How to Lead a Study Group on Next Generation Science Standards (NGSS) First Public Draft

Presented by: Gerry Wheeler, Harold Pratt, and Ted Willard

May 16, 2012
NGSS First Public Draft Released Friday, May 11

Unprecedented to have such widespread involvement of so many states and stakeholders—including classroom teachers—involved in science standards development.

NGSS will have a profound influence on curriculum, assessment, and teacher professional development in the years ahead.

NSTA encourages all teachers to review the NGSS draft and provide feedback to Achieve by June 1.
NSTA role with the NGSS

- One of four partners in a state-led process, including:
  - National Research Council of the National Academies
  - Achieve Inc.
  - National Science Teachers Association
  - American Association for the Advancement of Science

- Provided guidance and reviews directly to the National Research Council and Achieve

- Provided names of teachers for writers on the writing teams
NSTA Outreach

- Inform science education community about the NGSS draft
- Encourage science educators to have a voice by engaging in the review process
- Help educators study and learn more about the document
What is your level of familiarity with the Next Generation Science Standards?

A. Tonight is my first exposure to it.

B. I’ve heard it mentioned, but don’t know many details.

C. I’ve attended one or more presentations about it and/or read about it in detail.

D. I participated in a lead state review or critical stakeholder review of one of the earlier drafts.
Purpose of Session

Help you to…

- Understand the structure of the standards
- Connect with colleagues to study and deeply understand them
- Provide feedback to Achieve
- Begin thinking about what it will take for you and other educators to use these standards
A Framework for K-12 Science Education

Three-Dimensions:

- Scientific and Engineering Practices
- Crosscutting Concepts
- Disciplinary Core Ideas

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NSTApress
National Science Teachers Association
www.nsta.org/store
What is your level of familiarity with the K-12 Framework for Science Education?

A. I’ve never heard of it.

B. I’ve heard of it, but have never looked at it.

C. I’ve heard a bit about it and/or skimmed its contents.

D. I’ve read through it.

E. I’ve studied it in detail.
### 1. Scientific and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in arguments from evidence
8. Obtaining, evaluating and communicating information

### 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

### 3. Disciplinary Core Ideas

- Physical Sciences
- Life Sciences
- Earth and Space Sciences
- Engineering, Technology, and the Applications of Science
Integration of the Three Dimensions

The practices are the processes of building and using the core ideas to make sense of the natural and designed world, and the cross cutting concepts hold the discipline together.
Framework and Standards

NRC
July 2011

Achieve
2011-2013

Assessments
Curricula
Instruction
Teacher development
Created in 1996 by the nation's governors and corporate leaders, Achieve is an independent, bipartisan, non-profit education reform organization that helps states raise academic standards and graduation requirements, improve assessments and strengthen accountability.

Achieve is involved in implementation of the Common Core State Standards (CCSS) effort and the Partnership for Assessment of Readiness for College and Careers (PARCC) Consortium.
Development Process

Lead states and writers identified Summer 2011

Writing Team Begins Work Summer 2011

State Draft Fall 2011

Writing Team Reacts to Review Winter 2011

State and Critical Stakeholder Draft Winter 2012

Writing Team Reacts to Review Winter 2011

Public Draft Spring 2012

Writing Team Reacts to Review Winter 2012

State and Critical Stakeholder Draft Summer 2012

Writing Team Reacts to Review Spring-Summer 2012

Public Draft Fall 2012

Writing Team Reacts to Review Summer 2012

Final State Draft Late Fall 2012

Writing Team Reacts to Review Fall 2012

Achieve Edits Final Document Late Fall 2012

NGSS Released for Adoption Early 2013

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Public Draft Fall 2012

Writing Team Reacts to Review Summer 2012

Public Draft Fall 2012

Writing Team Reacts to Review Fall 2012

Final State Draft Fall 2012

Writing Team Reacts to Review Fall 2012

Achieve Edits Final Document Fall 2012

NGSS Released for Adoption 2013

We are here!
Inside the NGSS Box
Inside the NGSS Box

**Standard**
A collection of several performance expectations describing what students should be able to do to master this standard.

