NSTA WEB SEMINARS

LIVE INTERACTIVE LEARNING @ YOUR DESKTOP

Putting the *NGSS* Evidence Statements to Work in Your Classroom

August 12, 2015

6:30 p.m. ET / 5:30 p.m. CT / 4:30 p.m. MT / 3:30 p.m. PT

Introducing today’s presenters

Peter McLaren
Director of State and District Support – Science
Achieve

Betsy O’Day
Elementary Science Specialist and *NGSS* Curator
Hallsville, MO

Patrick Goff
8th grade Science Teacher
Lexington, KY

NGSS Evidence Statements Introductory Web Seminar August 12, 2015

Introductions and Overview

- What are the NGSS Evidence Statements?
- How can Evidence Statements be used to support student learning?
- What are some things to look out for when using Evidence Statements?

About Achieve

- Achieve is a non-partisan, non-profit organization that helps states raise academic standards, and improve assessment and accountability systems to prepare all young people for postsecondary education, work, and citizenship.
- What we do:
  - Convene states and educators
  - Provide technical assistance to states
  - Conduct research and resource development
  - Offer advocacy, communications, and implementation tools and support.

What is the NGSS?

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Developing the Standards

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

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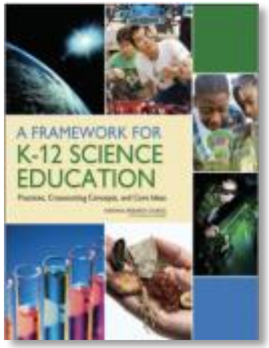
NEXT GENERATION SCIENCE STANDARDS
For States, By States

NSTA National Science Teachers Association

AAAS
ADVANCING SCIENCE, SERVING SOCIETY

Developing the Standards



NEXT GENERATION
SCIENCE
STANDARDS
For States, By States

- Curricula
- Instruction
- Assessments
- Pre-Service Education
- Professional Learning

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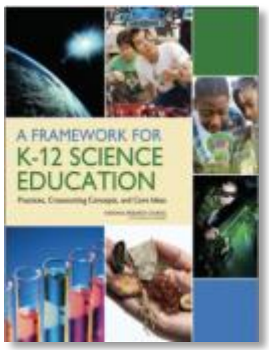
July 2011

Developing the Standards



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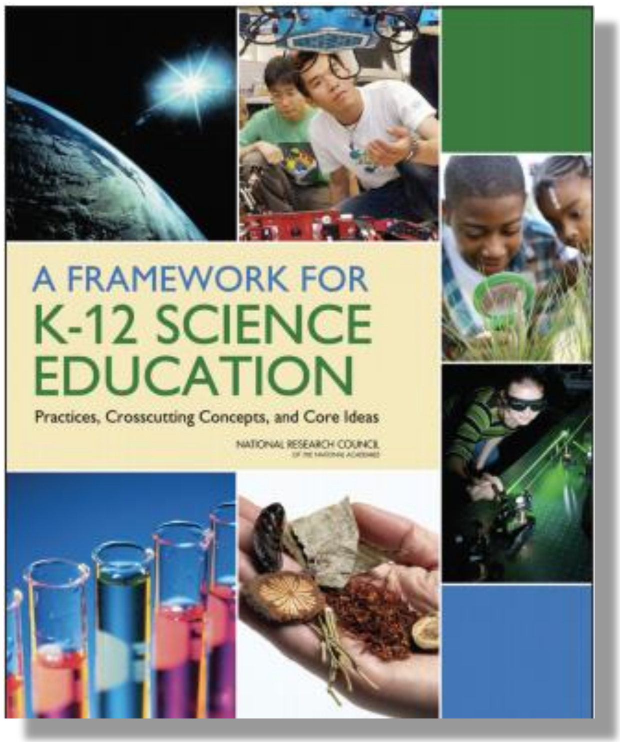
A Framework for K-12 Science Education



Three-Dimensions:

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

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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

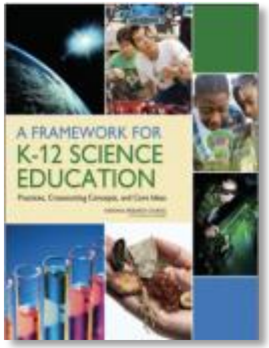
Disciplinary Core Ideas

Life Science	Physical Science
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	PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth and Human Activity	ETS1: Engineering Design ETS2: Links Among Engineering, Technology, Science, and Society

Disciplinary Core Ideas

Life Science	Earth & Space Science	Physical Science	Engineering & Technology
LS1: From Molecules to Organisms: Structures and Processes LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**PS1: Matter and Its Interactions** PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World ***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



