Earth and Space Sciences and the Next Generation Science Standards

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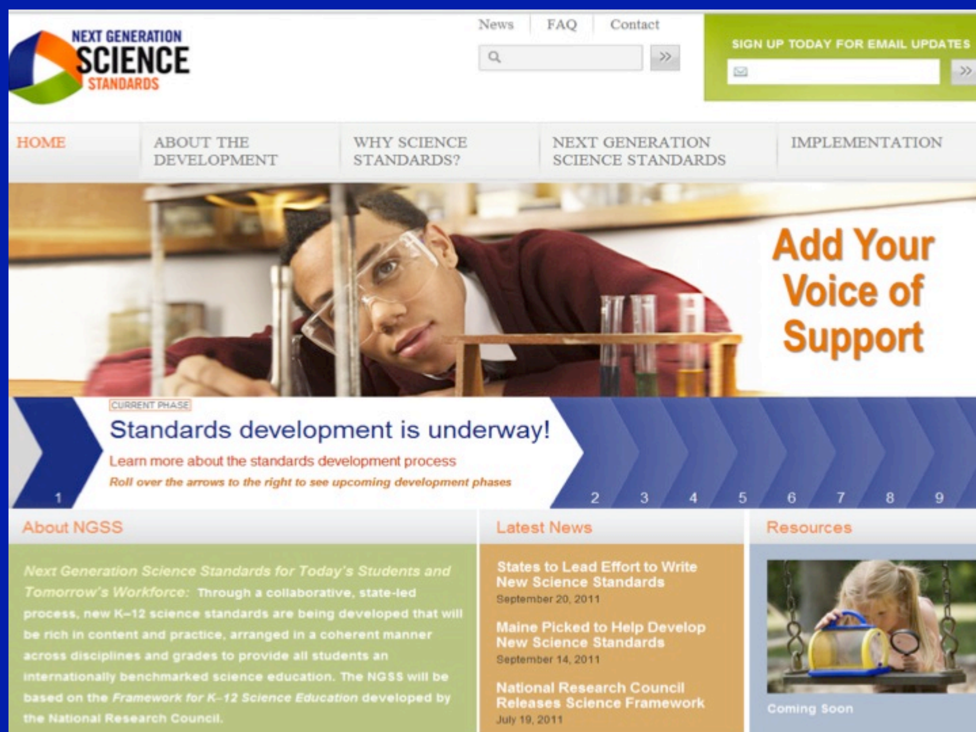
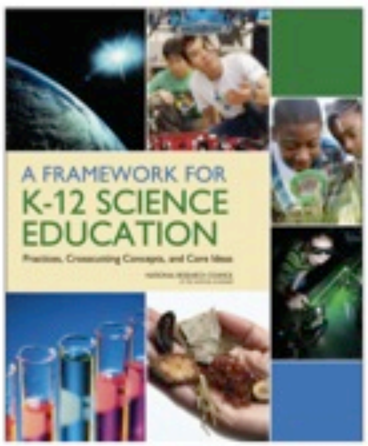