**Foundation Box**
The practices, core disciplinary ideas, and crosscutting concepts from the Framework for K-12 Science Education that were used to form the performance expectations.

**Connection Box**
Other standards in the Next Generation Science Standards or in the Common Core State Standards that are related to this standard.

**Title and Code**
Two standards at different grade levels may use the same name of they focus on the same topic. The code, however, is a unique identifier for each standard based on the grade level, content area, and topic of the standard.

**Performance Expectation**
A statement that combines practices, core ideas, and crosscutting concepts into a single statement describing how students can show what they have learned.

**Scientific & Engineering Practices**
Practices are the activities that scientists and engineers engage in to either understand the world or solve a problem.

**Disciplinary Core Ideas**
Core Ideas are those concepts in science and engineering that have broad importance within and across disciplines as well as relevance in people’s lives.

**Crosscutting Concepts**
Crosscutting Concepts are those ideas, such as Patterns and Cause and Effect, which are not specific to any one discipline but cut across them all.

**Lowercase Letters**
Lowercase letters at the end of Practices, Core Ideas, and Crosscutting Concepts designate which Performance Expectation incorporates them.
Left Side
Inside the NGSS Box

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<tr>
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<td>a. Construct and use models to explain that atoms combine to form new substances or yield properties that are different from those of the original substances.</td>
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<td>b. Plan and carry out investigations individually and collaboratively, identifying independent and dependent variables, and controls, to provide evidence that demonstrates an understanding of the structure and behavior of matter.</td>
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<td>c. Use a simulation or mechanical model to determine the effect of changing the temperature and mole fractions of atoms and molecules of different substances when thermal energy is added to or removed from the substance.</td>
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<td>d. Construct an argument that explains the effect of adding or removing thermal energy to a pure substance in different phases and changes in terms of atomic and molecular motion.</td>
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**Science and Engineering Practices**
- **Modeling and Data Analysis:** Students should be able to create and use models to explain and predict phenomena in their investigations. (e.g., using mathematical representations, graphs, and diagrams).

**Crosscutting Concepts**
- **Structure and Function:** Structures and functions of materials and systems can be identified, modeled, and used to describe how their function depends on the shape, composition, and arrangement of their parts (e.g., materials and their properties). Understanding the relationship between the temperature and the total energy of a system can depend on its phase changes, states, and amounts of energy.

**Common Core State Standards Connections**
- **ELA:** Students should be able to read and comprehend informational texts, including articles, essays, and other nonfiction texts, to support their understanding of the content.
- **Math:** Students should be able to perform mathematical operations and solve problems using mathematical concepts and skills.
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Performance Expectation
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Scientific & Engineering Practices
Practices are the activities that scientists and engineers engage in to either understand the world or solve a problem.
Inside the NGSS Box

Core Ideas are those concepts in science and engineering that have broad importance within and across disciplines as well as relevance in people’s lives.

Disciplinary Core Ideas

- **Structure and Properties of Matter**
  - Matter includes all substances that have mass and take up space.
  - All substances are made up of tiny particles that have mass and movement.
  - Chemical reactions are interactions between substances that cause changes in their properties.
  - Physical changes do not change the composition of matter.

- **Energy and Matter**
  - Energy is necessary for matter to exist.
  - Energy can be transferred from one object to another through work and heat.
  - Energy can be conserved and transformed from one form to another.

- **Electricity and Magnetism**
  - Electricity is the flow of electric charge.
  - Magnets are made of magnetic materials.
  - Magnetic fields are created by moving electric charges.

- **Systems, Energy, and Environment**
  - Life systems are powered by energy.
  - Energy from the sun drives the global energy cycle.
  - The environment affects the availability of resources and the management of waste.

- **Physical Science**
  - Physical science includes the study of the physical universe and its laws.
  - Physical science relies on observation and experimentation to understand the world.
  - Physical science includes the study of matter, energy, and the environment.

