If schools in those states aligned their curricula and instruction to the NGSS, their students would likely be better off when it comes to science education.

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[1] ACT, Inc., "The Condition of College & Career Readiness" (Iowa City, IA: ACT, Inc., 2011), http://www.act.org/research/policymakers/cccr11/readiness1.html.

[2] As we did in comparing the Common Core standards for English language arts and math with those of individual states, we believe that any state scoring two or more points higher on our 0-10 point rubric has standards that are "clearly superior" to the NGSS. Similarly, any state whose standards score two or more points lower than NGSS has

Jurisdiction	Grade	Score (out of 10)	Relative quality
California	A	10	clearly superior
D.C.	A	10	clearly superior
Indiana	A-	9	clearly superior
Massachusetts	A-	9	clearly superior
NAEP Framework	*A-*	*9*	clearly superior
South Carolina	A-	9	clearly superior
TIMSS Framework	*A-*	*9*	clearly superior
Virginia	A-	9	clearly superior
New York	B+	8	clearly superior
Arkansas	B	7	clearly superior
Kansas	B	7	clearly superior
Louisiana	B	7	clearly superior
Maryland	B	7	clearly superior
Ohio	B	7	clearly superior
Utah	B	7	clearly superior
ACT Framework	*C*	*6*	Too close to call
Connecticut	C	6	Too close to call
Georgia	C	6	Too close to call
Michigan	C	6	Too close to call
Missouri	C	6	Too close to call
New Mexico	C	6	Too close to call
Texas	C	6	Too close to call
Washington	C	6	Too close to call
NGSS	*C*	*5*	
Delaware	C	5	Too close to call
Florida	C	5	Too close to call
Minnesota	C	5	Too close to call
Mississippi	C	5	Too close to call
PISA Framework	*C*	*5*	Too close to call
Vermont	C	5	Too close to call
Alabama	D	4	Too close to call
Arizona	D	4	Too close to call

standards that are "clearly inferior." That means any state whose standards score *within* that range has standards whose relative superiority/inferiority is "too close to call." The NGSS earned 5 out of a possible 10 points. Hence any state whose standards earned 4, 5, or 6 is, in our view, "too close to call." Any state whose standards earned 0, 1, 2, or 3 has standards that are "clearly inferior" to the NGSS. In our state-by-state review of K-12 science standards, sixteen states earned a 0, 1, 2, or 3; therefore the NGSS are "clearly superior" to the standards governing teaching and learning in those sixteen states.

Jurisdiction	Grade	Score (out of 10)	Relative quality
Hawaii	D	4	Too close to call
Illinois	D	4	Too close to call
Maine	D	4	Too close to call
New Hampshire	D	4	Too close to call
North Carolina	D	4	Too close to call
Rhode Island	D	4	Too close to call
Tennessee	D	4	Too close to call
West Virginia	D	4	Too close to call
Colorado	D	3	Clearly inferior
Iowa	D	3	Clearly inferior
Kentucky	D	3	Clearly inferior
Nevada	D	3	Clearly inferior
New Jersey	D	3	Clearly inferior
Pennsylvania	D	3	Clearly inferior
Alaska	F	2	Clearly inferior
Idaho	F	2	Clearly inferior
Nebraska	F	2	Clearly inferior
Oklahoma	F	2	Clearly inferior
Oregon	F	2	Clearly inferior
South Dakota	F	2	Clearly inferior
Wyoming	F	2	Clearly inferior
Montana	F	1	Clearly inferior
North Dakota	F	1	Clearly inferior
Wisconsin	F	0	Clearly inferior

Having said that, by our lights the NGSS are inferior to the science standards of an almost equal number of states, and qualitatively on par with the expectations of a number of others. Students in those states would do better to be taught to the expectations of one of the states that have already done this really well. (Or to standards constructed upon the NAEP or TIMSS frameworks, both of which earned grades of A- from Fordham's reviewers.)

At day's end, of course, whether standards have *any* impact on achievement hinges on implementation and execution across the many moving parts of the education enterprise. Standards are just the beginning—a description of the goals to be attained, the destinations to be reached. They're not vehicles for getting there. Alas, we have long, glum experience with states whose standards look swell on paper but whose achievement is dreadful—because they never really operationalized their own standards. That could turn out to be as true of NGSS as of individual state standards.