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Developing the Standards

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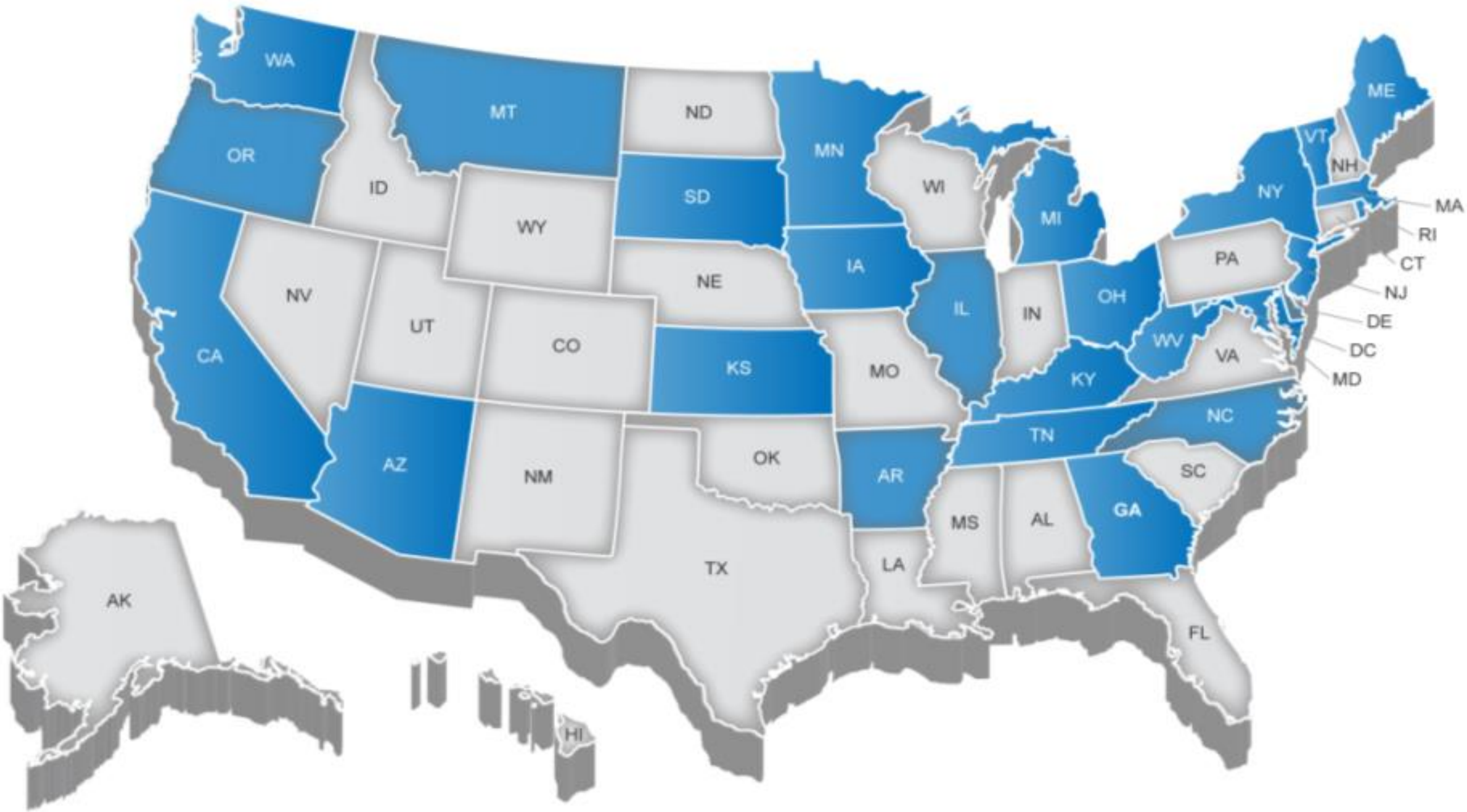
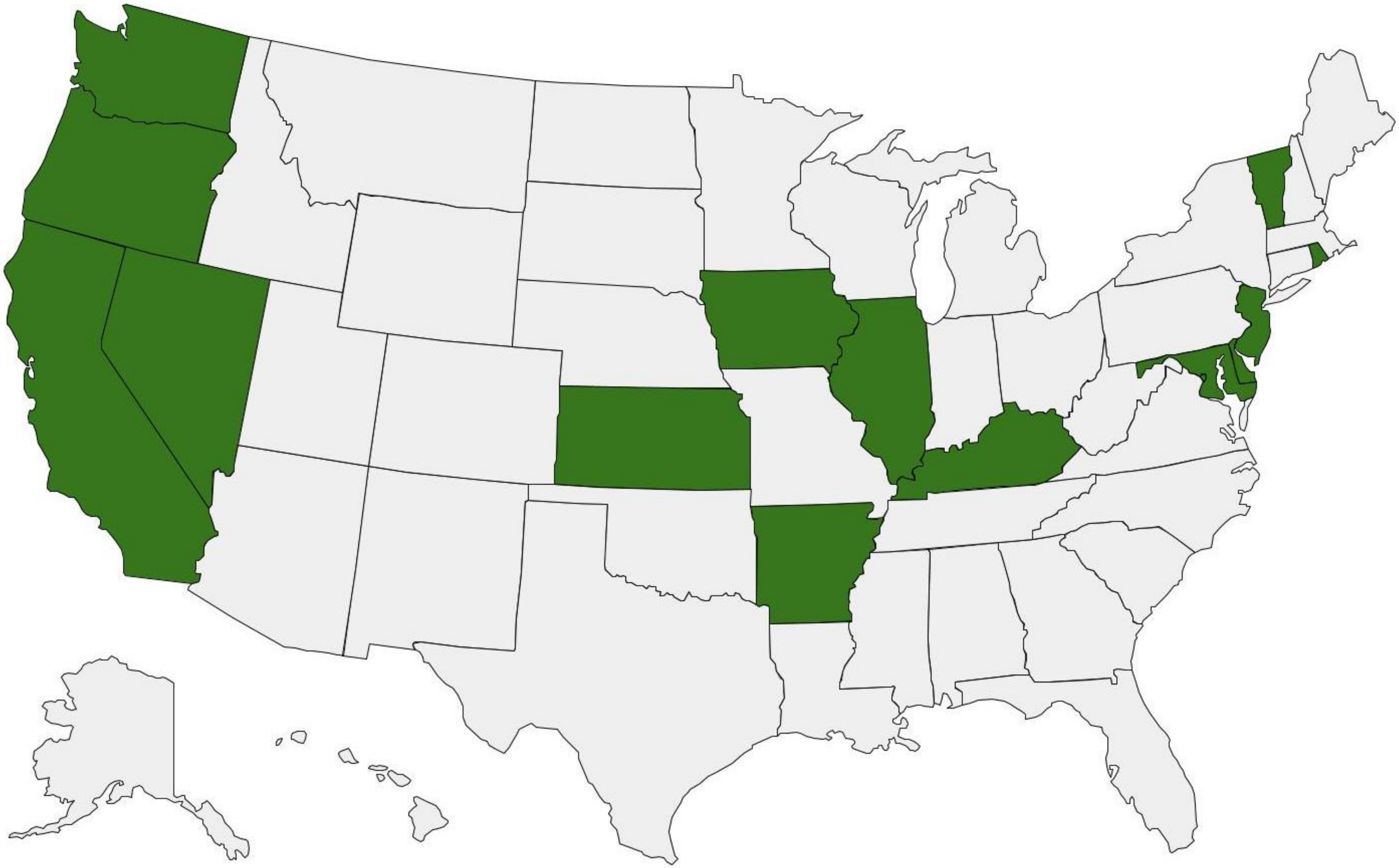
NGSS Lead State Partners



