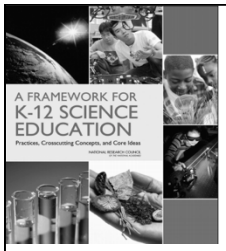


Preparing for the Second Public Review

NEXT GENERATION SCIENCE STANDARDS

Next Generation Science Standards for Today's Students and Tomorrow's Workforce

Developed by:

Phil Lafontaine, Director
Professional Learning Support Division
California Department of Education

Dean Gilbert, Science Coordinator
Orange County Department of Education

January 2013

NEXT GENERATION SCIENCE STANDARDS

Lead Partners

NRC

AAAS ADVANCING SCIENCE, SERVING SOCIETY

NSTA National Science Teachers Association

Council of State Science Supervisors

Achieve

2

NGSS Lead States

California is actively participating in NGSS development.

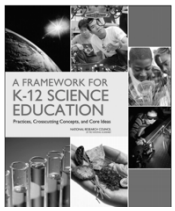
3

California Internal Review Team

K-12 Teachers
County Offices of Education
College and University Faculty
Practicing Scientists
Leaders in Business and Industry
Formal and Informal Science programs
California Science Teachers Association
California Mathematics and Science Projects
California Department of Education

4

Two-Step Process



NRC

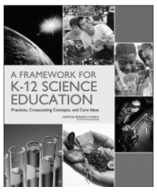
NEXT GENERATION SCIENCE STANDARDS

http://www.nextgenscience.org/

5

A Framework for Science Education

Practices, Crosscutting Concepts, and Core Ideas



Vision
- Science for ALL Students
- Coherent Learning

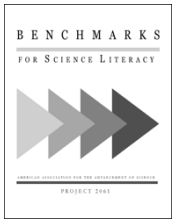
Realizing the Vision
- Integrating the Three Dimensions
- Implementation
- Equity and Diversity
- Guidance for Standards Development
- Looking Toward the Future: Research to Inform K-12 Science Education Standards

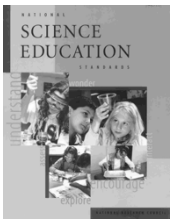
Three Dimensions
- Scientific and Engineering Practices
- Crosscutting Concepts
- Core Ideas

6

Vision for Science Education

Builds on Existing National Science Education Efforts





7

8

Focus of the Framework

Three Dimensions

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

9

Dimension 1
Scientific and Engineering Practices

Inquiry = Practices

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

For each, the Framework includes a description of the practice, the culminating 12th grade learning goals, and what we know about progression over time.

15

Dimension 2
Crosscutting Concepts

Crosscutting Concepts = Disciplinary Connective Tissue

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

11

Dimension 3- Disciplinary Core Idea

Disciplinary Core Ideas = Defines Content Knowledge

- *Disciplinary Significance*
  - Has broad importance across multiple science or engineering disciplines, a key organizing concept of a single discipline
- *Explanatory Power*
  - Can be used to explain a host of phenomena
- *Generative*
  - Provides a key tool for understanding or investigating more complex ideas and solving problems
- *Relevant to Peoples' Lives*
  - Relates to the interests and life experiences of students, connected to societal or personal concerns
- *Usable from K to 12*
  - Is teachable and learnable over multiple grades at increasing levels of depth and sophistication

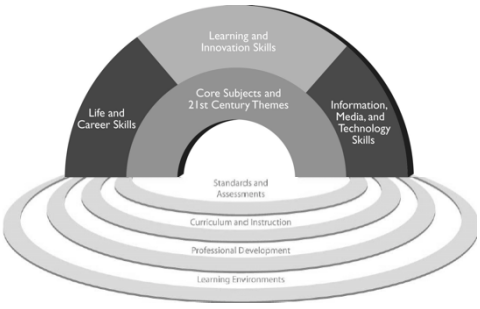
12

Organized Around Core Ideas

- Fewer, clearer, higher
  - "Many existing national, state, and local standards and assessments, as well as the typical curricula in use in the US, contain too many disconnected topics given equal priority." (NRC, 2009)
  - Standards and curriculum materials should be focused on a ***limited number*** of ***core ideas***.
  - Allows learners to develop understanding that can be used to solve problems and explain phenomena.