One more crucial point at the outset: most states already have full plates of education reforms that are plenty challenging to implement, often including the Common Core State Standards for English language arts and math. Before undertaking any major change in their handling of science education, state leaders would be wise to consider whether they have the capacity to accomplish this in the near term, too. We caution against adopting any new standards until and unless the education system can be serious about putting them into operation across a vast enterprise that stretches from curriculum and textbooks to assessment and accountability regimes, from teacher preparation to graduation expectations, and much more. Absent thorough and effective implementation, even the finest of standards are but a hollow promise.

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NSTA - National Science Teachers Association

About NSTA

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NSTA Statement Responding to Fordham Institute Report on Next Generation Science Standards

Arlington, Va. June 13, 2013 — The National Science Teachers Association (NSTA), the largest organization in the world promoting excellence and innovation in science teaching and learning for all, issued the following statement today regarding the release of a report by the Thomas B. Fordham Institute on the Next Generation Science Standards. The statement can be attributed to Dr. David L. Evans, NSTA Executive Director.

> The National Science Teachers Association strongly disagrees with the opinions of the Fordham Institute regarding the Next Generation Science Standards (NGSS). The NGSS contains rigorous and substantive science content that will give *all* students the skills and knowledge they need to be informed citizens, college ready, and prepared for careers in a workforce that now considers science skills and knowledge to be basic and fundamental requirements. We also applaud the NGSS writers for maintaining a teachable number of core ideas. If fully implemented, we believe the majority of students will leave high school with a far greater understanding and working knowledge of science than is currently being achieved.
>
> The NGSS is based on a current and robust body of research established by our nation's leading scientists. In contrast, the Fordham review is based on personal opinions and lacks serious substantive research. We need to prepare students for the next generation, not the last.
>
> Research shows that the best way to gain a deep understanding of science is to engage in scientific and engineering practices and NGSS effectively integrates these practices with

rigorous content. A thorough understanding of the practices will not only help students learn important facts, it will help all of us become intelligent consumers of science.

It is important to note that science education leaders, educators, and others from 26 states led the charge to develop and write the new science standards with input from thousands in the science and science education community, including science teachers. This unprecedented involvement of so many groups and individuals—especially those who will be charged with implementing the standards in the classroom—sends a strong message about the promise of and support for NGSS.

Science teachers are optimistic and ready for NGSS. In an informal poll, more than 83 percent of those who responded indicated that NGSS will have a positive impact on the quality of science education. NSTA shares their optimism and maintains that the NGSS has the power to transform science education. We encourage states to adopt and commit the resources and support that schools and teachers will need to implement them.

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About NSTA

The Arlington, VA-based National Science Teachers Association (NSTA) is the largest professional organization in the world promoting excellence and innovation in science teaching and learning for all. NSTA's current membership includes approximately 60,000 science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in science education.

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EDUCATION WEEK
Published Online: June 28, 2013

New Science Standards Designed for Wide Range of Learners

By Lesli A. Maxwell

Back to Story

When the writers of the **Next Generation Science Standards** began sketching out a new vision for K-12 science education, they gave themselves a mandate: Develop standards with *all* students in mind, not just the high achievers already expected to excel in the subject.

Now, three years later, their notion—that every student should get a deep, rigorous science education that would prepare them for demanding coursework, a college degree in the sciences, and a career that could follow—has helped produce a set of standards meant for the most-advanced science students, as well as students who previously may have been steered away from taking a science class, writers of the standards said.

Teachers and advocates for these "diverse" learners said the standards and the supporting documents that accompany them offer an unprecedented opportunity to push a far broader array of students into the science, technology, engineering, and mathematics career pipeline. But they also acknowledge that raising the cognitive demands of science education when there are already yawning achievement gaps between white, Asian, and affluent students, and their poorer, English-learning, black, and Hispanic peers will require major shifts in practice for many science teachers. Eighth grade English-learners who took the 2011 earth, life, and physical sciences portion of the National Assessment of Educational Progress, or NAEP, for example, scored an average of 106 on a 300-point scale, far below a score of 170, which is science proficiency on the test.

"Science really can be the great equalizer," said Stephen L. Pruitt, a former high school chemistry teacher who oversaw the development of the new science standards as a senior vice president at the Washington nonprofit Achieve, one of the organizations leading the science standards-setting effort. "But because science has the unfortunate stigma for only being for a select group of students, we couldn't afford to come out of the gate without having our

diversity and equity work, and some resources for teachers, as a companion to the new standards."

