Exploring the New Standards

How to form a study group to examine the Next Generation Science Standards, *second public draft*

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This is an exciting time to be in science education. New science standards are being developed by a group of science educators from across the country, working with 26 states in a process managed by Achieve, Inc., a non-profit education reform organization. The development of the *Next Generation Science Standards* (NGSS) promises to be the most influential event in science education in nearly two decades. NSTA fully supports the development of NGSS and is pleased to play an important role in its development.

FIGURE 1

Sample performance expectation.

A performance expectation, such as the one in the white box below, combines practices, core ideas, and crosscutting concepts into a single statement. The blue, orange, and green boxes then provide further details to aid educators in interpreting the performance expectations.

MS.PS-SPM 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 (H_2) and Oxygen (O_2) combining to form hydrogen peroxide (H_2O_2) or water (H_2O).

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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.

It is important that all science educators have a chance to participate in shaping this important document by providing feedback on drafts as they become available. Last May, thousands of teachers took advantage of the opportunity to review and comment on the first public draft. Don't worry if you didn't get a chance to read the draft or submit your comments, because you will have another chance this fall, when the second public draft is released.

Standards documents, including NGSS, are a unique type of document that many science educators might find unfamiliar. When the first draft was released for public input, NSTA developed a guide to help science educators organize groups to read, discuss, and study it in more depth. We heard from many of you that the guide was valuable for both individuals and groups that helped you more deeply understand the NGSS draft and prepare to give feedback to Achieve.

For the upcoming second public review, we have developed a similar guide that we hope will be equally as useful. At this writing, we have not yet seen the second public draft, nor have we seen the survey instrument that Achieve will post online to capture feedback. Regardless, the general questions and procedures provided below will help individuals and groups orient themselves to the document, including the NGSS features and characteristics.

By using the review process outlined here, you will not only be able to provide more extensive and informed feedback to the standards writers, you will acquire deeper insight into the structure and content of the NGSS. This will be most helpful as you consider and plan for the implementation of the standards in the future.

Essential reading and background

We might sound like a broken record, but it's essential to first have a thorough understanding of the foundation for the new standards: *A Framework for K–12 Science Education* (NRC 2011). This report describes the major practices, crosscutting concepts, and disciplinary core ideas that all students should be familiar with by the end of high school and shows how these practices, concepts, and ideas should be developed across the grade levels. You can download and view a free PDF of the *Framework* at the National Academies Press website or purchase a copy from NSTA Press (see "Resources").

NSTA has produced a number of other resources to help you better understand the *Framework*, including The *NSTA Reader's Guide to A Framework for K–12 Science Education* and a series of articles published in NSTA member journals. NSTA Press has assembled the guide and the journal articles into one useful publication, *The NSTA Reader's Guide to A Framework for K–12 Science Education, Expanded Edition* (see "Resources").

The NGSS architecture represents a major conceptual shift from previous standards documents. NGSS includes performance expectations that showcase how students demonstrate what they have learned (see example, Figure 1). Performance expectations integrate three important dimensions

FIGURE 2

Section 1: Taking a close look at one set of performance expectations.

The following discussion questions require participants to focus on one set of performance expectations.

A. Clarity and specificity

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

- Do you have a clear idea of what students must know and be able to do?
- How open to interpretation are the performance expectations?
- Is it clear what is and is not included?

B. Integration of the three dimensions in the performance expectations

Each performance expectation contains a scientific or engineering practice, a core idea, and a crosscutting concept. Successful completion of a given performance expectation indicates that a student has achieved the practices, core ideas, and crosscutting concepts that it is based on.

- In what ways can the inclusion of all three components 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 expectations has achieved mastery of the core ideas? Practices? Crosscutting concepts?

C. Coherence of performance expectations

To answer these questions, consider whether all of the performance expectation outcomes would make sense in the same instructional unit. Use examples to clarify your response.

- Is the set of performance expectations conceptually coherent?
- Do they all define a cohesive and related set of ideas or outcomes?
- Are any of the performance expectations out of place?

D. Achievability and preparedness

To answer these questions, think about what students need to know and be able to do to be successful in life and also consider the time and effort needed to help all students achieve the stated expectations.

- Would students who achieve the task described in the performance expectations be prepared for success at college and/or in their careers?
- Are the tasks described in the performance expectations reasonable expectations for all students?
- Are the practices described in the foundation box reasonable expectations for all students?
- Are the disciplinary core ideas described in the foundation box reasonable expectations for all students?
- Are the crosscutting concepts described in the foundation box reasonable expectations for all students?
- How much instructional time (days) will be required to meet the all of the performance expectations in this set?

E. Instructional implications of the performance expectations

The intent of the performance expectations is to describe what students should be able to do at the end of instruction. They are not meant to specify what students should do as part of instruction. However, some readers have interpreted them that way.

- Do the performance expectations seem to prescribe specific instructional sequences and instructional strategies? Why or why not?
- Do you think that performance expectations should prescribe specific instructional sequences and instructional strategies? Why or why not?

from the *Framework*—science and engineering practices, disciplinary core ideas, and crosscutting concepts—into a single statement. For each standard, the set of performance expectations defines what is to be assessed. Before the release of the second draft, learn more about the NGSS structure and conceptual shifts by visiting the dedicated NGSS website.

Organizing a study group

First decide the scope of your study group, which will determine the optimal number of participants. You may choose to take a broad look at the entire NGSS second-draft document or focus on a smaller number of core ideas or specific grade levels.

