Teaching NGSS in Elementary School—Second Grade

Presented by: Carla Zembal-Saul, Mary Starr, and Kathy Renfrew

November 19, 2014
6:30 p.m. ET / 5:30 p.m. CT / 4:30 p.m. MT / 3:30 p.m. PT
Introducing today’s presenters...

Ted Willard
Director, NGSS@NSTA
National Science Teachers Association

Carla Zembal-Saul
Professor of Science Education
Penn State University

Mary Starr
Executive Director
Michigan Mathematics and Science Centers Network

Kathy Renfrew
K-5 Science Coordinator, VT Agency of Education
NGSS Curator
Developing the Standards
Developing the Standards

July 2011
Developing the Standards

July 2011
A Framework for K-12 Science Education

Three-Dimensions:

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

View free PDF from The National Academies Press at www.nap.edu

Secure your own copy from www.nsta.org/store
Scientific 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
Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change
## Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LS1:</strong> From Molecules to Organisms: Structures and Processes</td>
<td><strong>PS1:</strong> Matter and Its Interactions</td>
</tr>
<tr>
<td><strong>LS2:</strong> Ecosystems: Interactions, Energy, and Dynamics</td>
<td><strong>PS2:</strong> Motion and Stability: Forces and Interactions</td>
</tr>
<tr>
<td><strong>LS3:</strong> Heredity: Inheritance and Variation of Traits</td>
<td><strong>PS3:</strong> Energy</td>
</tr>
<tr>
<td><strong>LS4:</strong> Biological Evolution: Unity and Diversity</td>
<td><strong>PS4:</strong> Waves and Their Applications in Technologies for Information Transfer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earth &amp; Space Science</th>
<th>Engineering &amp; Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESS1:</strong> Earth’s Place in the Universe</td>
<td><strong>ETS1:</strong> Engineering Design</td>
</tr>
<tr>
<td><strong>ESS2:</strong> Earth’s Systems</td>
<td><strong>ETS2:</strong> Links Among Engineering, Technology, Science, and Society</td>
</tr>
<tr>
<td><strong>ESS3:</strong> Earth and Human Activity</td>
<td></td>
</tr>
<tr>
<td>Life Science</td>
<td>Earth &amp; Space Science</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>LS1: From Molecules to Organisms: Structures and Processes</td>
<td>ESS1: Earth’s Place in the Universe</td>
</tr>
<tr>
<td><strong>ESS3: Earth and Human Activity</strong></td>
<td>ESS2.E: Biogeology</td>
</tr>
<tr>
<td><strong>LS2: Ecosystems: Interactions, Energy, and Dynamics</strong></td>
<td><strong>PS4: Waves and Their Applications in Technologies for Information Transfer</strong></td>
</tr>
<tr>
<td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</td>
<td><strong>LS3: Heredity: Inheritance and Variation of Traits</strong></td>
</tr>
</tbody>
</table>

Note: In NGSS, the core ideas for Engineering, Technology, and the Application of Science are integrated with the Life Science, Earth & Space Science, and Physical Science core ideas.
Developing the Standards

July 2011

Curricula
Instruction
Assessments
Pre-Service Education
Professional Learning
Developing the Standards
NGSS Lead State Partners
NGSS Writers
Adoption of NGSS

About 3 in 10 students in the US live in states that have adopted NGSS
### 2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

#### 2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.

| Clarification Statement: None. |
| Assessment Boundary: Assessment is limited to testing one variable at a time. |

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

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>• Plants depend on water and light to grow. (2-LS2-1)</td>
<td>• Events have causes that generate observable patterns. (2-LS2-1)</td>
</tr>
<tr>
<td>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed. They are not instructional strategies or objectives for a lesson.
### 2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

**2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.**

*Clarification Statement: None.*

*Assessment Boundary: Assessment is limited to testing one variable at a time.*

---

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

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
- Plants depend on water and light to grow. (2-LS2-1) | Cause and Effect  
- Events have causes that generate observable patterns. (2-LS2-1) |

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)

---

**Note:** Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed.

They are not instructional strategies or objectives for a lesson.
### 2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

**2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.**

**Clarification Statement:** None.

**Assessment Boundary:** Assessment is limited to testing one variable at a time.

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

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cause and Effect</td>
<td>- Events have causes that generate observable patterns. (2-LS2-1)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed.

They are not instructional strategies or objectives for a lesson.
### Closer Look at a Performance Expectation

**2-LS2 Ecosystems: Interactions, Energy, and Dynamics**

Students who demonstrate understanding can:

**2-LS2-1.** Plan and conduct an investigation to determine if plants need sunlight and water to grow.

*Clarification Statement:* None.