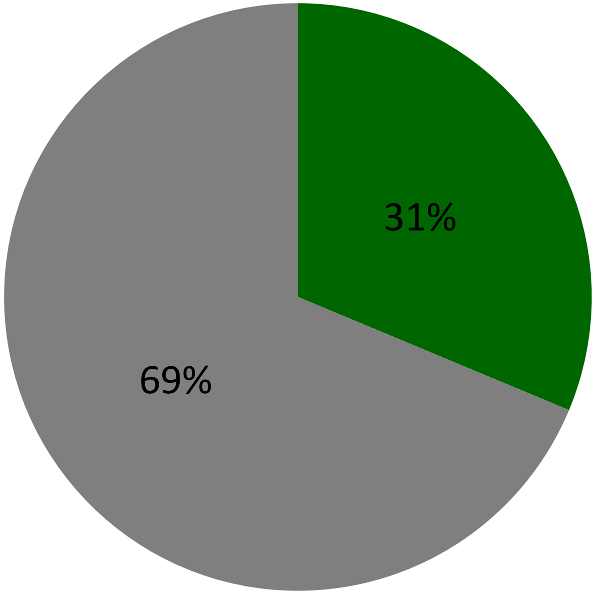
NGSS Writers

Adoption of NGSS



Adoption of NGSS

Percent of Students in NGSS States



Over 30% of students in the US live in states that have adopted NGSS

A Closer Look at a Performance Expectation

MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

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 support explanations, describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS1-5) --- **Connections to Nature of Science** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)	**PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-5) • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	**Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)

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.

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How much time have you already spent looking at the NGSS Evidence Statements?

A. I have thoroughly read them and already incorporated them in my planning.
B. I have read the introductory material as well as the evidence statements for my grade level.
C. I have glanced through the materials.
D. I haven’t yet read them.

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What are Evidence Statements?

