I would like to make a few comments about "Next Generation Science Standards":

1. These are counterparts to CCSS for ELA and literacy and for math. They simply use different terms.

2. In CCSS for ELA and for math, there have been criticisms of no accommodations for special ed or ELLs. Is science addressing student diversity and equity?

3. How do we add science on top of CCSS for ELA and math? We need to capitalize on the synergy among the three subject areas.

4. Science is typically not part of state accountability or only a portion of state accountability. When science standards become available, is our state going to adopt NGSS?

Topics

1. **Context**
   - Increasing diversity in demographics
   - Persistent achievement gaps
   - Emerging educational policies
2. **National Initiatives**
   - *Next Generation Science Standards*
   - *Understanding Language Initiative*
3. **What (Science) Teachers Need to Know and Do with ELLs**

Demographics and Achievement Gaps

- According to the 2010 U.S. Census, 45% of the U.S. population under 19 years old are racial minorities.
- More than 20% of school age children speak a language other than English at home, and limited English Proficient (LEP) students (the federal term) have more than doubled from 5% in 1993 to 11% in 2007.
- Achievement gaps persist.

"Under 19 years old" indicates the school-age population.

It is projected that the year 2022, 10 years from now, will be the turning point when minorities collectively will become the majority in terms of percentage of the population but are likely to remain minorities in terms of status. After that point, there is no turning back.

But more than the 11% are ELLs, just no longer receiving services

We have kept pace, but how can get ahead of the curve (i.e., close the gaps)?

Educational Policies

- Common Core State Standards (CCSS) for English Language Arts and Math – 45 states and 3 territories including D.C. choosing common standards
- Comprehensive Assessment Consortia (PARCC and Smarter Balanced) to measure CCSS
- Next Generation Science Standards (NGSS)

Previous generation of standards was initiated by professional organizations, such as NCTE, NCTM, NRC, etc.

The current generation of standards is, de facto, “national standards,” although not national curriculum.

If you have not implemented CCSS yet, it will extend from lower grades to higher grades every year.

By the time CCSS are implemented across all grade levels, Comprehensive Assessment (PARCC and Smarter Balanced) will be administered starting in 2014 – “national assessments”

Science standards will be announced in the mix of CCSS and Comprehensive Assessments

Synergy across these subject areas is critical.

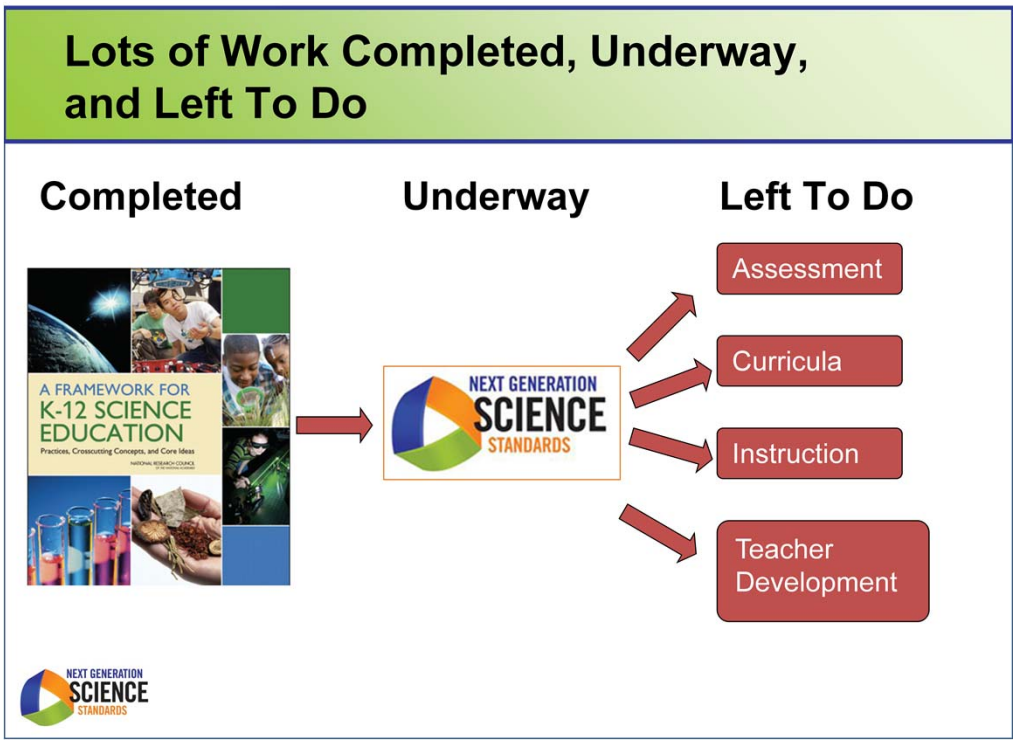
Your Thoughts

What does the information about changing demographics and persistent achievement gaps urge you to think about your own practices?