- **Chemical Science**
  - Chemical science includes the study of the composition and properties of matter.
  - Chemical science relies on observation and experimentation to understand the world.
  - Chemical science includes the study of matter, energy, and the environment.

- **Earth and Space Science**
  - Earth and space science includes the study of the physical universe and its laws.
  - Earth and space science relies on observation and experimentation to understand the world.
  - Earth and space science includes the study of matter, energy, and the environment.

- **Engineering Design**
  - Engineering design involves the creation of new and improved technologies.
  - Engineering design relies on observation and experimentation to understand the world.
  - Engineering design includes the study of matter, energy, and the environment.

- **Science and Engineering Practices**
  - Science and engineering practices include the use of scientific evidence and reasoning to support claims.
  - Science and engineering practices rely on observation and experimentation to understand the world.
  - Science and engineering practices include the study of matter, energy, and the environment.

- **Crosscutting Concepts**
  - Crosscutting concepts include the use of scientific evidence and reasoning to support claims.
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Inside the NGSS Box
Closer Look at a Performance Expectation

**MS.PS-SPM.a. Structure and Properties of Matter**

Students who demonstrate understanding can:
a. Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits. [Clarification Statement: Examples of atoms combining can include Hydrogen (H₂) and Oxygen (O₂) combining to form hydrogen peroxide (H₂O₂) or water (H₂O).] [Assessment Boundary: Restricted to macroscopic interactions.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

- **Developing and Using Models**
  - Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems.
  - Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs.

- **PS1.A: Structure and Properties of Matter**
  - All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
  - Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

- **Patterns**
  - Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data.

Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement. The set of performance expectations make up the standard on a particular topic defining what is to be assessed.
## NGSS Matrix of Standards by Grade Level and Topic

<table>
<thead>
<tr>
<th>Elementary School</th>
<th>Life Science</th>
<th>Earth Space Science</th>
<th>Physical Science</th>
<th>Engineering &amp; Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K</strong></td>
<td>Organisms and Their Environments</td>
<td>Weather</td>
<td>Structure and Properties of Matter</td>
<td></td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>Structure and Function</td>
<td>Patterns and Cycles</td>
<td>Light and Sound</td>
<td></td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Interdependence of Organisms and their Surroundings</td>
<td>Earth's Changing Surface</td>
<td>Structure, Properties, and Interactions of Matter Pushes and Pulls</td>
<td></td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Environmental Impacts on Organisms Structure, Function, and Stimuli</td>
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</tr>
<tr>
<td><strong>4</strong></td>
<td>Life Cycles and Traits</td>
<td>Processes that Shape the Earth</td>
<td>Energy Waves</td>
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</tr>
<tr>
<td><strong>5</strong></td>
<td>Matter and Energy in Ecosystems</td>
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<th>Middle School</th>
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<table>
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</thead>
</table>
Which dimension do you usually find most difficult for students to learn?

A. Scientific and Engineering Practices

B. Disciplinary Core Ideas

C. Crosscutting Concepts

D. All are equally easy for students to learn

E. All are equally difficult for students to learn
Any Questions?
NSTA Guide for Leading a Study Group on Next Generation Science Standards

- Located online at [www.nsta.org/ngss](http://www.nsta.org/ngss)
- Sample Agendas (half-day & full-day)
- Facilitator Guide
- Suggested Questions
- Checklist
NSTA Guide for Leading a Study Group on Next Generation Science Standards

Check List for Planning an NGSS Study Group

1. Determine scope in terms of topic(s) and grade level(s)
2. Establish starting time, duration, and location
   - Internet access?
3. Select and invite participants
4. Assign teams to specific standards
5. Prepare participants
   - Be familiar with *Framework* and other standards
   - Send background reading/resources, agenda, questions
6. Facilitate meeting
7. Collect group feedback and fill out Achieve survey or encourage members to provide individual feedback
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</tbody>
</table>

* In grades K-5, Engineering and Technology Standards are included in other domains
Check List for Planning an NGSS Study Group