The Next Generation Science Standards—through the work of a diversity and equity team composed mostly of classroom teachers—went through extensive bias and sensitivity reviews to make sure the standards didn't include language with multiple meanings, like "draw on evidence," that might confuse students still learning English, for example.

The diversity and equity team wrote a 21-page companion document to the standards—**Appendix D**—that discusses how the standards can be made accessible to all students and the specific instructional approaches that teachers may use with various types of learners.

And, in a major undertaking to help teachers, the team wrote **real-life case studies** describing how effective instruction using the new standards might look in classrooms filled with seven different types of science learners: English-language learners, students with disabilities, students who are racial and ethnic minorities, poor students, girls, students in alternative education settings, and gifted and talented students.

"We wanted to show teachers that the NGSS are doable and that they can do this with any student," said Emily Miller, a 2nd and 3rd grade English-as-a-second-language and bilingual resource teacher in Madison, Wis., who was one of the 41 writers of the standards and a member of the diversity and equity team. "We also wanted to demonstrate through these case studies that squeezing out science in schools that are under [accountability] pressures has been the wrong direction. We show the value of using a part of the day that is among the most engaging for kids and how you can integrate reading and math."

Learning Like Scientists

The Next Generation Science Standards, developed over three years by a coalition of 26 states and some national groups, seek to foster K-12 students' deeper understanding of science in part by asking them to use the same kinds of practices that actual scientists would use. The standards—adopted so far

Next Generation Science Standards Focus on diverse learners

- Economically disadvantaged students
- English-language learners
- Racial and ethnic minorities
- Students with disabilities
- Girls
- Gifted and talented students
- Students in alternative education

The diversity and equity team was composed of classroom science teachers with expertise and experience in working with at least one of the target groups of diverse learners.

Major components of diversity and equity team's work:

- Bias reviews – The diversity and equity team twice combed through each standard to review it for any gender, language, cultural, and contextual bias that might present barriers to different types of learners.
- Appendix D – A 21-page document that accompanies the NGSS and presents a strong case for how the new standards are designed for all students. It includes detailed information on the science achievement, demographic growth, and effective instructional practices for each major category of diverse learner.
- Case studies – Real-world, detailed descriptions written by teachers, who developed lessons based on some of the new standards, taught them over multiple days in their home classrooms, and closely documented the strategies they used to reach their target group of learners and how students reacted.
- Diversity/Equity theme throughout NGSS – The team incorporated instructional practices and relevant research on teaching diverse learners throughout all the NGSS materials.

Source: *Education Week*

by Rhode Island, Kansas, Kentucky, Maryland, and Vermont—ask students to apply what they learn through the practices of scientific inquiry and engineering design. The standards weave together three dimensions—disciplinary core ideas, science and engineering practices, and cross-cutting concepts—and outline clear performance expectations. Those performance expectations spell out the actions students must perform to demonstrate what they've learned, such as planning and conducting investigations, analyzing data, and building models.

Much of the push to keep traditionally struggling students at the forefront of the writing team as it was developing the standards came from Andrés Henríquez, who at the outset of the standards-writing process was a senior program officer at Carnegie Corporation of New York, the major funder of the NGSS. (Mr. Henríquez is now a program officer at the National Science Foundation.) Mr. Henríquez has long been an advocate for English-language learners and other diverse learners.

Mr. Pruitt, of Achieve, made understanding the wide range of students' learning needs a top priority as he helped recruit and select members of the writing team, which included several science teachers with expertise in working with diverse learners. An often-cited critique of the Common Core State Standards in English/language arts and mathematics is that the needs of diverse learners didn't get top billing as the standards were being written.

"Diverse learners and equity for all students was key to the work from the inception of the NGSS," said Okhee Lee, a professor of science education at New York University who was on the standards-writing team and who was tapped by Achieve's Mr. Pruitt to lead the diversity and equity team. "The common-core documents do not have any modifications or adaptations for diverse learners. Those are now in the hands of practitioners to figure out."