13

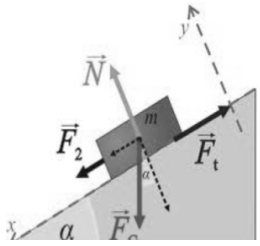
The Partnership for 21st Century Skills



14

Physical Sciences

- Matter and Its Interactions
- Motion and Stability
- Energy
- Waves and Their Applications



15

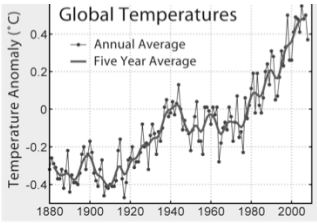
Life Sciences

- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy, and Dynamics
- Heredity: Inheritance and Variation of Traits
- Biological Evolution: Unity and Diversity

16

Earth and Space Sciences

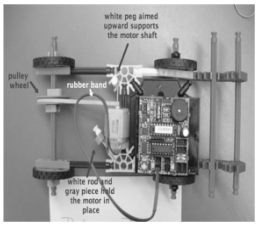
- Earth's Place in the Universe
- Earth Systems
- Earth and Human Activity



17

Engineering, Technology and Applications of Sciences

- Engineering Design
- Links Among Engineering, Technology, Science and Society

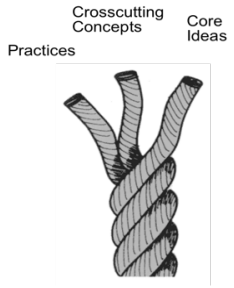


18

Next Generation Of Science Standards Architecture

Integration of 3 Dimensions:

Practices
Crosscutting Concepts
Core Ideas



19

Alignment to Common Core

- Each science standard is correlated to the cognitive demands of both English Language Arts standards and mathematics standards.
- Specific correlation of the Common Core standards are noted in the architecture of each individual science standard.

20

Habits of Mind

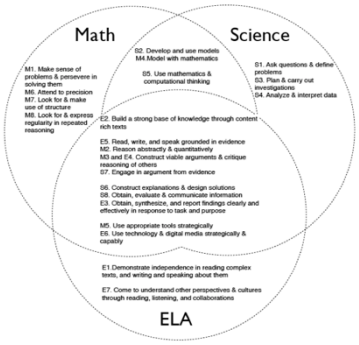
SCIENCE
Science and Engineering Practices

ELA
College and Career Readiness Anchor Standards

MATH
Standards for Mathematical Practice

21

Habits of Mind



22

Performance Expectations Guide Summative Assessment

Shayna had a small bottle of Bromine gas. The bottle was closed with a cork. She tied a string to the cork, and then placed the bottle inside a larger bottle. She sealed the large bottle shut (Figure 1). Next, Shayna opened the small bottle by pulling the string connected to the cork. Figure 2 shows what happened after the cork of the small bottle was opened.

1. Draw a model that shows what is happening in this experiment.
2. Explain in writing what is happening in your model.

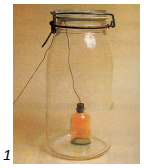


Figure 1

Figure 2

23

Product Not The Process

Performance expectations represent "the product" which defines what **each** student should know and be able to do.

It **does NOT** define "the process" Curriculum/instructional strategies that the teacher utilizes to achieve the outcome.

NEXT GENERATION SCIENCE STANDARDS

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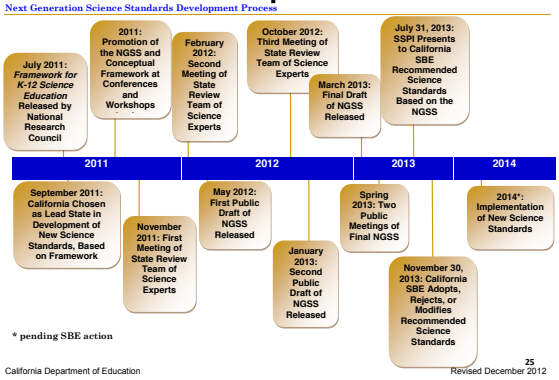
NGSS Development Timeline

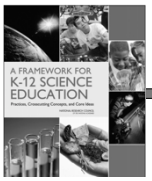
Next Generation Science Standards Development Process