Next Generation Science Standards Timeline

January, 2010
– July, 2011



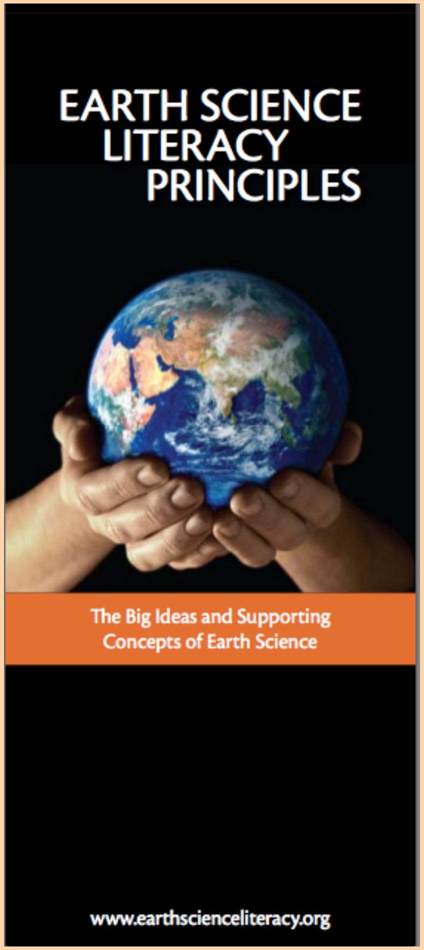
November, 2010
– March, 2013

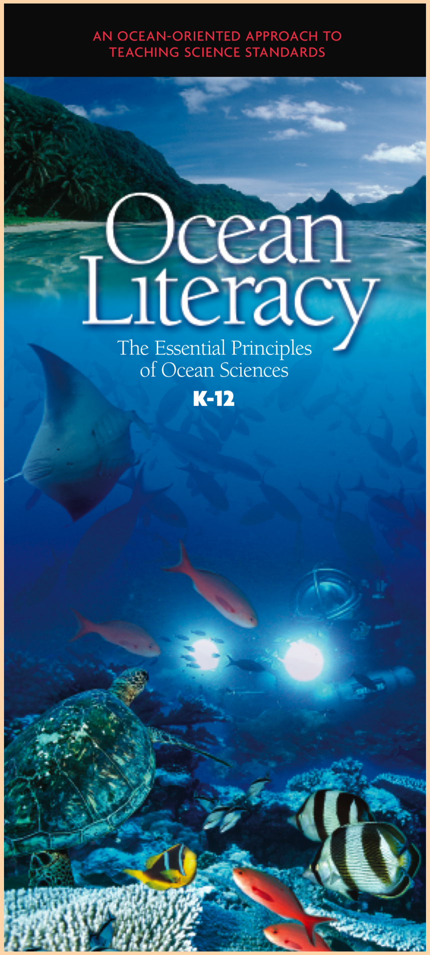
NEXT GENERATION SCIENCE STANDARDS

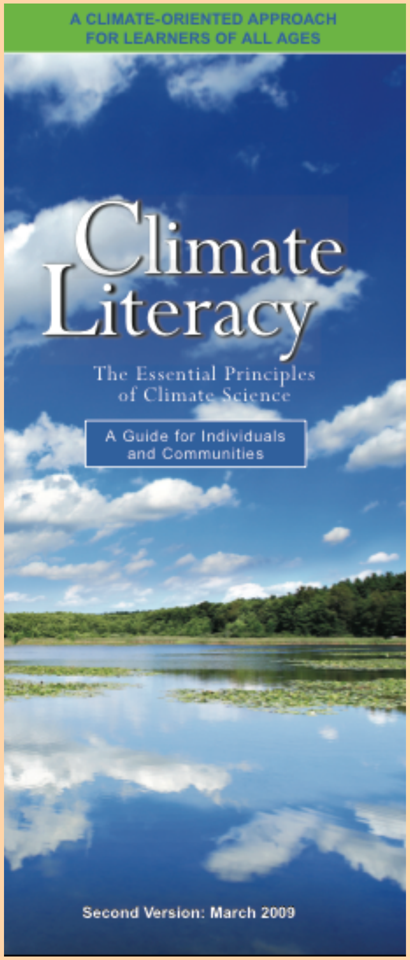
- Assessment
- Curricula
- Instruction
- Teacher Development