*Assessment Boundary:* Assessment is limited to testing one variable at a time.

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 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.
  - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)

- **Disciplinary Core Ideas**
  - **LS2.A: Interdependent Relationships in Ecosystems**
    - Plants depend on water and light to grow. (2-LS2-1)

- **Crosscutting Concepts**
  - **Cause and Effect**
    - Events have causes that generate observable patterns. (2-LS2-1)

**Note:** Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed.

They are not instructional strategies or objectives for a lesson.
Teaching NGSS in Elementary School
Second Grade: Matter and Its Interactions

November 19, 2014
Introductions

Carla Zembal-Saul – czem@psu.edu
Professor of Science Education, Penn State University
Twitter: @czem

Mary Starr – mary@starrscience.com
Executive Director, Michigan Mathematics and Science Centers Network
Co-author, *Project-Based Inquiry Science*
Twitter: @starrscience

Kathy Renfrew - Kathy.Renfrew@state.vt.us
K-5 Science Coordinator, VT Agency of Education, NGSS Curator
Twitter: @krsciencelady
NGSS Webinar Series for K-5

- Importance of engaging young children in *meaningful science learning* and scientific discourse and practices
- *Foundation* for future learning in science
- Opportunity to examine NGSS in early grades and *focus on teaching* particular content and practices
- *Connecting* core ideas with ELA and mathematics
- Development of a *community of practice* focused on elementary grades
- Vehicle to access instructional *resources* for teaching
Overview: NGSS for Second Grade

- NGSS topics for second grade
- Unpacking performance expectation 2-PS1-4
- Focus on matter and its interactions
- Scientific practices: Argumentation
- Video: Teaching about changes to solids and liquids
- Approaches for supporting NGSS in the classroom
- Resources to support instruction
Poll: Familiarity with NGSS

- Not at all
- Somewhat
- Very
Web Seminar Interactions

- Be an engaged participant.
- Participate by responding to polls and using the CHAT window to share ideas.
- Presume positive intentions!
Beyond Activities

- Activities ("hands-on") alone are not enough

- Integration of core ideas, scientific practices, and cross-cutting concepts (3D learning) essential for meaningful science learning

- Investigations as a vehicle for...
  - Engaging with scientific phenomena
  - Collecting data from which to construct arguments and explanations
  - Testing ideas and explanations
Scientific and Engineering Practices

1. Asking probing 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. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Scientific and Engineering Practices

1. Asking probing 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. **Developing explanations and designing solutions**
7. **Engaging in argument from evidence**
8. Obtaining, evaluating, and communicating information
NGSS Topics for Second Grade

- Life Science: Interdependent relationships in Ecosystems
- Earth and Space Systems: Earth’s Systems
- Physical Science: Matter and Its Interactions
Core Idea PS1: Matter and Its Interactions

Structure and Properties of Matter

- The performance expectations in second grade help students formulate answers to questions such as: *How are materials similar and different from one another, and how do the properties of the materials relate to their use?*

- Students are expected to develop an understanding of the observable properties of materials through analysis and classification of different materials.

NGSS Second grade Storyline or NGSS “Related Content” link

2. Structure and Properties of Matter

How to read the standards »
Go back to search results
Related Content »

Views: Disable Popups / Black and white

Students who demonstrate understanding can:

2-PS1-1. Plan and conduct an investigation to describe matter. [Clarification Statement: Observations could include properties that different materials share.]

2-PS1-2. Analyze data obtained from testing different materials to determine which is better suited for an intended purpose. [Clarification Statement: Observations could include properties such as texture, and absorbency.] [Assessment Boundary: Students do not need to test more than one property of a material.]

2-PS1-3. Make observations to construct an evidence-based argument that some materials can be disassembled and made into a new object. [Clarification Statement: Examples of reversible changes could include objects that are melted or vaporized.]

2-PS1-4. Construct an argument with evidence that some materials cannot. [Clarification Statement: Examples of irreversible changes could include objects that are burned or broken into pieces.]
Support in NGSS - Storylines

http://www.nextgenscience.org/search-standards
Core Idea PS1  

**Matter and Its Interactions**

*How can one explain the structure, properties, and interactions of matter?*

The existence of atoms, now supported by evidence from modern instruments, was first postulated as a model that could explain both qualitative and quantitative observations about matter (e.g., Brownian motion, ratios of reactants and products in chemical reactions). Matter can be understood in terms of the types of atoms present and the interactions both between and within them. The states (i.e., solid, liquid, gas, or plasma), properties (e.g., hardness, conductivity), and reactions (both physical and chemical) of matter can be described and predicted based on the types, interactions, and motions of the atoms within it. Chemical reactions, which underlie so many observed phenomena in living and nonliving systems alike, conserve the number of atoms of each type but change their arrangement into molecules. Nuclear reactions involve changes in the types of atomic nuclei present and are key to the energy release from the sun and the balance of isotopes in matter.