Case Studies

When the diversity and equity team set out to write its case studies, team members first had to develop lessons based on some of the standards, talk about the strategies they would use to reach all their students, and then teach the lesson over a period of time and document how it went. The studies, or vignettes, are rich on detail, with citations on the instructional strategies the teachers used and packed with thorough descriptions of how students' understanding of content—the composition of soil samples from different areas of their neighborhood, for example—unfolded at the same time they were stretched to express themselves in English, a language they are still learning.

Ms. Miller, the 2nd and 3rd grade resource teacher who wrote the case study that focuses on English-learners, said she hears all the time from colleagues that rigorous science instruction for poor, minority, and English-learning kids is "impossible."

"What we hope the vignettes show to teachers is that we are normal teachers, just like them, and we did this in our classrooms and it worked, and it was amazing for our class," she said.

In the case study focused on economically disadvantaged students, a 9th grade chemistry teacher challenged her students, in a multi-day lesson on matter, to explain why a railroad tanker car had dramatically imploded after it had been washed out with steam and all its outlet valves closed. She kicked off the unit with a whole class discussion to size up her students' prior knowledge on the molecular nature of matter by asking them questions about how gases had behaved in earlier investigations they had done. As students responded, she wrote their answers on a chart.

After showing them the video of the imploding tanker car, she asked them to work in small groups to talk about what had happened and to develop models that would explain the implosion. She circulated among them, asking guiding questions as they drew their models and discussed what they thought had happened. One group of students noted that they see smashed aluminum cans in their neighborhood all the time and that maybe an "airfoot" had stomped the tanker down. "What is the imaginary foot?" the teacher asked them. "Air," answered one of them. The teacher told them to add that idea to their model, a strategy that validated the students' discussion of smashed cans as a real-world connection between their neighborhood and science.

Over the next two days, the teacher asked her 9th graders to revise their models after conducting simulations of the imploding tanker with aluminum soda cans. Working in small groups, students filled the cans with water and each group subjected them to different variables (amount of water in the can, temperature of a water bath for submerging the cans, time on a hot plate, volume of the can, and how much each can was sealed shut) to see what would happen. They made predictions and had to defend them when questioned by the teacher. She also gave students a reading assignment on air pressure for homework to help build their understanding.

By the end of the multi-day lesson, students had continued to improve their models and, drawing on the evidence they'd gleaned from their experiments, were able to explain why the tanker, filled with steam and sealed shut, had imploded.

Said team member Rita Janusyk, a 4th grade teacher in a suburban Chicago district who previously was a science coordinator and director of enrichment programs for gifted students: "The idea was to paint a very vivid picture of what this looks like in the classroom and to show a slice of life in a complex world of science instruction in a particular classroom."

Peter McLaren, a state specialist in science and technology for the Rhode Island Department of Education and a member of the standards-writing team, said he will use the vignettes as a key piece of professional development for teachers. In addition to the detailed descriptions of how lessons unfolded and how students responded, he said the contextual information about the historic performance of diverse learners in science and their increasing numbers in classrooms that have traditionally been populated with middle and upper-class white students is really important for teachers to understand.

"The case studies are really about kids," he said. "And for some of my colleagues who are only now beginning to see these kids show up in their classrooms and are asking themselves how they are going to teach them, this is a tremendous resource."

Ms. Lee, an expert on how science learning can support English-language acquisition for ELLs, said as a content area, science has the strongest potential to be relevant for students who come from backgrounds not traditionally seen as the mainstream.

"In and of itself, science is about understanding and explaining the natural phenomenon in the context of where a person lives," she said. "We just have to provide those connections and that relevance to our students."

Coverage of the implementation of the Common Core State Standards and the common assessments is supported in part by a grant from the GE Foundation, at ***www.ge.com/foundation****. Education Week retains sole editorial control over the content of this coverage.*

WEB ONLY

General Response to Fordham Evaluation of the Final Next Generation Science Standards

Summary of Achieve's Response to Fordham (June 2013, OSPI)

The Fordham Foundation released its views on the Next Generation Science Standards on June 13, 2013. There is little argument with Fordham's position that a new set of standards will necessitate a need for teacher professional development and resource allocation on the part districts and schools. An examination of the Fordham critique, however, highlights six overarching concerns with their review.

I. The Fordham Foundation has an ingrained philosophy of science education contrary to the National Research Council *Framework for K-12 Science Education* and the NGSS.

a. Content and practices are integrated in the NGSS because that is how science is practiced—and more importantly, based on 20 years of research cited by the NRC in the *Framework,* how science is best learned by students.

b. Fordham's insistence on "last generation" thinking is contrary to current and best practice research (their philosophy is just that, there is no research base) on how science is practiced, and is at odds with the direction in which AP, PISA, NAEP and other leading indicators of science and science education are leading.