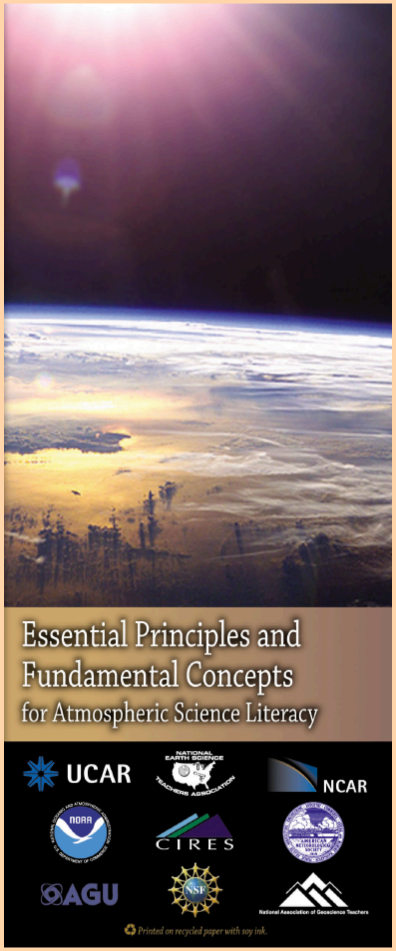
NEXT GENERATION SCIENCE STANDARDS

2004 – 2009: Four Community-Driven Geoscience Literacy Documents are Published







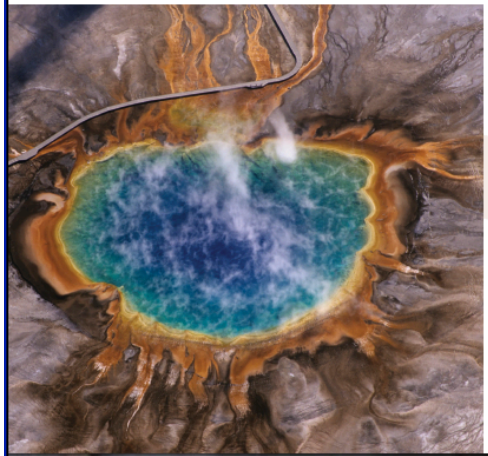


BIG IDEA 3. Earth is a complex system of interacting rock, water, air, and life.

3.1 **The four major systems of Earth are the geosphere, hydrosphere, atmosphere, and biosphere.** The geosphere includes a metallic core, solid and molten rock, soil, and sediments. The atmosphere is the envelope of gas surrounding Earth. The hydrosphere includes the ice, water vapor, and liquid water in the atmosphere, the ocean, lakes, streams, soils, and groundwater. The biosphere includes Earth's life, which can be found in many parts of the geosphere, hydrosphere, and atmosphere. Humans are part of the biosphere, and human activities have important impacts on all four spheres.

3.2 **All Earth processes are the result of energy flowing and mass cycling within and between Earth's systems.** This energy is derived from the sun and Earth's interior. The flowing energy and cycling matter cause chemical and physical changes in Earth's materials and living organisms. For example, large amounts of carbon continually cycle among systems of rock, water, air, organisms, and fossil fuels such as coal and oil.

Steam vigorously rises from the hot waters of Grand Prismatic Spring, known for its rainbow colors produced by thermophilic ("heat loving") organisms. This hot spring is fueled by heat from a large reservoir of partially molten rock (magma), just a few miles beneath Yellowstone, that drives one of the world's largest volcanic systems.



3.3 **Earth exchanges mass and energy with the rest of the Solar System.** Earth gains and loses energy through incoming solar radiation, heat loss to space, and gravitational forces from the sun, moon, and planets. Earth gains mass from the impacts of meteoroids and comets and loses mass by the escape of gases into space.

3.4 **Earth's systems interact over a wide range of temporal and spatial scales.** These scales range from microscopic to global in size and operate over fractions of a second to billions of years. These interactions among Earth's systems have shaped Earth's history and will determine Earth's future.

3.5 **Regions where organisms actively interact with each other and their environment are called ecosystems.** Ecosystems provide the goods (food, fuel, oxygen, and nutrients) and services (climate regulation, water cycling and purification, and soil development and maintenance) necessary to sustain the biosphere. Ecosystems are considered the planet's essential life-support units.

3.6 **Earth's systems are dynamic; they continually react to changing influences.** Components of Earth's systems may appear stable, change slowly over long periods of time, or change abruptly with significant consequences for living organisms.

3.7 **Changes in part of one system can cause new changes to that system or to other systems, often in surprising and complex ways.** These new changes may take the form of "feedbacks" that can increase or decrease the original changes and can be unpredictable and/or irreversible. A deep knowledge of how most feedbacks work within and between Earth's systems is still lacking.

3.8 **Earth's climate is an example of how complex interactions among systems can result in relatively sudden and significant changes.** The geologic record shows that interactions among tectonic events, solar inputs, planetary orbits, ocean circulation, volcanic activity, glaciers, vegetation, and human activities can cause appreciable, and in some cases rapid, changes to global and regional patterns of temperature and precipitation.

BIG IDEA 4. Earth is continuously changing.

4.1 **Earth's geosphere changes through geological, hydrological, physical, chemical, and biological processes that are explained by universal laws.** These changes can be small or large, continuous or sporadic, and gradual or catastrophic.

4.2 **Earth, like other planets, is still cooling, though radioactive decay continuously generates internal heat.** This heat flows through and out of Earth's interior largely through convection, but also through conduction and radiation. The flow of Earth's heat is like its lifeblood, driving its internal motions.