**PS1.A: STRUCTURE AND PROPERTIES OF MATTER**

*How do particles combine to form the variety of matter one observes?*

While too small to be seen with visible light, atoms have substructures of their own. They have a small central region or nucleus—containing protons and neutrons—surrounded by a layer of negatively charged electrons. The number of protons...
2-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

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

2-PS1-4. Construct an argument with evidence that some changes caused by heating and cooling can be reversed and some cannot. [Clarification Statement: Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]
Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)
High School: Each atom has a charged substructure. The periodic table orders elements. The repeating patterns of the periodic table reflect patterns of electron states. Chemical processes, their rates and energy can be understood in terms of the collisions of molecules, with consequent changes in the sum of all bond energies.

Middle School: Substances are made from different types of atoms, which combine in various ways. Atoms form molecules that range in size. Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. Changes in state that occur with variations in temperature or pressure can be described using models of matter.

Fifth Grade: Matter can be subdivided into particles too small to see but can be detected by other means. Measurements of a variety of properties can be used to identify materials.

Second Grade: Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. Patterns of properties exist.
By the end of grade 2. **Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature.** Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces (e.g., blocks, construction sets). Objects or samples of a substance can be weighed, and their size can be described and measured. (Boundary: volume is introduced only for liquid measure.)

Check Point

What questions do you have about…

Making sense of 2nd grade performance expectations

and/or

Preparing to teach the content of matter and its interactions
Poll: Matter in Elementary School

Which response best reflects how you have taught matter in the elementary grades (or observed matter being taught in the K-5)?

a. Focus on change of state – melting, freezing, boiling water
b. “Mystery powders” activity – properties sugar, salt, flour, corn starch
c. Classifying materials by physical properties – hard and soft, rough and smooth, etc.
d. Other (please describe briefly)

After you have answered the poll, watch as the results unfold and read the chat box for teacher’s descriptions of other activities.
Performance Expectation

2-PS1-4 **Construct an argument with evidence** that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]
Teaching Video:
Changes to solids and liquids

❖ Central, rural Pennsylvania
❖ Lessons from second week in November 2014
❖ Class consists of 24 students (3 IEPs and 4 ESL)
❖ Teacher graduated in 2009
❖ Video edited down from a 90 minute lesson
❖ Respect for colleagues who share their classrooms
Before this lesson...

- Prior knowledge about solids and liquids
- Characteristics of solids and liquids
- Predictions: *What happens to solids in the presence of a source of heat?*
Analyze the Video

**STUDENTS**

- Which ideas do students have difficulty applying? Which ideas seem more accessible to them?
- In what ways do students contribute to constructing an evidence-based claim about what happens to solids in the presence of a source of heat?

**TEACHER**

- How does the teacher engage children with changes to matter as scientific phenomena?
- What kinds of talk moves facilitate students’ productive participation in the science talk?
- How does the teacher scaffold the experience of negotiating the claim?
Reflection

How did the teacher support learners in developing toward the performance expectation?
From the Video

❖ Highlighted thinking scientifically and doing scientific work

❖ Approached changes to matter as phenomena with which students can interact, observe and manipulate

❖ Emphasized collecting and recording observations

❖ Created opportunities for children to identify patterns across a variety of examples

❖ Used talk moves intended to get at students’ ideas and scaffolded constructing a claim from evidence
After this lesson...

- Predictions about whether the samples would change back to solids
- Samples allowed to sit overnight
- Small groups compared observations with photos of samples from the prior lesson
Developing claims from evidence
Scientific and Engineering Practices

1. Asking probing 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. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Explanation and Argument

**Constructing scientific explanation** – the use of observations/data and science ideas to construct evidence-based accounts of natural phenomena

**Argument from evidence** – the process of reaching agreement about explanations
CLAIM – A statement/conclusion that responds to the *question* under investigation

EVIDENCE – Scientific data that is appropriate and sufficient to support the claim

REASONING – Justification that shows why the data count as evidence to support the claim AND includes appropriate science ideas

REBUTTAL – Alternative claims and/or counter evidence and reasoning for why an explanation is not appropriate

McNeill & Krajcik, 2012; McNeill et al., 2006
CER Framework

- Engage with phenomena
- Ask questions that require investigation

McNeill & Krajcik, 2012
How do solids and liquids respond in the presence of a heat source?