We had a previous wave of science standards starting with “Science for All Americans” by American Association for the Advancement of Science (1989) and “National Science Education Standards” by National Research Council (1996), which have remained up to this point (almost 2 decades).

NGSS is likely to stay for at least one decade or more.

Therefore, it is imperative that we do it right.



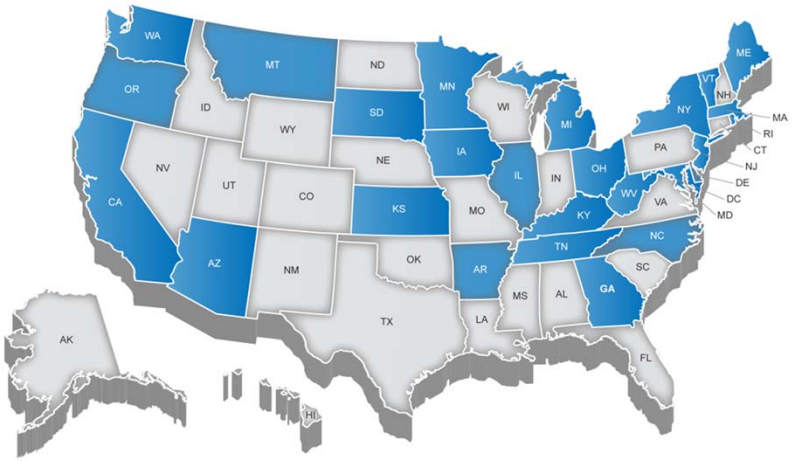
NGSS will be principally based on the Framework, so that you can predict what

NGSS will look like based on the Framework

Next Generation Science Standards (NGSS)

- Achieve, Inc. is overseeing the development
- The design team consists of classroom teachers, state and district supervisors, faculty from higher education institutions, and representatives from the private sector
- There will be public release of drafts for feedback – May and November 2012
- The first draft of NGSS is expected in early 2013

Lead State Partners



Source: http://www.nextgenscience.org/lead-state-partners

9

26 states have volunteered as lead state partners. This suggests a high level of interest at the state level, like CCSS for ELA and math. Science standards MAY follow the case of CCSS for ELA and math.

Shifts in the NGSS

1. The NGSS focus on deeper understanding, application of content, and real world connections
2. Science concepts build coherently across K–12
3. Science and engineering are integrated in science education from K–12
4. Science and engineering practices, crosscutting concepts, and disciplinary core ideas should be integrated throughout the year
5. Science standards coordinate with Common Core State Standards for English language arts and mathematics