4.3 **Earth's interior is in constant motion through the process of convection, with important consequences for the surface.** Convection in the iron-rich liquid outer core, along with Earth's rotation around its axis, generates Earth's magnetic field. By deflecting solar wind around the planet, the magnetic field prevents the solar wind from stripping away Earth's atmosphere. Convection in the solid mantle drives the many processes of plate tectonics, including the formation and movements of the continents and oceanic crust.

4.4 **Earth's tectonic plates consist of the rocky crust and uppermost mantle, and move slowly with respect to one another.** New oceanic plate continuously forms at mid-ocean ridges and other spreading centers, sinking back into the mantle at ocean trenches. Tectonic plates move steadily at rates of up to 10 centimeters per year.

4.5 **Many active geologic processes occur at plate boundaries.** Plate interactions change the shapes, sizes, and positions of continents and ocean basins, the locations of mountain ranges and basins, the patterns of ocean circulation and climate, the locations of earthquakes and volcanoes, and the distribution of resources and living organisms.

4.6 **Earth materials take many different forms as they cycle through the geosphere.** Rocks form from the cooling of magma, the accumulation and consolidation of sediments, and the alteration of older rocks by heat, pressure, and fluids. These three processes form igneous, sedimentary, and metamorphic rocks.

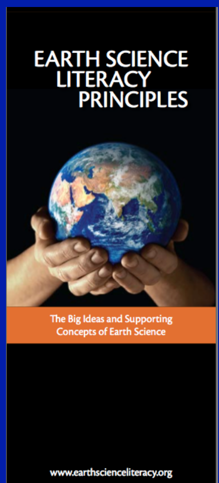
Suspended clay particles, eroded from the Cascade Mountains of Washington State, give Lake Diablo its brilliant color. The active volcanoes of the Cascades result from the subduction of the Juan de Fuca plate beneath North America. (Courtesy of Nicole LaDue)

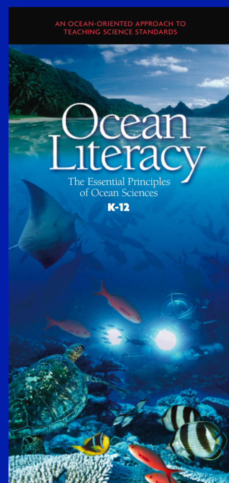
4.7 **Landscapes result from the dynamic interplay between processes that form and uplift new crust and processes that destroy and depress the crust.** This interplay is affected by gravity, density differences, plate tectonics, climate, water, the actions of living organisms, and the resistance of Earth materials to weathering and erosion.

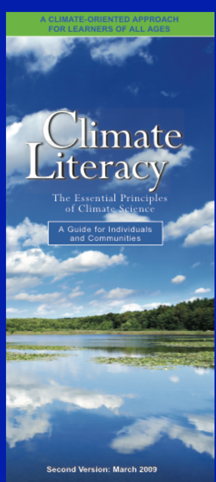
4.8 **Weathered and unstable rock materials erode from some parts of Earth's surface and are deposited in others.** Under the influence of gravity, rocks fall downhill. Water, ice, and air carry eroded sediments to lower elevations, and ultimately to the ocean.

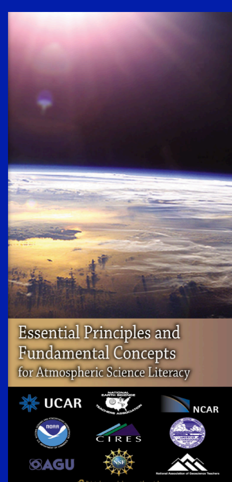
4.9 **Shorelines move back and forth across continents, depositing sediments that become the surface rocks of the land.** Through dynamic processes of plate tectonics and glaciation, Earth's sea level rises and falls by up to hundreds of meters. This fluctuation causes shorelines to advance and recede by hundreds of kilometers. The upper rock layers of most continents formed when rising sea levels repeatedly flooded the interiors of continents.