**EVIDENCE:** When we put the pie pan with crayons on the burner, they melted into a liquid. When we removed them from the heat, they turned back into a solid. This also happened with chocolate, butter, and ice. The ice did not change back into a solid after being removed from the burner.
Recording data/observations – photos
Recording data/observations – science notebooks
How do solids and liquids respond in the presence of a heat source?

CLAIM: Some solids change to a liquid when heat is added. When the source of heat is removed, some materials change back from a liquid to a solid.

EVIDENCE: When we put the pie pan with crayons on the burner, they melted into a liquid. When we removed them from the heat, they turned back into a solid. This also happened with chocolate, butter, and ice. The ice did not change back into a solid after being removed from the burner.
How do solids and liquids respond in the presence of a heat source?

CLAIM: Some solids change to a liquid when heat is added. When the source of heat is removed, some materials change back from a liquid to a solid.

EVIDENCE: When we put the pie pan with crayons on the burner, they melted into a liquid. When we removed them from the heat, they turned back into a solid. This also happened with chocolate, butter, and ice. The ice did not change back into a solid after being removed from the burner.

REASONING: Heating and cooling can cause some materials to “change state” from a solid to a liquid or a liquid to a solid.
How do solids and liquids respond in the presence of a heat source?

CLAIM: Some solids change to a liquid when heat is added. When the source of heat is removed, some materials change back from a liquid to a solid.

EVIDENCE: When we put the pie pan with crayons on the burner, they melted into a liquid. When we removed them from the heat, they turned back into a solid. This also happened with chocolate, butter, and ice. The ice did not change back into a solid after being removed from the burner.

REASONING: Heating and cooling can cause some materials to “change state” from a solid to a liquid or a liquid to a solid.

WONDERING: We know we need it to be colder for water to change to ice. Will other liquids change to solids in the freezer?
Documenting claims, evidence and new questions
KLEWS Chart

**K** – What do we **think** we **know**? (i.e., beginning ideas, predictions)

**L** – What are we **learning**? (i.e., claim)

**E** – What is our **evidence**?

**W** – What do we **wonder** about the phenomena? (i.e., testable and researchable questions)

**S** – What **science ideas** make our explanation stronger? (i.e., scientific principles and terminology)
Scientific and Engineering Practices

1. Asking probing 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. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

WONDERINGS:
We know we need it to be colder for water to change to ice. Will other liquids change to solids in the freezer? Clay gets hard when you heat it up. Can we change it back?
Why science talk? Because talk…

- Provides a lens into student thinking.
- Supports rigorous science learning by ramping up the academic language, providing opportunities for students to make connections by building on the ideas of others.
- Encourages students to think and argue “scientifically” using evidence.
- Allows students to converse as scientists and practice collaboration.
- Allows students to engage with the content at many different levels of understanding because they feel safe, know their ideas are valued and believe they can learn from each other.
- Connects across the disciplines.
- Is a rehearsal for writing.
What is needed for productive science talk to happen?

- A belief the students can do it, all the students!
- Norms for science meetings.
- A purpose, science discussions will lead to deeper understanding.
- An understanding of the content.
Norms for Productive Science Talk

- Sit so that all students can see each other – a circle or horseshoe.
- Look at the person speaking.
- Listen carefully.
- Have quiet hands and body.
- Everyone participates.
- Take turns. Pause and look at each other.
- Stay on topic.

Talk Science Primer, Sarah Michaels and Cathy O’Connor

Science and Literacy : A Natural Fit
Karen Worth, Wheelock College, Jeff Winokur, Sally Crissman, Tufts University, Martha Heller-Winokur, Martha Davis
Constructing Arguments from Evidence

What are the essential elements?

- A focused, initial question
- NOT sharing time
- Evidence is required!
- Using relationships and patterns found in group data to build shared understanding
Facilitating Productive Talk

- Sets the stage for the talk.
- Makes sure students bring the tools they need to the meeting.
- Notices who is talking and who is not talking.
- Uses wait time to allow for thinking.
- Invites and encourage participation.
- Records notes important to the whole group.
- Employs talk moves.
Talk Moves from *What’s Your Evidence*?