* pending SBE action

Lots of work completed, underway, and left to do

California's Next Steps

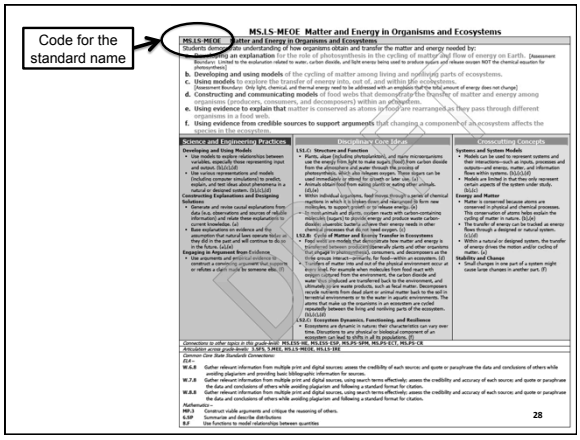


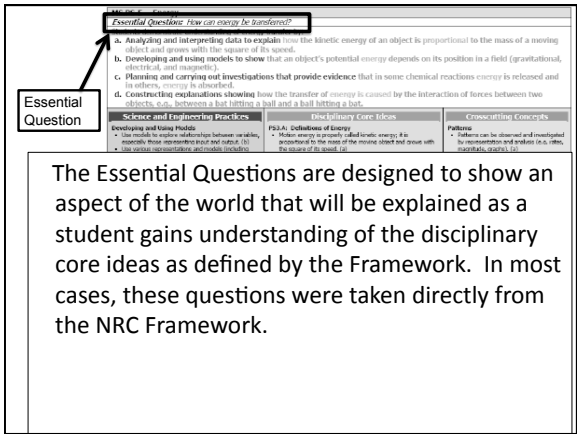
NEXT GENERATION SCIENCE STANDARDS

- SBE Adoption of NGSS
- State Framework Development
- Instruction and Assessment
- Professional Development

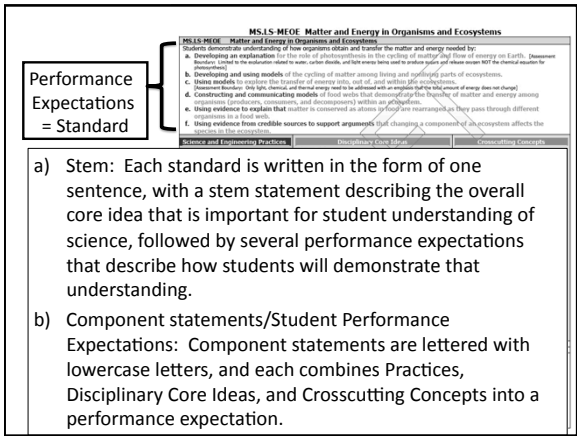
NEXT GENERATION SCIENCE STANDARDS

How to Read the Standards Map





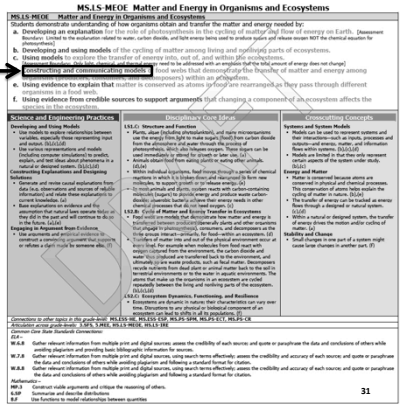
The Essential Questions are designed to show an aspect of the world that will be explained as a student gains understanding of the disciplinary core ideas as defined by the Framework. In most cases, these questions were taken directly from the NRC Framework.



a) Stem: Each standard is written in the form of one sentence, with a stem statement describing the overall core idea that is important for student understanding of science, followed by several performance expectations that describe how students will demonstrate that understanding.

b) Component statements/Student Performance Expectations: Component statements are lettered with lowercase letters, and each combines Practices, Disciplinary Core Ideas, and Crosscutting Concepts into a performance expectation.