II. The Fordham Foundation asserts that a laundry list of content should be added to the NGSS.

a. Fordham's committee of seven (minus the math reviewers that will contribute later) proposes a set of criteria on which they base their review but there is no mention in their review as to what research is used to support their position.

b. The NGSS college and career readiness committees (approximately 140 post-secondary faculty, staff, and employers) found that none of the topics mentioned by Fordham are necessary for a student's success in college and careers.

c. Some of the content mentioned as missing is just not called out by the name that Fordham is likely searching for.

III. Fordham's Views on Science Education are Decidedly Last Generation—All Students Deserve a Science Education that prepares them for College and Career.

a. The *Framework* and subsequently the NGSS, are meant to prepare all students to be college and career ready. Not only are some of the statements in the report antiquated, they also guarantee that we keep exposure to science restricted to students who some consider to "deserve" a good science education as opposed to opening the opportunity to all.

b. The NGSS will better prepare more students to pursue more advanced course taking (AP, IB, dual enrollment) in high school by giving more students the foundation they need for advanced study.

c. The NGSS will—along with CCSS math and ELA—give all students the option to pursue STEM majors and careers by ensuring that they have a solid foundation in each—and a view of how STEM works in the real world.

IV. Fordham's review team has very little K-12 science or science education background.

a. Five of the Fordham seven reviewers are without any K–12 teaching experience, none have studied education or science education.

b. Only two of the seven (excludes math reviewers Stephen Wilson and Bill Schmidt) Fordham reviewers of the NGSS have any experience in K–12 teaching, and only one has any K–12 experience in the last 30 years.

V. Fordham grading has been inconsistent over time—and the criteria used were created *by the reviewers* and without a research base.

a. Fordham admitted in a conference call briefing on their report that the reviewers created and applied their own criteria. There is no research base given for the criteria.

VI. The Fordham report contains errors.

a. Donald Wink – Professor of Chemical Education, University of Illinois at Chicago responding to critique on the physical science standards around chemistry:

I strongly disagree with the especially critical review that the report has about chemistry. The NGSS presents content in a much more authentic way as a set of concepts rooted in chemical behavior that goes beyond the rote skills of the past. I am afraid the approach taken by the Fordham report writers simply prevents them from seeing how this content approach will work to reach many traditional content goals. *Let me give one example: with chemical calculations involving mass (stoichiometry). The Fordham report includes "the mole concept and chemical arithmetic" on a list of chemistry content omissions (p. 36-37). That is simply not the case. Standard HS-PS1-7 has "Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction." That is precisely what is meant by the mole concept and points to instruction that involves the proportional calculations of traditional stoichiometry.*

Key Activities in Next Generation Science Standards Development Washington State, Summer 2011 to Present		
When	**Activity**	**Who/Outcome**
Summer 2011	Lead State Application	Comprehensive Writing Team of OSPI, Higher Ed, LASER, ESDs, WA STEM, Governor's Office, Informal Educators
Fall 2011	Lead State Partner Selection	Invitation of Leadership Review Teams based on State Application
Late Fall 2011	First Confidential Draft Review	Focus Group Spokane; 2 Leadership Teams – Formal and Informal Educators
Winter 2012	Second Confidential Draft Review	Focus Group Sequim 2 Leadership Teams – Formal and Informal Educators
	Building Capacity For State Science Education (BCSSE) convenes in Raleigh	5 Member State Leadership Team (42 states attending): Phil Bell (UW), C. Landel (WA STEM), B. Sotak (Everett SD), C. Lydon (PSESD), P. Willcuts (PNNL), E. Ebert (OSPI) (Funded by Merck, Eli Lily, Burroughs Wellcome)
Spring 2012	First Public Draft Review	Focus groups convened across 9 State Regions hosted by LASER/ESD Partners. Battelle-PNNL supported reviews with a small grant administered through LASER/PNNL
Summer 2012	College and Career Readiness Review	Four member team: J. Dorsey (MESA), J. Estes (PNNL), S. Addison (Lake Washington Institute of Technology), G. Nelson (WWU), E. Ebert (OSPI)
Late Summer 2012	Third Confidential Draft Review	2 Leadership Teams – Formal and Informal Educators
Fall 2012	Second BCSSE convening in Indianapolis	5 Member State Leadership Team (46 states attending): J. Estes (PNNL) attending for P. Bell (UW), B. Sotak (Everett SD), C. Lydon (PSESD), P. Willcuts (PNNL), E. Ebert (OSPI), WA STEM unable to attend. (Funded by Eli Lily)
Fall 2012	Workshop – *Deep Dive* into A Framework for K12 Science Education	LASER received a $200,000 grant from Boeing to support science education and NGSS. Initial money was used to bring 30 LASER/ESD Directors and co-directors and WSTA representatives together to study Framework. Partnership between OSPI/LASER/ESDs for continuing professional learning about the NGSS.
Fall 2012	WA Federal Math Science Partnership Request for Proposal Process	Included a call for professional learning in STEM education at the elementary and secondary levels focused on the NGSS and Framework elements of Science and Engineering Practices and Crosscutting Concepts (3 year grants to be issues in January 2013).
January 2013	Second Public Draft Release of NGSS	Reviews to be conducted across WA hosted by LASER/ESD Partners. Support by Boeing and PNNL. Expected 1000