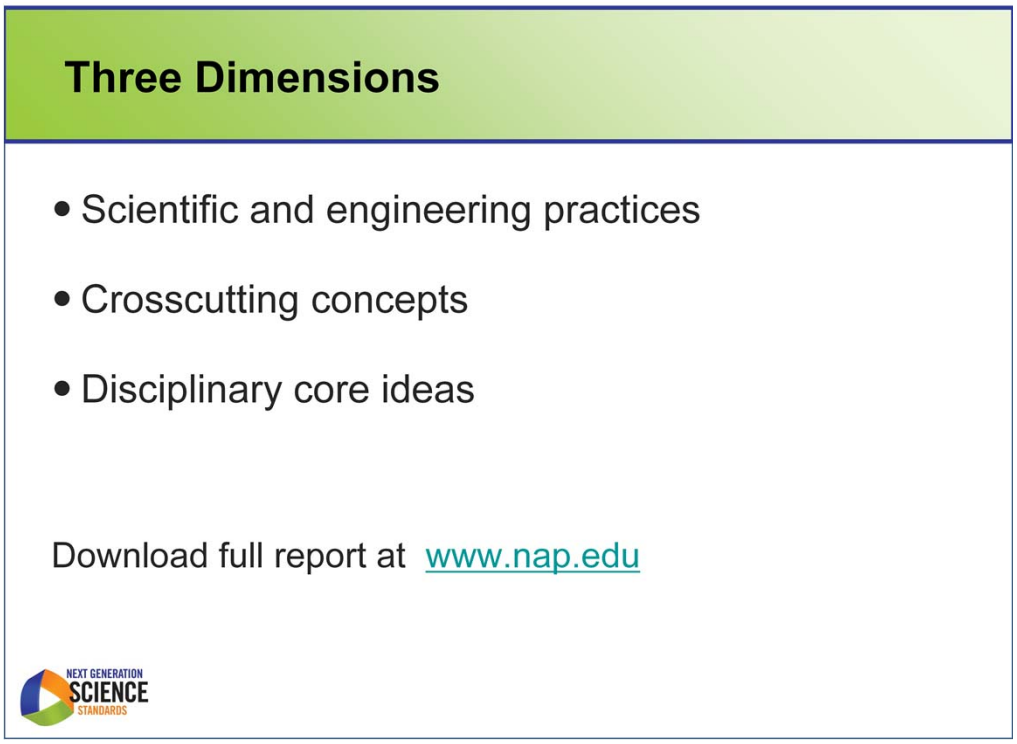
NEXT GENERATION SCIENCE STANDARDS

2. Learning progression

3. Science and engineering

4. Intersections of three domains

5. Coordination with CCSS in ELA and math



Three dimensions in the science framework

Dimension 1:
Science and Engineering Practices

1. Ask questions (for science) and define problems (for engineering)
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations (for science) and design solutions (for engineering)
7. Engage in argument from evidence
8. Obtain, evaluate, and communicate information

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

Concepts that cut across science disciplines

Dimension 3: Disciplinary Core Ideas

- Physical sciences
- Life sciences
- Earth and space sciences
- Engineering, technology and applications of science

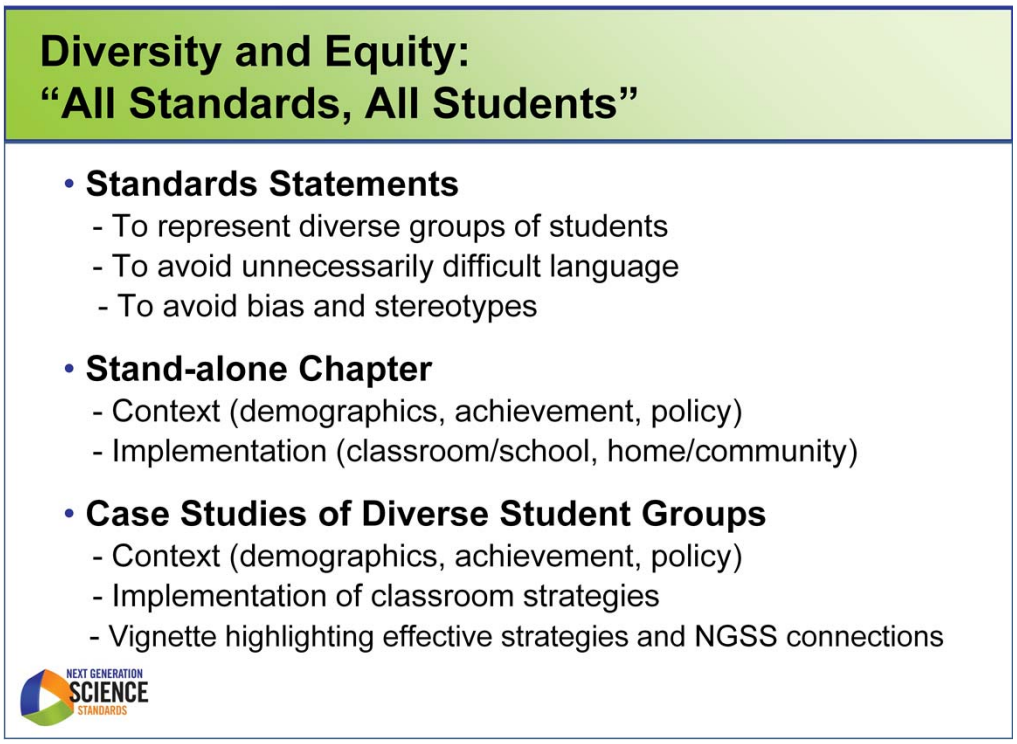
Physical sciences have 4 core ideas

Life sciences have 4 core ideas

Earth and space sciences have 3 core ideas

Engineering, technology and applications of science have 2 core ideas

A total of 13 core ideas across science disciplines



CCSS in ELA and math did not address diversity and equity issues for various reasons.