Blue font designates a science and engineering practice concept



MS.LS-MEOE Matter and Energy in Organisms and Ecosystems

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Students demonstrate understanding of how organisms obtain and transfer the matter and energy needed by:

a. **Developing an explanation** for the role of photosynthesis in the cycling of matter and flow of energy on Earth. [Assessment Boundary: Limited to the exclusion related to water, carbon dioxide, and light energy being used to produce sugars and release oxygen NOT the chemical equation for photosynthesis]

b. **Developing and using models** of the cycling of matter among living and nonliving parts of ecosystems.

c. **Using models** to explore the transfer of energy into, out of, and within life ecosystems. [Assessment Boundary: Only light, chemical, and thermal energy need to be addressed with an emphasis that the total amount of energy does not change]

d. **Constructing and communicating models** of food webs that demonstrate the transfer of matter and energy among organisms (producers, consumers, and decomposers) within an ecosystem.

e. **Using evidence to explain that** matter is conserved as atoms in food are rearranged as they pass through different organisms in a food web.

f. **Using evidence from credible sources to support arguments** that changing a component of an ecosystem affects the species in the ecosystem.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use models to explore relationships between variables, especially those representing input and output. [6.LS.1],[7.LS1]	**LS1.C: Structure and Function** • Plants, algae (including photosynthetic), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. [6.LS.1] • Animals obtain food from eating plants or eating other animals. [6.LS.1] • 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. [6.LS.1] • In most animals and plants, oxygen reacts with carbon-containing molecules (sugars) to provide energy and produce waste carbon-dioxide. Likewise bacteria achieve their energy needs in other chemical processes that do not need oxygen. [7.LS1]	**Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. [6.LS.1],[8] • Models are limited in that they only represent certain aspects of the system under study. [6.LS.1] **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. This conservation of atoms helps explain the cycling of matter in nature. [6.LS.1] • The transfer of energy can be tracked as energy flows through a designed or natural system. [6.LS.1] • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. [6.LS.1] **Stability and Change** • Small changes in one part of a system might cause large changes in another part. [7]
Constructing Explanations and Designing Solutions • Generate and revise causal explanations from data (e.g. observations and sources of reliable information) and relate these explanations to current knowledge. [6.LS.1] • Base explanations on evidence and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. [6.LS.1] **Engaging in Argument from Evidence** • Use arguments and empirical evidence to construct a convincing argument that supports or refutes a claim must be someone else. [7]	**LS2.A: Interdependent Relationships in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers (generally plants and other organisms that engage in photosynthesis), consumers, and decomposers as the three groups interact—primarily for food—within an ecosystem. [6] • Transfers of matter into and out of the physical environment occur at every level. For example when molecules from food react with oxygen captured from the environment, the carbon dioxide and water that is produced are transferred back to the environment, and ultimately to are waste products, such as fecal matter. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. [6.LS.1],[8] **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. [7]	

Connections to other topics in this grade-level: **MS.LS1-SE, MS.LS1-ESP, MS.PS-SPM, MS.PS-ECT, MS.PS-CR**

Articulation across grade-levels: **3.SP.5, 5.MEE, MS.LS-MEOE, HS.LS-IRE**

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Mathematics –

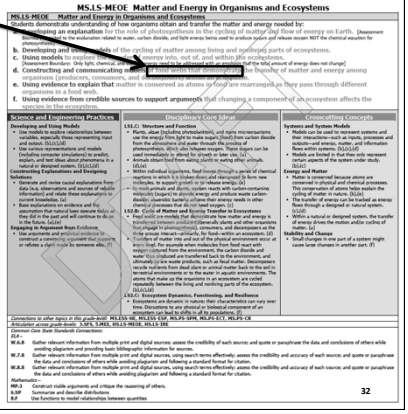
MP.3 Construct viable arguments and critique the reasoning of others.

6.SP Summarize and describe distributions

8.F Use functions to model relationships between quantities

31

Orange font designates a disciplinary core idea



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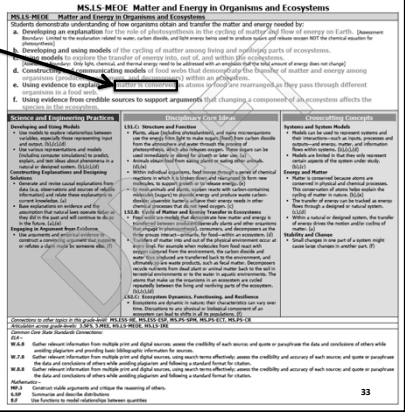