		participants.
March 2013	Map out WA State Adoption Process and Implementation Plans for NGSS	OSPI, Leadership Teams, Feedback from focus groups
April 2013	NGSS Finalized (anticipated)	Achieve to finalize the NGSS and make available to States for adoption considerations
	House Education Committee Update	J. Vavrus (OSPI), R. Munson (OSPI), E. Ebert (OSPI), C. Lydon (PSESD), M. Johnson (Chimacum SD), and R. Tatlonghari (Tacoma SD) provided NGSS Update
	Draft Transition Plan and Timeline Developed	Draft Transition Plan and Timeline developed by E. Ebert (OSPI) and presented to WSTA Board, ESD Regional Science Coordinators, and Selected Science Leadership team for vetting and review.
	NGSX Exemplar WS in Boston	J. Ryan (ESD 114) and M. LaLane (ESD 171) attended the NGSX WS in Boston. Both were trained on the pilot project which delivers professional development on the NGSS and the K12 Framework. The focus was on modeling and reasoning around the concept of air.
May 2013	Workshop 2– *Deep Dive* into A Framework for K12 Science Education	Continuation of LASER's Boeing grant supporting science education and NGSS review. Workshop II brings 35 LASER/ESD directors and co-directors and WSTA representatives together to study Framework and NGSS. Draft Transition Plan will be presented to the participants for feedback.
	CARC Updated	J. Vavrus (OSPI), E. Ebert (OSPI) and C. Gabler (ESD 113) review transition plans and timelines with Curriculum Advisory Review Committee (CARC)
	State Board of Education Update	J. Vavrus (OSPI) presentation to SBE updating on NGSS Adoption/Implementation Plans
	Independent Contractor engaged to write Bias and Sensitivity Report and Cross Analysis Report	Relevant Strategies LLC contracted to facilitate and summarize findings related to Bias and Sensitivity Process and Comparison Analysis of NGSS with WA Science Learning Content Standards.
	Conduct Comparisons of final NGSS with WA 2009 Science Standards; Bias and Sensitivity Review	NGSS State Leadership Team; Teacher/Stakeholder Outreach; over 35+ participants in each one day process.
	Work with Statewide Partners on Adoption and Transition Considerations	WSTA Membership; CARC; NGSS State Leadership Team

June 2013	BCSSE Convening of 46 states in Pittsburg.	Six member state team: J. Vavrus (OSPI), E. Ebert (OSPI), C. Lydon (PSESD), B. Day (Everett SD); P. Bell (UW-Life Center); Sandi Everlove (WA STEM)
	Final Report Cross Analysis and Bias and Sensitivity Review	Completed by independent contractor
Summer 2013	NGSS Anticipated Adoption by Superintendent Dorn	
	Transition Plan developed	In partnership with AESD Network and in concert with implementation of CCSS statewide transition plans
	Math Science Partnerships Grants initiate professional learning around key features of the K12 Framework and NGSS	Materials developed through the regional MSP grant projects focused on Science and STEM will provide Open Education Resources to be made available through OSPI website.
August 2013	Initiate NGSX Pilot Project in Olympic, Wenatchee and Puget Sound ESDs.	10+ teachers in each of these regions will participate in the pilot professional development offered by NGSX Project. Project directors nationally include Brian Reisner from Northwestern University, Sarah Michals from Clark College, MA and Jean Moon from Tidemark Institute in Maine.
Fall 2013	Statewide Implementation Planning and Awareness	During the Fall and Winter, OSPI in partnership with the AESD, LASER, WSTA and Higher Education will continue building teacher background knowledge on the Science and Engineering Practices new to the NGSS.