It is ideal to have at least two people working as a team to review standards within a core idea. They could be grouped by grade level. If, for example, you held your meeting with middle school colleagues, you might have two people explore life science, two physical science, two Earth and space science, and perhaps everyone engineering. This allows participants to focus on one area. At the elementary level, two people

FIGURE 3

Section II: Checking for a progression across all grades.

The following discussion questions require participants to look across multiple sets of performance expectations at different grade levels. Skim the standards to find the relevant sections and then review those sections in more detail to answer the questions.

Performance expectations

For these questions, focus on the sections that deal with a single topic, such as the *Structure and Properties of Matter*.

- Do the performance expectations at each grade level build upon those of earlier grades and properly prepare students for the performance expectations at later grades?
- Are the tasks described in the performance expectations at each grade level reasonable expectations for all students at that grade level? Should any of the performance expectations move up or down in the progression?

Practices

For these questions, focus on the sections that deal with a single practice, such as *Developing and Using Models*.

- Do the practices at each grade level build upon those of earlier grades and properly prepare students for the practices at later grades?
- Are the practices at each grade level reasonable expectations for all students at that grade level? Should any of the practices move up or down in the progression?
- Are the practices represented with enough frequency in each grade span so that students can master the practice by the end of that grade span?

Disciplinary core ideas

For these questions, focus on the sections that deal with a single topic, such as the *Structure and Properties of Matter*.

- Do the disciplinary core ideas at each grade level build upon those of earlier grades and properly prepare students for the disciplinary core ideas at later grades?
- Are the disciplinary core ideas at each grade level reasonable expectations for all students at that grade level? Should any of the disciplinary core ideas move up or down in the progression?

Crosscutting concepts

For these questions, focus on the sections that deal with a single crosscutting concept, such as *Patterns*.

- Do the crosscutting concepts at each grade level build upon those of earlier grades and properly prepare students for the crosscutting concepts at later grades?
- Are the crosscutting concepts at each grade level reasonable expectations for all students at that grade level? Should any of the crosscutting concepts move up or down in the progression?
- Are the crosscutting concepts represented with enough frequency so that students will understand them as relevant to all the disciplines within science and not relevant to just some areas of science (life science, Earth science, physical science, engineering and technology)?
- Will students recognize and see the pervasive and useful nature of the crosscutting concept as a result of their inclusion in the instruction?

could focus on each grade level, or two individuals could explore adjacent grade levels.

If you can organize a larger group, you could create several teams to study multiple sections of the draft standards. To take a comprehensive look, you would need two people each to study elementary life, physical science, and Earth and space science; all in the group would study engineering. This would be repeated for middle and high school, for a minimum of 18 reviewers.

Assign participants to focus on specific standards based on their area of expertise or current teaching assignment. If science supervisors attend, you could assign them to areas where you lack the proper number of participants. Regardless of the size of the team, the emphasis should be on depth rather than breadth. It is much more important to have an in-depth exploration of a few sections of the document, rather than a limited look at many of them.

If you are reviewing the NGSS as an individual, you may want to take only one strand or grade level/band to review. This may seem like a small segment of the total document, but it will allow you to become familiar with a portion of the standards and will result in a deeper and more valuable review for Achieve. A cursory review with limited depth of feedback, we think, is of little value.

One new aspect of NGSS is the inclusion of engineering as a core idea alongside life, Earth, and physical science. Even if you don't currently focus on engineering and technology in your classroom, you may want to explore these standards. Depending on how your state and district choose to address these standards, they may eventually become part of your curriculum. In grades 6–12, sets of performance expectations are included that specifically address engineering and technology. In the elementary grades, the core engineering ideas are integrated with other core ideas.

Next, decide how long you and your participants can devote to the study group meeting, find a location, and invite and prepare your participants. Provide participants with Wi-Fi access so they can view the draft standards document online during the meeting. You will also need space and tables for participants to work in teams.

Facilitating the meeting

NSTA has developed a list of Suggested Study Group Questions to focus the group discussion. The first section of questions (Figure 2, page 35) looks at one full set of performance expectations; the second section (Figure 3) explores a progression across all grades. Each section takes 60–90 minutes to do on a single topic. A full-day meeting should allow time to be spent on all of the suggested questions on multiple topics. If you only have part of a day, focus participants on just a few topics. Even just an hour to review a single set of performance expectations can be productive. It's also possible to spread the work out in smaller chunks over several days. Participants should have a copy of the questions and of the NGSS draft.

If you put together a large group, identify someone to lead the group through the study questions, allowing appropriate time for each. Encourage participants to bring laptops to record notes and key points from their team discussions. The notes from your meeting can be shared electronically with group members. The facilitator could also use the notes to summarize the group's work.

Reflecting on what you've learned

As we've noted, an in-depth study of the NGSS draft serves two important purposes. The process will help you provide informed and thoughtful feedback on the NGSS draft. The process also is an excellent means of becoming deeply familiar with the NGSS in preparation for implementation decisions and plans when the final document is released in 2013. In the meantime, the discussions you've held can help you reflect on your current teaching practices and how you might improve teaching and learning science in your classroom.

Visit NSTA's dedicated NGSS web page at *www.nsta.org/ngss* for updates on this guide or for additional resources to help conduct a group or individual review. ■

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Resources

National Academies Press: *www.nap.edu*

Next Generation Science Standards (NGSS): *www.nextgenscience.org*

NGSS resources: *www.nsta.org/ngss*

The NSTA Reader's Guide to A Framework for K–12 Science Education, Expanded Edition (item #PB326X): *www.nsta.org/store*.

NSTA Press: *www.nsta.org/store*

Reference

National Research Council (NRC). 2011. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.