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use models to explore relationships between variables, especially those representing input and output. [6.LS.1],[7.LS1]	**LS1.C: Structure and Function** • Plants, algae (including photosynthetic), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. [6.LS.1] • Animals obtain food from eating plants or eating other animals. [6.LS.1] • 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. [6.LS.1] • In most animals and plants, oxygen reacts with carbon-containing molecules (sugars) to provide energy and produce waste carbon-dioxide. Likewise bacteria achieve their energy needs in other chemical processes that do not need oxygen. [7.LS1]	**Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. [6.LS.1],[8] • Models are limited in that they only represent certain aspects of the system under study. [6.LS.1] **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. This conservation of atoms helps explain the cycling of matter in nature. [6.LS.1] • The transfer of energy can be tracked as energy flows through a designed or natural system. [6.LS.1] • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. [6.LS.1] **Stability and Change** • Small changes in one part of a system might cause large changes in another part. [7]
Constructing Explanations and Designing Solutions • Generate and revise causal explanations from data (e.g. observations and sources of reliable information) and relate these explanations to current knowledge. [6.LS.1] • Base explanations on evidence and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. [6.LS.1] **Engaging in Argument from Evidence** • Use arguments and empirical evidence to construct a convincing argument that supports or refutes a claim must be someone else. [7]	**LS2.A: Interdependent Relationships in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers (generally plants and other organisms that engage in photosynthesis), consumers, and decomposers as the three groups interact—primarily for food—within an ecosystem. [6] • Transfers of matter into and out of the physical environment occur at every level. For example when molecules from food react with oxygen captured from the environment, the carbon dioxide and water that is produced are transferred back to the environment, and ultimately to are waste products, such as fecal matter. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. [6.LS.1],[8] **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. [7]	

Connections to other topics in this grade-level: **MS.LS1-SE, MS.LS1-ESP, MS.PS-SPM, MS.PS-ECT, MS.PS-CR**

Articulation across grade-levels: **3.SP.5, 5.MEE, MS.LS-MEOE, HS.LS-IRE**

Common Core State Standards Connections:

ELA –

W.6.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

W.7.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

W.8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Mathematics –

MP.3 Construct viable arguments and critique the reasoning of others.