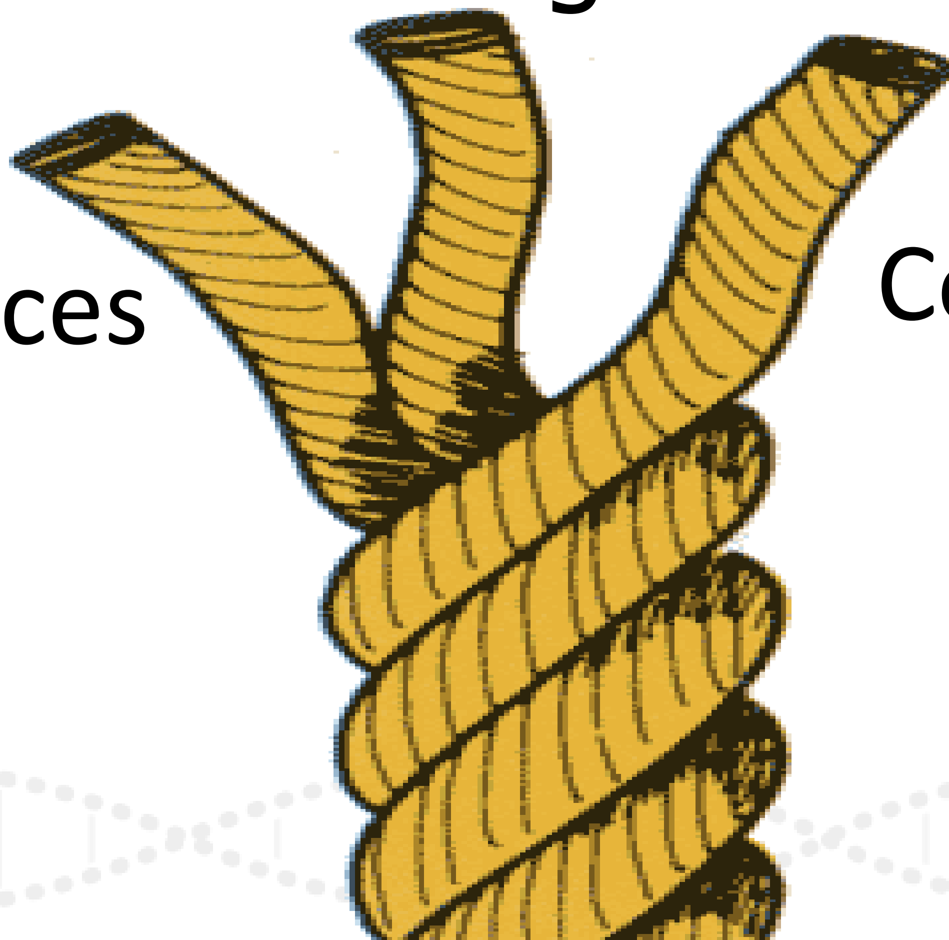
NEXT GENERATION SCIENCE STANDARDS

For States, By States

What Does a Three-Dimensional Student Performance Look Like?

Crosscutting Concepts

Practices



Core Ideas

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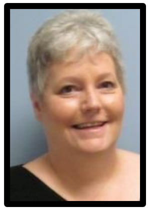
For States, By States



What are Evidence Statements?

Evidence statements provide detail on how students will use the

- practices
- crosscutting concepts
- disciplinary core ideas

together to demonstrate proficiency on the PE's.

NEXT GENERATION SCIENCE STANDARDS For States, By States

What are Evidence Statements?

- Same grain size as a PE
- Intended to provide clear, measurable components that, if met, fully satisfy each PE described within the NGSS.
- intended to better clarify what abilities and knowledge the students should be able to demonstrate **at the end** of instruction, **without limiting or dictating instruction**.
- written to allow for multiple methods and contexts of assessment, including assessing multiple related PEs together (bundling) at the same time.

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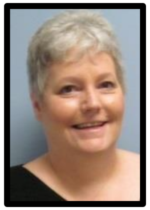
Where can I find them?



Nextgenscience.org/resources

The Science Science Education Standards Comparison Tool supports administrators in comparing the differences, both in purpose and structure, between different sets of standards.

Classroom Sample Tasks: (Introduction and Overview) (View and Download Tasks Here)
The Classroom Sample Tasks blend content, practices, and concepts from both the NGSS and the Common Core State Standards. Teachers across the disciplines have collaborated to write sample tasks, which are the result of a vision of integrating science, engineering, and mathematics for classroom use.

NGSS Evidence Statements: (Executive Summary) (Introduction and Overview) (Grades K-5) (Grades 6-8) (Grades 9-12)
NGSS Evidence Statements provide educators with additional detail on what students should know and be able to do. These Evidence Statements are statements of observable and measureable components that, if met, will satisfy NGSS performance expectations.

Rhode Island / Delaware Instructional Materials Collaborative
The Rhode Island / Delaware Instructional Materials Collaborative Brief provides an overview of an interstate collaboration to transition instructional materials toward alignment with the NGSS. Intended for those who are interested in learning more about this collaboration or intending to replicate ideas from it, the brief explains how the collaborative was formed, how the teams worked together, and lessons learned during the first year of this partnership.