NGSS is addressing diversity and equity issues from the start, not as an after-thought.

I am working with a group to talented classroom teachers to address how to make NGSS accessible to all students, thus the title "All Standards, All Students"

The case studies are written by the team members in their own classrooms. The case studies involve five NCLB groups, including major racial and ethnic groups, students with special needs, limited English proficient students (ELLs), economically disadvantaged, and gender. The case studies also add two more groups, including students in alternative education programs and gifted and talented students.

Implications for Diversity and Equity: For Example, Practices

- From hands-on science, to minds-on science, to science, to scientific and engineering practices
- Inter-related to one another in the sense-making process
- Relatively unfamiliar to most science teachers today and requires shifts for teaching
- Common across English language arts (ELA), math, science, and other subjects

Your Thoughts

How do you think the Next Generation Science Standards will impact science education of all students, especially ELLs?

Understanding Language Initiative: Three Goals

- Engage in a healthy public dialogue around what the CCSS and NGSS imply for English language learners (ELLs)
- Develop exemplars of what CCSS and NGSS-aligned instruction looks like
- Develop a vibrant, inquisitive, engaging online community

http://ell.stanford.edu

"Understanding Language" project at Stanford University.

Educators in language learning and second language acquisition become concerned about lack of consideration of ELLs across CCSS for ELA and for math. They have initiated a project involving experts in second language acquisition and content areas of ELA, math, and science to address the question: "What are language demands and opportunities as ELLs engage in CCSS in ELA, math, and science?"

For science, Helen Quinn, Chair of the Science Framework document, and I are involved in the project

One member of the project describes it as "a magical moment" where language and content people come together for ELLs.

Dimensions of ELA Standards

Student Portraits	Key Features
1. Demonstrate independence 2. Build strong content knowledge 3. Respond to the varying demands of audience, task, purpose, and discipline 4. Comprehend as well as critique 5. Value evidence 6. Use technology and digital media strategically and capably 7. Understand other perspectives and cultures	Reading: Text complexity and the growth of comprehension Writing: Text types, responding to reading, and research Speaking & Listening: Flexible communication & collaboration Language: Conventions, effective use, and vocabulary

Full title of the CCSS for ELA and literacy: "English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects"

Dimensions of Math Standards

Mathematical Practices

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Core Ideas

K-5
- Counting & Cardinality (K)
- Operations & Algebraic Thinking
- Number & Operations
  - Fractions (3)
- Measurement & Data
- Geometry

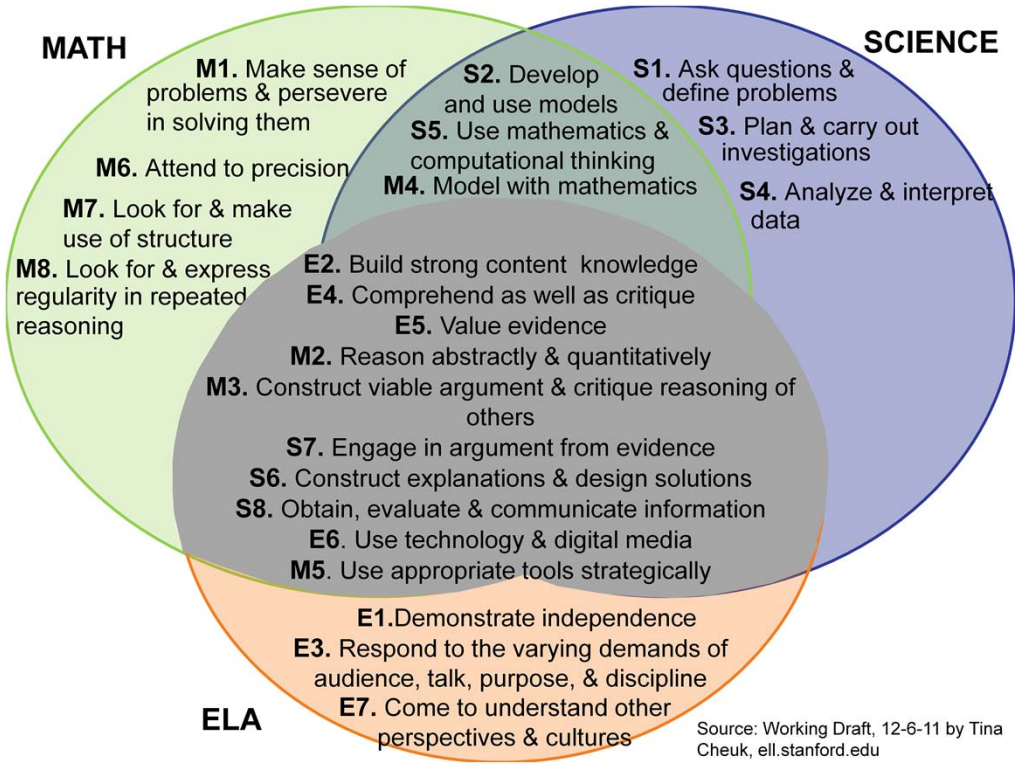
6-8
- Ratios & Proportional Relationships
- Number System
- Expressions & Equations
  - Functions (8)
- Geometry
- Statistics & Probability

