The Next Generation Science Standards (NGSS): An Overview

Kristen Winn
Science and Engineering Coordinator

Presentation adapted from the work of: John Spiegel
Science Coordinator
San Diego County Office of Education
john.spiegel@sdcoe.net

and Sara Dozier Alameda County Office of Education
SMCOE Goal

SMCOE will actively work to erase San Mateo County’s Achievement Gap by working with teachers, leaders, and systems to insure every student has access to academically rigorous, culturally responsive instruction and to a support system that fosters academic success. We will do this in this session by:

• Gaining a better understanding of the Three Dimensions of the Next Generation Science Standards (NGSS)

• Analyze the Performance Expectations in order to examine the progressions from K-12 grade bands

• Begin to plan the early transition to the NGSS (while implementing the CCSS)
Agenda

• Assessing Background Knowledge
• Adoption Timeline
• NRC Framework for K-12 Science Education
• Three Dimensions of the Next Generation Science Standards (NGSS)
• The Structure and Cognitive Shifts of the NGSS
• Unwrapping the Performance Expectations
• Appendix Review
Where are we?

1. How would you describe your knowledge or implementation level with the Common Core State Standards (CCSS) in your science program?

2. How would you describe your knowledge of the National Research Council’s K-12 Science Framework?

3. How would you describe your knowledge or implementation level of the Next Generation Science Standards in your science class?
Next Generation Science Standards

Step 1:
Vision for Science

Step 2:
Develop NGSS

Design Phase

2011

2012

2013

2014

Awareness Phase

State Adoption of NGSS

Begin CA Science Framework

Middle School Sequence

IMSS
Next Generation Science Standards

2015 → 2016 → 2017

Awareness Phase → Implementation Phase

California Science Framework
the details about HOW to teach NGSS in CA
Finished Jan 2016

Assessments
Curricula
Teacher Development

DON’T PANIC!
Next Generation Science Standards

Three Dimensions – Chapter 3; NRC Framework

Dimension 1: Science and Engineering Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world.

Dimension 2: Crosscutting Concepts

They are a way of linking the different domains in science.

Dimension 3: Disciplinary Core Ideas

Describes core ideas in the science disciplines and of the relationships among science, engineering and technology.
Dimension 1: Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
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 (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Table Talk

What are the implications of these scientific practices for curriculum and instruction?
Dimension 2: Crosscutting Concepts

- Patterns, similarity, and diversity
- Cause and effect
- Scale, proportional and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change
Dimension 3: Disciplinary Core Ideas

- Physical sciences
- Life sciences
- Earth and space sciences
- Engineering, technology and application of science
Disciplinary Core Idea (DCI): Physical Sciences

• PS1. Matter and Its Interactions

• PS2. Motion and Stability

• PS3. Energy

• PS4. Waves and Their Applications
DCI: Life Sciences

• LS1. From Molecules to Organisms: Structures and Processes

• LS2. Ecosystems: Interactions, Energy, and Dynamics

• LS3. Heredity: Inheritance and Variation of Traits

• LS4. Biological Evolution: Unity and Diversity
DCI: Earth and Space Sciences

• ESS1. Earth’s Place in the Universe

• ESS2. Earth’s Systems

• ESS3. Earth and Human Activity
DCI: Engineering, Technology and Applications of Science

• ETS1. Engineering Design

• ETS2. Links among Engineering, Technology, Science and Society
Conceptual Shifts

1. K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world

2. The NGSS are student performance expectations – NOT curriculum

3. NGSS focuses on enduring Disciplinary Core Ideas, rather than isolated science facts

4. The science concepts build coherently from K-12
Conceptual Shifts

5. The NGSS focus on deeper understanding of content as well as application of content

6. Science and Engineering are integrated in the NGSS from K-12

7. The NGSS are designed to prepare students for college, career, and citizenship

8. The NGSS and Common Core State Standards are aligned
## Adopted Middle Grades Learning Progression

<table>
<thead>
<tr>
<th>Crosscutting Concepts</th>
<th>Life</th>
<th>Earth and Space</th>
<th>Physical</th>
<th>Human Impact Engineering</th>
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<td><em>8th</em></td>
<td>Natural Selection</td>
<td>History of Earth Space systems</td>
<td>Waves/EM Radiation</td>
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<td>Cause and Effect</td>
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1-ESS1 Earth’s Place in the Universe

Students who demonstrate understanding can:

1-ESS1-1. **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.]

1-ESS1-2. **Make observations at different times of year to relate the amount of daylight to the time of year.** [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

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**
- Planning and Carrying Out Investigations
  - Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
  - Make observations (firsthand or from media) to collect data that can be used to make comparisons.
  - Analyzing and Interpreting Data
  - Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
  - Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

**Disciplinary Core Ideas**

**ESS1.A: The Universe and its Stars**
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)

**ESS1.B: Earth and the Solar System**
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)

**Crosscutting Concepts**

- **Patterns**
  - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1), (1-ESS1-2)

*Connections to Nature of Science*

- **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**
  - Science assumes natural events happen today as they happened in the past. (1-ESS1-1)
  - Many events are repeated. (1-ESS1-1)

**Articulation of DCIs across grade-bands**: 3.PS2.A (1-ESS1-1); 5.PS2.B (1-ESS1-1), (1-ESS1-2); 5-ESS1.B (1-ESS1-1), (1-ESS1-2)

**Common Core State Standards Connections**:
- **ELA/Literacy**
  - **W.1.7** Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions). (1-ESS1-1), (1-ESS1-2)
  - **W.1.8** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1), (1-ESS1-2)
- **Mathematics**
  - **MP.2** Reason abstractly and quantitatively. (1-ESS1-2)
  - **MP.4** Model with mathematics. (1-ESS1-2)
  - **MP.5** Use appropriate tools strategically. (1-ESS1-2)
  - **1.OA.A.1** Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem. (1-ESS1-2)
  - **1.MD.C.4** Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. (1-ESS1-2)
NGSS Architecture

How to Read the
NEXT GENERATION
SCIENCE
STANDARDS
K-12 Framework

Take a few minutes to read the framework for your discipline.

Discuss these questions with others at your table:

How is it similar to your current teaching?
How is it different?
Unwrapping the Performance Expectations

Each packet has 3-4 Performance Expectations

Identify the following component of each Performance Expectation:

Science and Engineering Practices
Enter in the BLUE section

Crosscutting Concepts
Enter in the GREEN section
Dimension 2: Crosscutting Concepts

- Patterns, similarity, and diversity
- Cause and effect
- Scale, proportional and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change
Unwrapping the Performance Expectations

Look at the full version of the PEs you analyzed.

Did you identify the same Practices and Crosscutters as NGSS?

If not, in what ways were your ideas different from the NGSS writers?
Working Dinner
Your Appendix is Bursting (with information)!

• Read through your assigned appendix

• With your partner, create a brief summary (on handout) that tells others what this appendix contains (information, tables, graphic organizers, etc.)

• Explain ways you can use the appendix to inform your instruction

• Explain how you could use the appendix at a board meeting, department meeting, parent night, or professional development training
What Now?

Practice reading and bundling more PEs

Modify labs to be more inquiry based and student-centered (see handout)

Modify Instructional Activities to be more rigorous and STEMy (CCSS) (template)

Focus on **Science and Engineering Practices**

Use PLC time to explore the progression of the Practices (Framework and Appendix F)

Choose one Practice and share strategies and activities that focus on building that skill within your existing content
3-2-1 Reflection

Describe 3 things you learned today that you did not know before

Ask 2 questions you still have

Explain 1 thing you learned today that you can implement immediately back at your site