Resources coming soon:

Accelerated Model Course Pathways - coming soon
NGSS Accelerated Model Course Pathways provide examples of how the NGSS can be tailored for accelerated students. Created by Advanced Placement teachers, these models are designed to help schools and districts to envision pathways for students intending to take advanced science

The Purpose of Evidence Statements

- Describe what teachers or assessors would observe (not infer).
- Provide specific, observable components of student performance that would demonstrate integrated proficiency for 3-Dimensional Learning, including:
  - practice to demonstrate understanding of the
  - disciplinary core ideas (DCIs)
  - through the lens of the crosscutting concepts (CCC).

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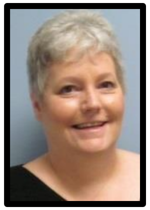
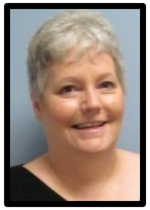
The Purpose of Evidence Statements



- Serve as supporting materials for the design of assessments.
- The vision for the Evidence Statements is for educators and assessors to see:
  - how these dimensions could be assessed together, rather than in independent units or sections;
  - the knowledge underlying each DCI;
  - how science and engineering practices provide a structure that makes students' thinking visible; and
  - how crosscutting concepts deepen students' understanding of phenomena.

Content of the Evidence Statements



- Convey the intent of the PE in the context of the foundation boxes.
- Include foundation box bullets from all three dimensions
- Call out specific mathematical formulae whenever they are required for student performance on the PE.
- Should be three-dimensional so that the practices, DCIs, and CCCs are all framed in the context of one another.
- Should not contain content or context beyond what is included or implied in the DCI or PE.
- Include only details absolutely necessary to understand the DCI and PE.

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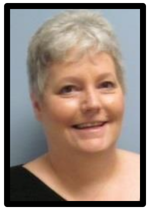
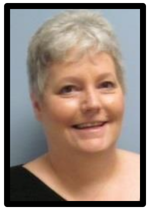


Structure

- Organized by Scientific and Engineering Practice
- Integrate all dimensions
- Developed specifically for the Performance Expectations

NEXT GENERATION SCIENCE STANDARDS
For States, By States

MS-LS1-7



MS-LS1-7

Students who demonstrate understanding can:

MS-LS1-7. **Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.**

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

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

PS3.D: Energy in Chemical Processes and Everyday Life

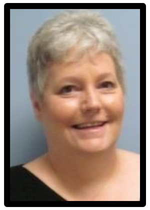
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.*(secondary)*

Crosscutting Concepts

Energy and Matter

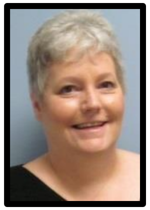
- Matter is conserved because atoms are conserved in physical and chemical processes.

MS-LS1-7 Evidence of Student Performance



Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing how food molecules are rearranged as matter moves through an organism, including:	
		i.	Molecules of food, which are complex carbon-containing molecules.
		ii.	Oxygen.
		iii.	Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv.	New types of molecules produced through chemical reactions involving food.
2	Relationships		
	a	In the model, students identify and describe the relationships between components, including:	
		i.	During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii.	The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections		
	a	Students use the model to describe:	
		i.	The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii.	That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii.	Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

Scientific Model Template



Using either a developed or given model to do the following:

1. Components of the model
   a. Students define and clearly label all of the essential variables or factors (components) within the system being modeled.
   b. When appropriate, students describe the boundaries and limitations of the model.
2. Relationships
   a. Students describe the relationships among the components of the model.
3. Connections
   a. Students connect the model to causal phenomena or scientific theories that students then describe or predict, using logical reasoning.

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MS-LS1-7 Evidence of Student Performance

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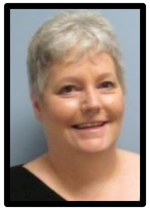

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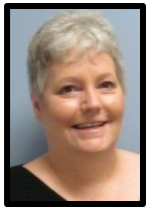

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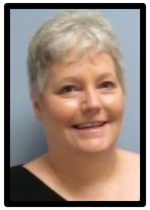
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

Asking and Evaluating Questions Template



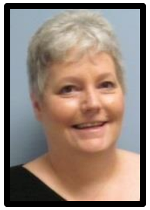
I. Asking Questions:

1. Addressing phenomena or scientific theories
   a. Students formulate specific questions based on examining models, phenomena, or theories.
   b. Students' questions could generate answers that would clarify the relationships between components in a system.
2. Empirical testability
   a. Students' questions are empirically testable by scientists.

II. Evaluating questions

1. Addressing phenomena or scientific theories
   a. Students evaluate questions in terms of whether or not answers to the questions would provide relevant information about the targeted phenomenon in a given context.
2. Evaluating empirical testability
   a. Students' evaluations of the questions include a description of whether or not answers to the questions would be empirically testable by scientists.