1. Determine scope in terms of topic(s) and grade level(s)
2. Establish starting time, duration, and location
   – Internet access?
3. Select and invite participants
4. Assign teams to specific standards
5. Prepare participants
   – Be familiar with Framework and other standards
   – Send background reading/resources, agenda, questions
6. Facilitate meeting
7. Collect group feedback and fill out Achieve survey or encourage members to provide individual feedback
Size and Scope of the Study Group

Study Groups can be as small as you want.
Size and Scope of the Study Group

Study Groups can be as small as you want.
Or as large as you want.
## Size and Scope of the Study Group

<table>
<thead>
<tr>
<th></th>
<th>Life Science</th>
<th>Earth &amp; Space Science</th>
<th>Physical Science</th>
<th>Engineering &amp; Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K-2</strong></td>
<td></td>
<td>2-3 Team Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3-5</strong></td>
<td></td>
<td>2-3 Team Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6-8</strong></td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
<tr>
<td><strong>9-12</strong></td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
</tbody>
</table>

In this configuration, you need a minimum of **16** people to examine all of the standards.
**Size and Scope of the Study Group**

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Life Science</th>
<th>Earth &amp; Space Science</th>
<th>Physical Science</th>
<th>Engineering &amp; Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-2</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
<tr>
<td>3-5</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
<tr>
<td>6-8</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
<tr>
<td>9-12</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>2-3 Team Members</td>
<td>?</td>
</tr>
</tbody>
</table>

In this configuration, you need a minimum of **18** people to examine all of the standards.
Check List for Planning an NGSS Study Group

1. Determine scope in terms of topic(s) and grade level(s)
2. Establish starting time, duration, and location
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3. Select and invite participants
4. Assign teams to specific standards
5. Prepare participants
   - Be familiar with Framework and other standards
   - Send background reading/resources, agenda, questions
6. Facilitate meeting
7. Collect group feedback and fill out Achieve survey or encourage members to provide individual feedback
Background Resources

- Next Generation Science Standards
- **NSTA Reader’s Guide** to the *Framework*
- NSTA Journal Articles about the *Framework* and the *Standards*

Links to all resources located at www.nsta.org/ngss
Check List for Planning an NGSS Study Group

1. Determine scope in terms of topic(s) and grade level(s)
2. Establish starting time, duration, and location
   – Internet access?
3. Select and invite participants
4. Prepare participants
   – Be familiar with *Framework* and other standards
   – Send background reading/resources, agenda, questions
5. Form teams and assign teams to specific standards
6. Facilitate meeting
7. Collect group feedback and fill out Achieve survey or encourage members to provide individual feedback
Handouts

- Standards
- NGSS Matrix Handout
- Study Group Questions from NSTA Guide
- Inside the Box Handout
Other details

Refreshments!

Computer with Internet
Looking at the Study Group
Questions from the NSTA Guide

NSTA Suggested Study Group Questions

Next Generation Science Standards First Public Draft

The questions in Section I require participants to focus on one standard. Please specify the standard you are reviewing. (For example: E/Life Organizations and Their Environments: 1.A.2 Weather, Climate, and Impacts, or M/LS.MT.P Structure, Function, and Information Processing)

Section I.

A. Clarity and Specificity:
- Do you have a clear idea of what students need to know and be able to do?
- How open is interpretation of the standard?
- Is it clear what is and is not included?

To answer these questions, think about whether the above elements in the standard are clear and specific enough for a classroom teacher to understand the outcome expected and assess whether a student has met the criterion specified in the standard. Base your answer on all of the information in the standard, including the title, performance expectations, and foundation boxes.

B. Integrated Performance Expectations:
- In what ways can the inclusion of all three dimensions in a single expectation lead to improved learning of the core idea? Be as specific as you can.
- Is there a clear connection between the performance expectations and the practices, core ideas, and crosscutting concepts in the foundation box?
- Is it reasonable to assume that a student who has successfully completed the performance expectation has achieved mastery of the core idea? Practices? Crosscutting concepts?
- Do you have other (new) ideas about how to integrate the three dimensions in the standards?