9-12
- Number & Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics & Probability

Three Dimensions of Science Framework

Science & Engineering Practices	Crosscutting Concepts
1. Ask questions (for science) and define problems (for engineering) 2. Develop and use models 3. Plan and carry out investigations 4. Analyze and interpret data 5. Use mathematics and computational thinking 6. Construct explanations (for science) and design solutions (for engineering) 7. Engage in argument from evidence 8. Obtain, evaluate, and communicate information	1. Patterns 2. Cause and effect 3. Scale, proportion and quantity 4. Systems and system models 5. Energy and matter 6. Structure and function 7. Stability and change **Core Ideas** 1. Physical Sciences 2. Life Sciences 3. Earth and Space Sciences 4. Engineering, Technology and Applications of Science

Crosscutting concepts appear only in science because science has multiple disciplines



When you combine student portraits and practices from the three content areas, you get this figure

Your Thoughts

How can teachers promote science learning according to the NGSS while supporting language development for ELLs?

How Language Develops

- Rich contexts – desire and opportunity to engage and contribute
- Multiple opportunities to hear and use (language)
- Appropriate supports
- Acceptance of “flawed” language

How Science Understanding Develops

- Rich contexts – desire and opportunity to engage and contribute
- Multiple opportunities to hear and use (science ideas)
- Appropriate supports
- Acceptance of “flawed” language; for example non-scientific language

There is a parallel between language development (the previous slide) and science understanding (this slide)

Promoting Both Science and Language Learning for ELLs

- ELLs can participate in classroom discourse focused on rich and exciting academic content
- ELLs learn language best when they engage with academic content
- Focusing on both text and discourse gives ELLs opportunities for extended engagement with complex ideas

Effective instruction with ELLs focuses on what students do with language as they develop and use models, construct explanations, and argue from evidence, even as the process reveals flaws in a model or explanation, or flawed use of language ("flawed English").

The emphasis is not so much on vocabulary, grammar, or native-like fluency, which have dominated the field of second language acquisition.

Science teachers are not expected to be language teachers. However, when science teachers attend to language issues with all students, which is critical for ELLs, they become more effective teachers.

Example: Argument from Evidence

Language tasks

- Listen or read to understand arguments
- Speak or write to express own arguments
- Analyze arguments

Science tasks

- Analyze, support, and refute claims of others
- Present and support own claims


What Science Teachers Need to Know and Do with ELLs
• Literacy strategies for all students
• ESOL strategies for ELLs
• Discourse strategies for ELLs
• Home language support
• Home culture connections

Literacy Strategies for All Students

Incorporate reading and writing strategies

- Activate prior knowledge
- Promote comprehension of expository science texts
- Promote scientific genres of writing
- Connect science process skills (e.g., describe, explain predict, conclude, report) to language functions (e.g., explain, compare, contrast)
- Use graphic organizers (e.g., concept map, word wall, Venn diagram, KWL)

ESOL Strategies for ELLs

Use language support strategies

- Promote hands-on inquiry
- Use realia (real objects or events)
- Encourage multiple modes of representations (gestural, oral, pictorial, graphic, textual)
- Use graphic devices (graphs, charts, tables, drawings, pictures)
- Use a small number of key terms in multiple contexts