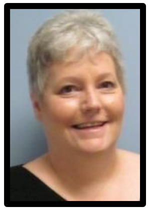
Defining Problems Template



III. Defining problems

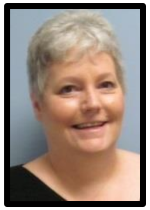
1. Identifying the problem to be solved
    a. Students' analyses include:
        i. A description of the challenge with a rationale for why it is a major global challenge;
        ii. A qualitative and quantitative description of the extent and depth of the problem and its major consequences to society and/or the natural world on both global and local scales if it remains unsolved; and
        iii. Documented background research on the problem from two or more sources, including research journals.
2. Defining the process or system boundaries, and the components of the process or system
    a. Students' analyses include identification of the physical system in which the problem is embedded, including the major elements and relationships in the system and boundaries so as to clarify what is and is not part of the problem.
    b. Students' analyses include a description of societal needs and wants that are relative to the problem (e.g., for controlling CO_2 emissions, societal needs include the need for cheap energy).
3. Defining the criteria and constraints
    a. Students specify the qualitative and quantitative criteria and constraints for acceptable solutions to the problem.

Planning and Conducting Investigations Template



1. Identifying the phenomenon to be investigated
   a. Students describe the phenomenon under investigation, question to be answered, or design solution to be tested.
2. Identifying the evidence to answer this question
   a. Students develop a plan for the investigation that includes a description of the evidence to be collected.
   b. Students describe how the evidence will be relevant to determining the answer.
3. Planning for the investigation
   a. Students include in the investigation plan a means to indicate, collect, or measure the data, including the variables to be tested or controlled.
   b. Students indicate whether the investigation will be conducted individually or collaboratively.
4. Collecting the data
   a. Students perform the investigation, collecting and recording data systematically.
5. Refining the design
   a. Students evaluate the accuracy and precision of the data collected.
   b. Students evaluate the ability of the data to be used to answer the question.
   c. If necessary, students refine the investigation plan to produce more accurate and precise data.

MS-LS1-7



MS-LS1-7

Students who demonstrate understanding can:

MS-LS1-7. **Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.**

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

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

PS3.D: Energy in Chemical Processes and Everyday Life

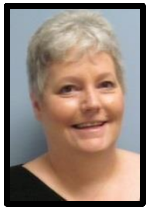
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.*(secondary)*

Crosscutting Concepts

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes.

MS-LS1-7 Evidence of Student Performance



Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing how food molecules are rearranged as matter moves through an organism, including:	
		i.	Molecules of food, which are complex carbon-containing molecules.
		ii.	Oxygen.
		iii.	Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv.	New types of molecules produced through chemical reactions involving food.
2	Relationships		
	a	In the model, students identify and describe the relationships between components, including:	
		i.	During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii.	The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections		
	a	Students use the model to describe:	
		i.	The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii.	That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii.	Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

Let’s pause for two questions

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Who's online?

A. Elementary Teachers
B. Middle School Teacher
C. High School Teacher
D. School-level science supervisor
E. District- or state-level science supervisor

Other? Please tell us via the chat window.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Who's online?

A. Elementary Teachers
B. Middle School Teacher
C. High School Teacher
D. School-level science supervisor
E. District- or state-level science supervisor

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Evidence Statements are Not…

- descriptors of teacher practice (i.e. prompts, techniques)
- descriptions of increasing levels of cognitive difficulty, Depth of Knowledge levels, or varying levels of student proficiency (e.g., using the first category as the least difficult or first stepping stone for developing student proficiency).
- a checklist that denotes the ordering of steps in a student's performance.
- instructional strategies or steps in a classroom activity.
- sufficient to replace lesson plans or assessment items
- scoring rubrics
- limits on student coursework

How Evidence Statements can be used

- Audience
  - all audiences should have a deep prior understanding of the NGSS and of the **NRC's Framework for K-12 Science Education**, on which the NGSS was based.
- Assessment
  - Evidence statements can be most directly useful when designing summative assessments (either classroom or large-scale), as they provide a starting point for describing student proficiency at the end of instruction.
  - To use the evidence statements in directly guiding assessment, they will need to be tailored to the specific examples or prompts within the context of the assessment item being created.
  - Evidence statements also can guide the development of a "proficient" level of a rubric, but they would similarly need to be tailored to the context of the assessment. Also, rubrics for other performance levels (e.g., advanced, basic) should be created that align with the specific context of the assessment.

How Evidence Statements can be used

- Instruction
  - Important! Evidence statements detail what students should be able to do at the **end of instruction**.
  - Evidence Statements should **NOT** be used to plan instruction, but they can be used to validate instructional plans.
  - NGSS PEs and the corresponding evidence statements are not a substitute for day-to-day lesson goals that drive the learning process.
  - Although evidence statements are listed individually for each performance expectation, this does not indicate that they should be measured individually, or that performance expectations should be taught or assessed individually.