Each performance expectation contains a scientific or engineering practice, a core idea, and one crosscutting concept with the expectation that successful completion of it is evidence that a student has achieved the practice, core idea, and crosscutting concept that is based on.

NSTA Guide 8/11/12 — Leading a Study Group on NGSS
Study Group Questions

Section I. Core Ideas

A. Clarity and Specificity
B. Integrated Performance Expectations
C. Coherence of Performance Expectations
D. Achievability
E. Instructional Implications
Study Group Questions, cont.

Section II. Scientific and Engineering Practices

Section III. Crosscutting Concepts

Section IV. Engineering Design

Section V. Nature of Science
# Suggested Agenda for Study Groups

<table>
<thead>
<tr>
<th>Section</th>
<th>Half-Day</th>
<th>Full-Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>45 min.</td>
<td>45 min.</td>
</tr>
<tr>
<td><strong>I.</strong> Core Ideas</td>
<td>60 min.</td>
<td>90 min.</td>
</tr>
<tr>
<td><strong>II.</strong> Practices</td>
<td>45 min.</td>
<td>45 min.</td>
</tr>
<tr>
<td><strong>III.</strong> Engineering Design</td>
<td>45 min.</td>
<td>45 min.</td>
</tr>
<tr>
<td><strong>IV.</strong> Crosscutting Concepts</td>
<td>45 min.</td>
<td>60 min.</td>
</tr>
<tr>
<td><strong>V.</strong> Nature of Science</td>
<td>-</td>
<td>30 min.</td>
</tr>
<tr>
<td>Wrap Up</td>
<td>30 min.</td>
<td>30 min.</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3 hours, 45 min.</td>
<td>5 hours, 45 min.</td>
</tr>
</tbody>
</table>
Reminder

Depth of review is more important than covering many or all the standards!!
Check List for Planning an NGSS Study Group

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7. Collect group feedback and fill out Achieve survey or encourage members to provide individual feedback
Supplying Feedback to Achieve

- Each grade level has a different survey
- In the grade level you are working on, you need to select the appropriate standard
Supplying Feedback to Achieve

You will reach a separate page to provide feedback about each standard.
Supplying Feedback to Achieve

Feedback can be pasted in two places on the form for each standard.
Any Questions?
Resources related to the *NGSS and Framework*

**NGSS Website**
www.nextgensscience.org

**National Research Council**
http://www7.nationalacademies.org/bose/Standards_Framework_Homepage.html
NSTA’s Home Page

www.nsta.org
NSTA’s Home Page
www.nsta.org
NSTA’s NGSS Page

www.nsta.org/ngss
Discussion Forums about NGSS in the NSTA Learning Center

Visit NSTA’s Next Generation Science Standards Forums in the NSTA Learning Center where you can share your thoughts with other teachers and ask questions about the standards. Forums are organized by grade level and topic to facilitate focused discussion about the standards.

http://learningcenter.nsta.org/discuss/#5
This immersive experience will bring together scores of individual science educators, teams (leaders and teachers), and administrators to explore the K–12 Framework and draft Next Generation Science Standards.
NSTA Print Resources

NSTA Reader’s Guide to the Framework

NSTA Journal Articles about the Framework and the Standards
COMPASS

Classroom Opportunities

Multiply Practices

Application of Science Standards
COMPASS

- Will support educators in the implementation of NGSS

- Will allow educators to access teaching and learning resources seamlessly from standards pages on nextgenscience.org

- Funded by the Carnegie Corporation, which also funded development of the Framework and NGSS
Three Aspects of COMPASS

1. Resources to support teaching and learning

2. A forum to network and collaborate with other educators

3. Tools for curriculum planning and professional development
Thank you to the sponsor of tonight's Web Seminar:

This web seminar contains information about programs, products, and services offered by third parties, as well as links to third-party websites. The presence of a listing or such information does not constitute an endorsement by NSTA of a particular company or organization, or its programs, products, or services.
http://learningcenter.nsta.org
National Science Teachers Association
Gerry Wheeler, Interim Executive Director
Zipporah Miller, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

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