6.SP Summarize and describe distributions

8.F Use functions to model relationships between quantities

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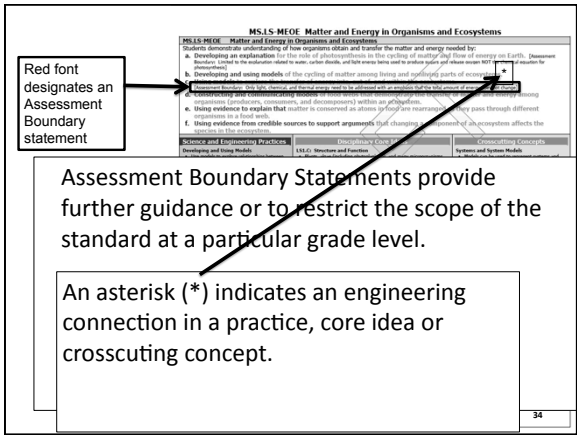
Red font designates an Assessment Boundary statement
MS.LS-MEOE Matter and Energy in Organisms and Ecosystems
Assessment Boundary Statements provide further guidance or to restrict the scope of the standard at a particular grade level.
An asterisk (*) indicates an engineering connection in a practice, core idea or crosscuting concept.
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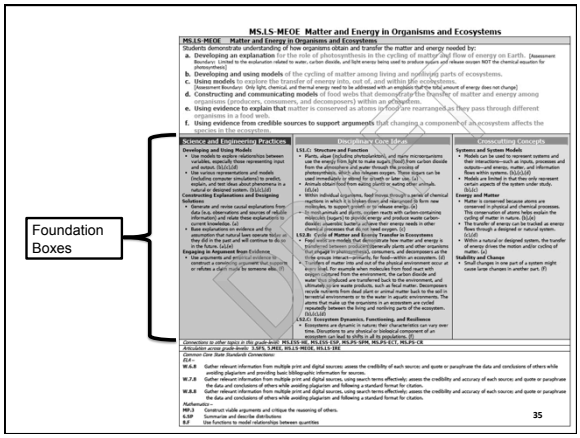
Foundation Boxes
MS.LS-MEOE Matter and Energy in Organisms and Ecosystems
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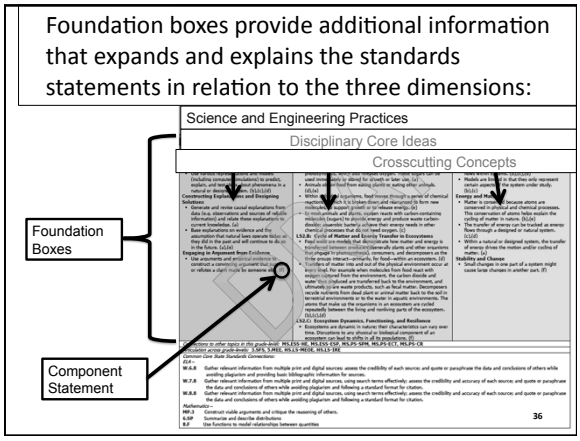
Foundation boxes provide additional information that expands and explains the standards statements in relation to the three dimensions:
Science and Engineering Practices
Disciplinary Core Ideas
Crosscutting Concepts
Foundation Boxes
Component Statement
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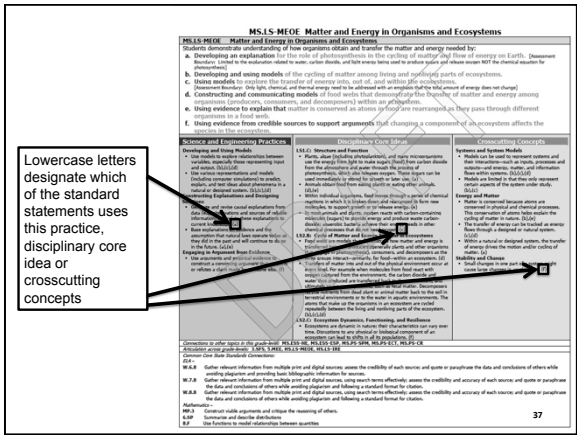
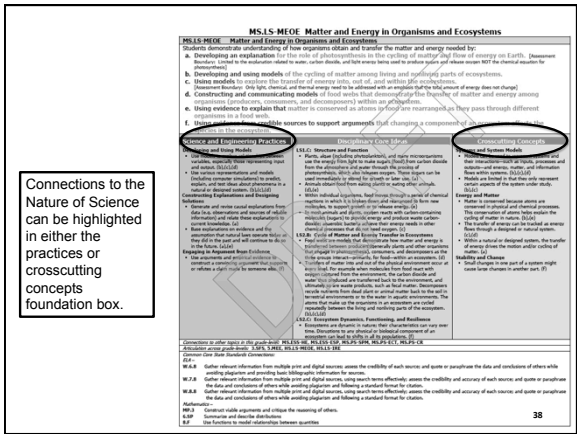


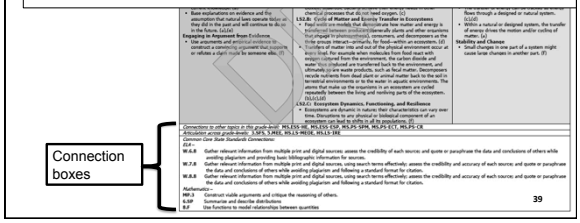


Connection Boxes provide:

a) connections to other topics in a particular grade level.

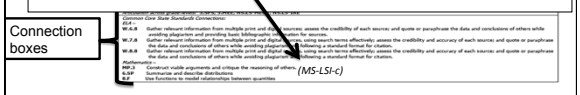
b) articulation across grade levels.

c) connections to Common Core State Standards.



Italics indicates a potential connection, rather than required prerequisite knowledge.

Connection boxes



(MS-LSI-c)

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Visit our website at
http://www.ocde.us/Science/Pages?Professional-Development.aspx

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Online Review

The draft standards and feedback survey is available on the Achieve Web site at

http://www.nextgenscience.org/

Review Period:

January 8, 2013 through January 28, 2013

Please visit Survey Monkey for an exit survey:

http://bit.ly/Wvf0pG

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