Discourse Strategies for ELLs

Reduce language load while maintaining the rigor of science content and process

- Recognize ELLs' varying levels of developing language proficiency and adjust norms of interaction with a student accordingly
- Build students' understanding and discourse skills (e.g., from "it is foggy" to "water vapor condenses into little water drops")
- Encourage students to share ideas, even as the process reveals flaws in a model or explanation, or flawed use of language ("flawed English")

Home Language Support

Use home language support

- Present science terms in multiple languages in the beginning of each lesson
- Use cognates (and highlight false cognates) in home language
- Allow code-switching
- Allow ELLs to discuss the lesson in class using their home language
- Encourage bilingual students to assist less English proficient students in their home language
- Allow ELLs to write about activities in home language

Home Culture Connections

Incorporate the ways students' cultural experiences influence science instruction

- Build on students' lived experiences at home and in the community (i.e., funds of knowledge)
- Explore culturally-based ways students communicate and interact in their home and community (i.e., cultural congruence)
- Use students' cultural artifacts, culturally relevant examples, and community resources
- Use texts with content that is familiar to ELLs

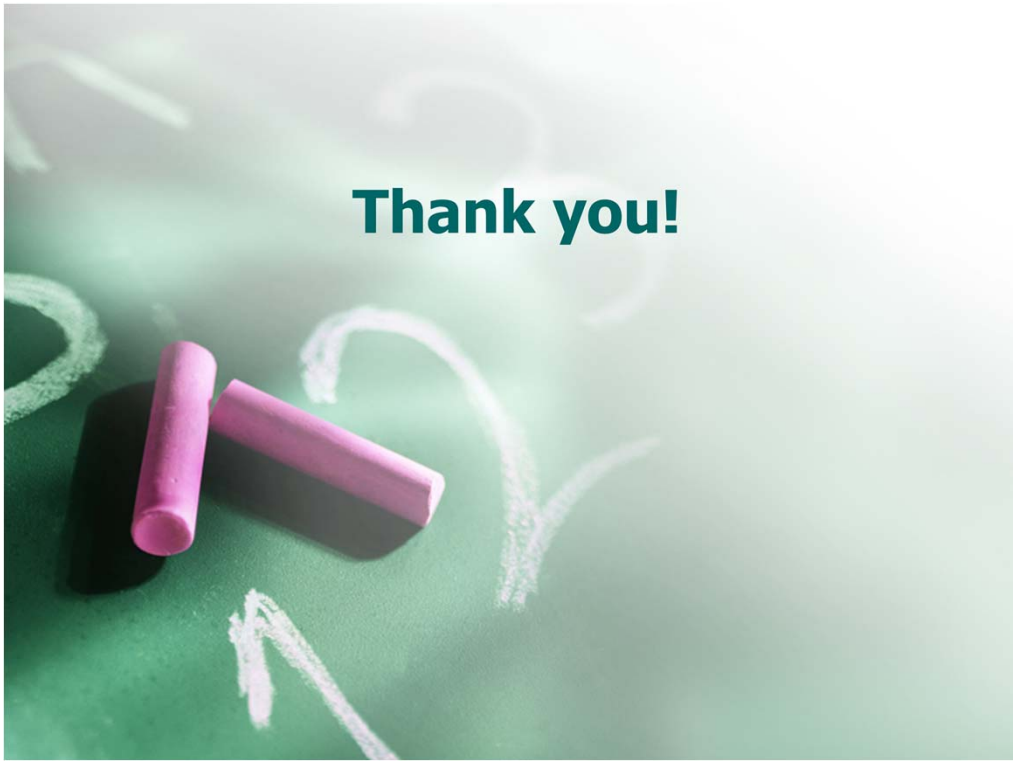
Take-Home Message

- High academic rigor through the NGSS
- Both language demands and learning opportunities through the NGSS
- A new set of teachers' knowledge and practices to enable all students, particularly ELLs, learn science according to the NGSS

Resources

1. *Language Demands and Opportunities in Relation to the Next Generation Science Standards,* by Helen Quinn, Okhee Lee, and Guadalupe Valdés.
   http://ell.stanford.edu/publication/3-language-demands-and-opportunities-relation-next-generation-science-standards-ells
2. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.*
   http://www.nap.edu/catalog.php?record_id=13165
3. *Diversity and Equity in the NGSS: All Standards, All Students*
   http://www.nextgenscience.org/next-generation-science-standards
4. NSTA series of free webinars focused on the 8 practices. (9/11-12/18).
   http://learningcenter.nsta.org/products/symposia_seminars/Ngss/webseminar.aspx

35


Thank you!