Simple Bundle

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

MS-LS1-7 and MS-PS1-5

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing how food molecules are rearranged as matter moves through an organism, including:	
		i.	Molecules of food, which are complex carbon-containing molecules.
		ii.	Oxygen.
		iii.	Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv.	New types of molecules produced through chemical reactions involving food.
2	Relationships		
	a	In the model, students identify and describe the relationships between components, including:	
		i.	During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii.	The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections		
	a	Students use the model to describe:	
		i.	The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii.	That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii.	Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components for a given chemical reaction, including:	
		i.	The types and number of molecules that make up the reactants.
		ii.	The types and number of molecules that make up the products.
2	Relationships		
	a	In the model, students describe relationships between the components, including:	
		i.	Each molecule in each of the reactants is made up of the same type(s) and number of atoms.
		ii.	When a chemical reaction occurs, the atoms that make up the molecules of reactants rearrange and form new molecules (i.e., products).
		iii.	The number and types of atoms that make up the products are equal to the number and types of atoms that make up the reactants.
		iv.	Each type of atom has a specific mass, which is the same for all atoms of that type.
3	Connections		
	a	Students use the model to describe that the atoms that make up the reactants rearrange and come together in different arrangements to form the products of a reaction.	
	b	Students use the model to provide a causal account that mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.	

MS-LS1-7 and MS-PS1-5

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing how food molecules are rearranged as matter moves through an organism, including:	
		i.	Molecules of food, which are complex carbon-containing molecules.
		ii.	Oxygen.
		iii.	Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv.	New types of molecules produced through chemical reactions involving food.
2	Relationships		
	a	In the model, students identify and describe the relationships between components, including:	
		i.	During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii.	The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections		
	a	Students use the model to describe:	
		i.	The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii.	That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii.	Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

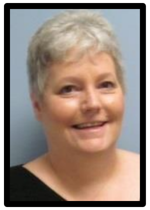
Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components for a given chemical reaction, including:	
		i.	The types and number of molecules that make up the reactants.
		ii.	The types and number of molecules that make up the products.
2	Relationships		
	a	In the model, students describe relationships between the components, including:	
		i.	Each molecule in each of the reactants is made up of the same type(s) and number of atoms.
		ii.	When a chemical reaction occurs, the atoms that make up the molecules of reactants rearrange and form new molecules (i.e., products).
		iii.	The number and types of atoms that make up the products are equal to the number and types of atoms that make up the reactants.
		iv.	Each type of atom has a specific mass, which is the same for all atoms of that type.
3	Connections		
	a	Students use the model to describe that the atoms that make up the reactants rearrange and come together in different arrangements to form the products of a reaction.	
	b	Students use the model to provide a causal account that mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.	

How could you use these to support student learning?

NEXT GENERATION SCIENCE STANDARDS

For States, By States

Thoughts about possible uses



Classroom Example – Middle School

Middle School Example:

1) Decide on the PE Bundle that you want to use. In my case, I was working on a Natural Hazard Unit
   1) **08-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.**
   2) **08-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.***
2) Then we decided on the Phenomena we wanted to center this unit/topic around.
3) Once our group had decided on the above two items, we took a look at the corresponding Evidence Statements (next slide).
4) We just wanted to review them to get a sense of the expectations for the student proficiency levels for the PE's.

NEXT GENERATION SCIENCE STANDARDS

For States, By States

Classroom Example: Middle School

Observable features of the student performance by the end of the course:			
1	Organizing data		
	a	Students organize given data that represent the type of natural hazard event and features associated with that type of event, including the location, magnitude, frequency, and any associated precursor event or geologic forces.	
	b	Students organize data in a way that facilitates analysis and interpretation.	
	c	Students describe what each dataset represents.	
2	Identifying relationships		
	a	Students analyze data to identify and describe patterns in the datasets, including:	
		i.	The location of natural hazard events relative to geographic and/or geologic features.
		ii.	Frequency of natural hazard events.
		iii.	Severity of natural hazard events.
		iv.	Types of damage caused by natural hazard events.
		v.	Location or timing of features and phenomena (e.g., aftershocks, flash floods) associated with natural hazard events.
	b	Students describe similarities and differences among identified patterns.	
3	Interpreting data		
	a	Students use the analyzed data to describe:	
		i.	Areas that are susceptible to the natural hazard events, including areas designated as at the greatest and least risk for severe events.
		ii.	How frequently areas, including areas experiencing the highest and lowest frequency of events, are at risk.
		iii.	What type of damage each area is at risk of during a given natural hazard event.
		iv.	What features, if any, occur before a given natural hazard event that can be used to predict the occurrence of the natural hazard event and when and where they can be observed.
	b	Using patterns in the data, students make a forecast for the potential of a natural hazard event to affect an area in the future, including information on frequency and/or probability of event occurrence; how severe the event is likely to be; where the event is most likely to cause the most damage; and what events, if any, are likely to precede the event.	
	c	Students give at least three examples of the technologies that engineers have developed to mitigate the effects of natural hazards (e.g., the design of buildings and bridges to resist earthquakes, warning sirens for tsunamis, storm shelters for tornados, levees along rivers to prevent flooding).	