<table>
<thead>
<tr>
<th>Talk Move</th>
<th>Example Teacher Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refocus on guiding question</td>
<td>How does that help us answer our guiding question, _________?</td>
</tr>
<tr>
<td>Analyzing Data</td>
<td>What patterns are you beginning to notice in your data?</td>
</tr>
<tr>
<td>Propose a draft claim</td>
<td>What claim can you make based on the data you have so far?</td>
</tr>
<tr>
<td>Consider alternatives</td>
<td>Is there a different claim that explains the data better?</td>
</tr>
<tr>
<td>Make new predictions</td>
<td>Given your results so far, what do you think will happen next?</td>
</tr>
</tbody>
</table>

Zembal-Saul et al., 2013, p. 73
Beyond Activities

❖ Activities ("hands-on") alone are not enough

❖ Integration of core ideas, scientific practices, and cross-cutting concepts (3D learning) essential for meaningful science learning

❖ Investigations as a vehicle for...

● *Engaging* with *scientific phenomena*

● Collecting data from which *to construct* *arguments and explanations*

● *Testing* ideas and explanations
Challenges in Bundling

Students who demonstrate understanding can:

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:
What teachers need to know...

❖ Disciplinary core ideas (and cross-cutting concepts)
❖ Scientific (and engineering) practices
❖ Children’s ideas and reasoning
❖ Learning progressions
❖ Strategies for rich classroom talk
❖ Formative assessment approaches
❖ Interdisciplinary connections
What teachers need to know...

❖ Disciplinary core ideas (and cross-cutting concepts)
❖ Scientific (and engineering) practices
❖ Children’s ideas and reasoning
❖ Learning progressions
❖ Strategies for rich classroom talk
❖ Formative assessment approaches
❖ Interdisciplinary connections
NGSS Webinar Series for K-5

- Importance of engaging young children in meaningful science learning and scientific discourse and practices
- Foundation for future learning in science
- Opportunity to examine NGSS in early grades and focus on teaching particular content and practices
- Connecting core ideas with ELA and mathematics
- Development of a community of practice focused on elementary grades
- Vehicle to access instructional resources for teaching
Professional Learning

What is one idea or practice from the webinar that you will take back to your instructional setting and use?

Please share in the chat window.
Teacher Learning Journeys: Learn Today...Your Way

Create your personalized learning journey based on your own unique learning needs and preferences where you can plan, track, and assess your progress over time. You can start at “Explore Learning Resources and Opportunities” below or by creating your game plan with the PD Plan and Portfolio tool. You may also review an archived Web Seminar overview of the Learning Center.
Instructional Resources

http://goo.gl/tMtpbe

http://goo.gl/7tSC35

http://goo.gl/2LM3SA

http://goo.gl/o4y6jf

http://goo.gl/WJRl5n

http://goo.gl/bQsYRd

Karen Worth, Wheelock College, Jeff Winokur, Sally Crissman, Tufts University, Martha Heller-Winokur, Martha Davis
On the Web

nextgenscience.org

nsta.org/ngss
Connect and Collaborate

Discussion forum on NGSS in the Learning center

NSTA Member-only Listserv on NGSS
Focus on the Elementary Grades

- **Kindergarten**: September 17
- **First Grade**: October 15
- **Second Grade**: November 19
- **Third Grade**: December 17
- **Fourth Grade**: January 21
- **Fifth Grade**: February 18

All web seminars will take place on Wednesday nights from 6:30-8:00 pm ET
NSTA Resources on NGSS

Web Seminar Archives

- Practices (Fall 2012)
- Crosscutting Concepts (Spring 2013)
- Disciplinary Core Ideas (Fall 2013, Spring 2014)
- Assessment (January 2014)

Journal Articles

- Science and Children
- Science Scope
- The Science Teacher
Fall 2014 Regional Conferences

Richmond, VA
October 16–18

Orlando, FL
November 6-8

Long Beach, CA
December 4-6
Conferences in 2015

National Conference
Chicago
March 26-29, 2015

STEM Forum
Minneapolis
May 20-23, 2015
Conferences in 2015

Reno, NV
October 22-24

Philadelphia, PA
November 12-14

Kansas City, MO
December 3-5
Thanks to today’s presenters!

**Ted Willard**
Director, NGSS@NSTA  
National Science Teachers Association

**Carla Zembal-Saul**
Professor of Science Education  
Penn State University

**Mary Starr**
Executive Director  
Michigan Mathematics and Science Centers Network

**Kathy Renfrew**
K-5 Science Coordinator, VT Agency of Education  
NGSS Curator
Thank you to the sponsor of today’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.
National Science Teachers Association
David Evans, Ph.D., Executive Director
Al Byers, Ph.D., Associate Executive Director, Services

NSTA Web Seminar Team
Flavio Mendez, Senior Director, NSTA Learning Center
Dayna Anderson, Help Desk Manager
Stephanie Erickson, e-Learning Coordinator
Jeff Layman, e-Learning Technical Coordinator