National Center for Education Statistics (NCES)

Institute of Education Sciences (IES)
National Assessment of Educational Progress (NAEP)

This report was generated using the NAEP Data Explorer.

Average scale scores for science, grade 8 by all students [TOTAL], year and jurisdiction: 2011

Year	Jurisdiction	All students		Fordham	Fordham Total
		Average scale	Standard error	Grade	(10 possible)
2011	North Dakota	164	(0.7)	F	1
	Montana	163	(0.7)	F	1
	Vermont	163	(0.8)	C	5
	New Hampshire	162	(0.7)	D	4
	South Dakota	162	(0.5)	F	2
	Utah	161	(0.8)	B	7
	Massachusetts	161	(1.1)	A-	9
	Minnesota	161	(1.0)	C	5
	DoDEA	161	(0.8)	A	10
	Colorado	161	(1.3)	D	3
	Wyoming	160	(0.5)	F	2
	Maine	160	(0.5)	D	4
	Virginia	160	(1.0)	A-	9
	Idaho	159	(0.7)	F	2
	Wisconsin	159	(1.0)	F	0
	Ohio	158	(1.0)	B	7
	Iowa	157	(0.8)	D	3
	Michigan	157	(1.0)	C	6
	Kentucky	157	(0.8)	D	3
	Nebraska	157	(0.7)	F	2
	Missouri	156	(1.1)	C	6
	Washington	156	(0.9)	C	6
	Kansas	156	(0.8)	B	7
	Oregon	155	(0.9)	F	2
	New Jersey	155	(1.2)	D	3
	Connecticut	155	(1.1)	C	6
	Alaska	153	(0.7)	F	2
	Indiana	153	(0.9)	A-	9
	Texas	153	(1.0)	C	6
	Maryland	152	(1.2)	B	7
	Pennsylvania	151	(1.3)	D	3
	Georgia	151	(1.4)	C	6
	Tennessee	150	(1.0)	D	4
	Delaware	150	(0.6)	C	5
	West Virginia	149	(1.0)	D	4
	Rhode Island	149	(0.7)	D	4
	South Carolina	149	(1.0)	A-	9
	New York	149	(1.0)	B+	8
	Florida	148	(1.1)	C	5
	Oklahoma	148	(1.1)	F	2
	North Carolina	148	(1.1)	D	4
	Arkansas	148	(1.1)	B	7
	Illinois	147	(1.0)	D	4
	New Mexico	145	(0.8)	C	6

Nevada	144	(0.8)	D	3
Arizona	144	(1.3)	D	4
Louisiana	143	(1.7)	B	7
Hawaii	142	(0.7)	D	4
California	140	(1.3)	A	10
Alabama	140	(1.4)	D	4
Mississippi	137	(1.3)	C	5
District of	112	(1.0)	A	10

NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2011 Science Assessment.

The NAEP test results are organized from highest to lowest achievement. The scores each state received from Fordham on their standards is presented along side the test results.

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June 27, 2013

State Superintendent Randy Dorn
Office of Superintendent of Public Instruction
Mail stop: 47200
Old Capitol Building
P.O. Box 47200
Olympia, WA 98504-7200

Dear Superintendent Dorn:

Pacific Science Center has a strong interest in, and commitment to, robust and effective science education. We have followed closely the development of the Next Generation Science Standards (NGSS) and believe they represent a significant systemic step forward towards improvement in our science teaching.

I am pleased to forward to you the following message from a group of local scientists who have been certified as current science ambassadors and excellent communicators through our Science Communication Fellowship program. All of them commit time to Pacific Science Center as volunteers. They want to register their enthusiasm for the NGSS.

We are scientists in the greater Puget Sound area in Washington state and we strongly support the Next Generation Science Standards (NGSS). We are committed to science education and volunteer at Pacific Science Center to engage their audiences in a range of science content areas.