Observable features of the student performance by the end of the course:			
1	Using scientific knowledge to generate design solutions		
	a	Given a problem related to human impact on the environment, students use scientific information and principles to generate a design solution that:	
		i.	Addresses the results of the particular human activity.
		ii.	Incorporates technologies that can be used to monitor and minimize negative effects that human activities have on the environment.
	b	Students identify relationships between the human activity and the negative environmental impact based on scientific principles, and distinguish between causal and correlational relationships to facilitate the design of the solution.	
2	Describing criteria and constraints, including quantification when appropriate		
	a	Students define and quantify, when appropriate, criteria and constraints for the solution, including:	
		i.	Individual or societal needs and desires.
		ii.	Constraints imposed by economic conditions (e.g., costs of building and maintaining the solution).
3	Evaluating potential solutions		
	a	Students describe how well the solution meets the criteria and constraints, including monitoring or minimizing a human impact based on the causal relationships between relevant scientific principles about the processes that occur in, as well as among, Earth systems and the human impact on the environment.	
	b	Students identify limitations of the use of technologies employed by the solution.	

Classroom Example – Middle School

5) Our group then decided on our culminating assessment.

6) Once we had this idea pretty well decided, we compared it to our Evidence Statements to see what types of observable evidence we would be able to collect.

7) After this, we started to design the instructional process, making sure to consult the Evidence Statements to review as we went along.

Classroom Example – Middle School

8) When the instructional sequence is complete, we will go back again, to see if our choices will allow us to get the necessary observable evidence or if we may need to tweek an assignment.

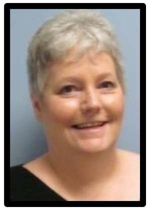
Classroom Example – Middle School

9) We did not use the Evidence Statements to design our sequence or assignments.

10) We used the Evidence Statements as a check to see if we were putting together an instructional sequence that would give us the necessary evidence to show student proficiency.

Challenges

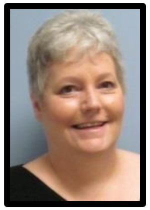
Let's pause for two questions



How is this different in K-5?

- Students build understanding of all three dimensions by **interacting with directly observable phenomena**.
- Students are responsible for **identifying relationships** between different pieces of a system and very simple (observable) mechanisms, rather than a focus on deeper understanding of mechanisms.
- Evidence statements **include clarifying examples**.

Challenges

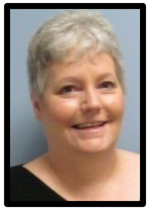


Classroom instruction and assessment should use many **different, appropriate, combinations** of

- practices,
- crosscutting concepts, and
- disciplinary core ideas,

such that by the end of instruction students have had ample experience with all aspects of the three dimensions and how they work together to meet the goal set by the PE.

NEXT GENERATION SCIENCE STANDARDS For States, By States



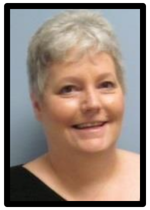
Challenges

Use both the existing evidence statements for your grade level (or grade span) and the practice template in the appendix to inform your classroom instruction and assessment.

- Not a checklist for student performance but as a guide for observable features
- As a model for integration of the three dimensions in both instruction and assessment

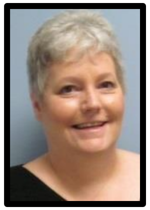
NEXT GENERATION SCIENCE STANDARDS For States, By States

Classroom Examples



Use the observable features of student performance in evidence statements to inform instruction:

- Instruction building towards proficiency in 4-PS3-2 and 4-PS3-4 Energy might include developing or using models of circuits (transfer of energy by electric currents) identifying the circuit as a system

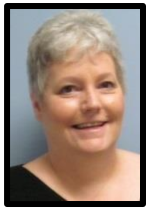


Scientific Model Template

Using either a developed or given model to do the following:

1. Components of the model
    a. Students define and clearly label all of the essential variables or factors (components) within the system being modeled.
    b. When appropriate, students describe the boundaries and limitations of the model.
2. Relationships
    a. Students describe the relationships among the components of the model.
3. Connections
    a. Students connect the model to causal phenomena or scientific theories that students then describe or predict, using logical reasoning.

NEXT GENERATION SCIENCE STANDARDS
For States, By States



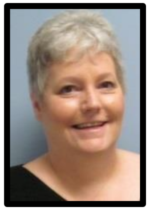
Classroom Examples

Systems in 4th Grade - **From Molecules to Organisms: Structures and Processes**

- 4-LS1-1 Construct and argument that plants and animals have internal and external Structures that function to support survival, growth behavior, and reproduction.
- 4-LS1-2 Use a model to describe that animals receive different types of information through their sense, process the information in their brain, and respond to the information in different ways.

NEXT GENERATION SCIENCE STANDARDS For States, By States

Now, how comfortable do you feel about using the Evidence Statements in your planning?



Not at all comfortable

Somewhat comfortable

Extremely comfortable

Summary

- NGSS Evidence Statements are a new resource that can be useful.
- Evidence Statements are not lesson plans!
- All parts of the evidence statements are needed – they all work together.

Let's pause for two questions

Thanks to our presenters!

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