We believe it is essential to embrace these new standards because they will help all students develop core knowledge and ways of thinking that can be used in everyday situations. Mastering the science standards will empower students to critique information, engage in scientific inquiry, build an argument based on evidence, and design a solution to fit an everyday need. We believe these standards will provide all students with a coherent and content-rich science education that will prepare them to be informed citizens, college ready and prepared for STEM careers.

If we want to equip our students with adequate skills to pursue employment opportunities in the rapidly growing STEM fields, they must have access to a quality K-12 science education. The NGSS have the power to transform science education and give all students the skills and knowledge they need to be successful in the 21st century. These new standards are designed to ensure that all students by the end of the 12th grade have appreciation for science, have sufficient knowledge of science and engineering to engage in public dialogue, are careful consumers of scientific and technological information, are able to continue to learn about science outside school and have the skills to enter careers of their choice.

PACIFIC SCIENCE CENTER

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It has been more than 15 years since science standards were introduced. Since then, we have had major advances in science and in our understanding of how students learn science. The time is right for new science standards.

We believe the Next Generation Science Standards will highlight the power of integrating science, build students' proficiency and enhance their appreciation of science. We look forward to seeing the new science standards implemented in our state.

Signed by:

Greg Brennan, D.V.M., Ph.D., Research Associate, Division of Human Biology, Fred Hutchinson Cancer Research Center

Terri L. Gilbert, Ph.D., Application Scientist, Allen Institute for Brain Science

John Jansen, Research Biologist, Alaska Fisheries Science Center, NOAA Fisheries

Dr. Bonnie Light, Ph.D., Principal Scientist, Polar Science Center, Applied Physics Laboratory; and Affiliate Associate Research Professor, Dept. of Atmospheric Sciences, University of Washington

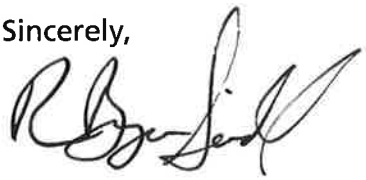
Angela M. Katsuyama, Ph.D., Postdoctoral Research Fellow, Dept. of Biology, University of Washington

Dina Popovkina, Graduate Student, Neurobiology & Behavior Program, University of Washington

Tamara M. Stawicki, Ph.D., Postdoctoral Fellow, Dept. of Biological Structure, University of Washington

Please consider these voices as decisions are contemplated regarding the adoption of the NGSS by Washington.

Sincerely,



R. Bryce Seidl
President & CEO

Randy Dorn
Old Capitol Building
P.O. Box 47200
Olympia, WA 98504-7200

Washington Science Teachers Association
Letter of Support

The Washington Science Teachers Association (WSTA) supports the adoption of the Next Generation Science Standards (NGSS). These standards are the logical next step from the state's 2009 science standards. The new NGSS effectively integrate the states four Essential Academic Learning Requirements (EALRS) for science into a focused set of performance expectations for grades K-12.

Each Next Generation Science Standard is a set of performance expectations that logically combine a practice of science and engineering with a disciplinary core idea of the life science, Earth and space science, physical science, or engineering design. Each performance expectation focuses on a practice of science and engineering resulting in deeper understanding of disciplinary core ideas.

The NGSS are truly STEM standards by making engineering as important as science, including technological applications throughout the standards, and connecting the standards to the Common Core State Standards for mathematics and language arts.

In addition to the connections to other disciplines, the NGSS performance expectations for one science are intentionally connected to another science with crosscutting concepts that allow for deeper levels of understanding.

The NGSS give K-5 grade-level performance expectations based on researched learning progressions for the big ideas of science and engineering. These give the state a firm basis for consistent grade-level elementary curriculum, instruction, and assessment without prescribing how we teach and assess our students.

The NGSS give grade 6-8 and grade 9-12 performance expectations and suggested ways to arrange them giving the state a basis for secondary curriculum, instruction, and assessment while keeping our local control of our courses and teaching.

The 2013 Next Generation Science Standards are 21st Century science performance expectations for the state to build a 21st Century science education system. We, as an organization, are excited about impact they could have on science instruction, and recommend they be adopted so they can begin impacting students across Washington State

Sincerely,

John G. Parker
WSTA President representing the WSTA Board of Directors, Washington Science Teachers Association