Four Geoscience Literacy Documents

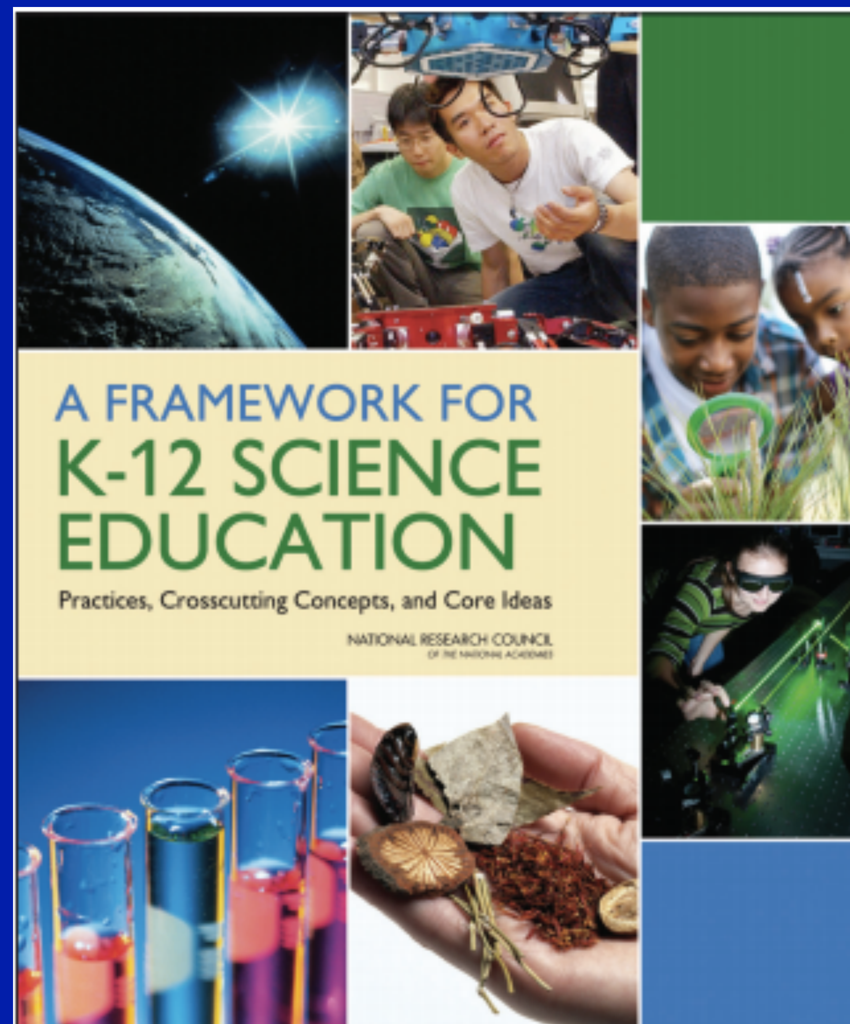








The Framework for new K-12 National Science Standards



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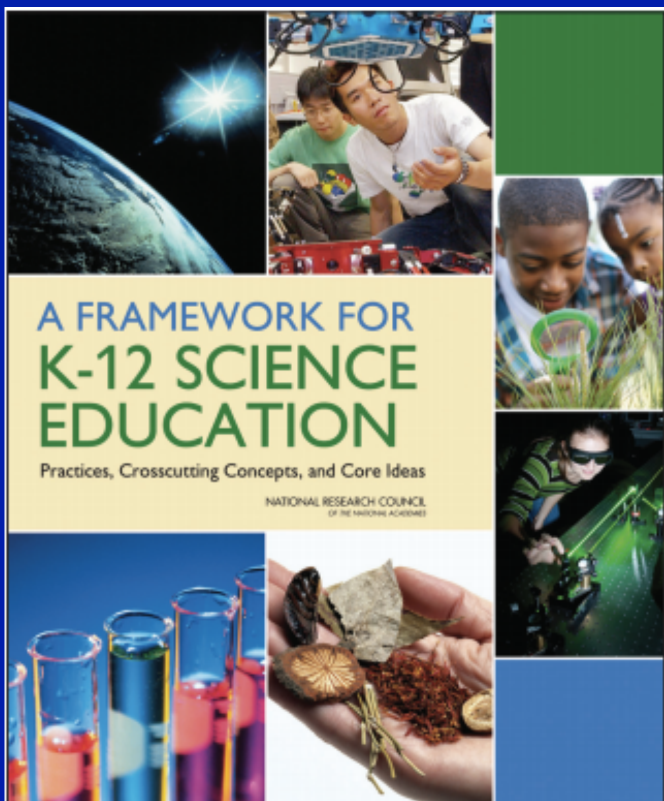
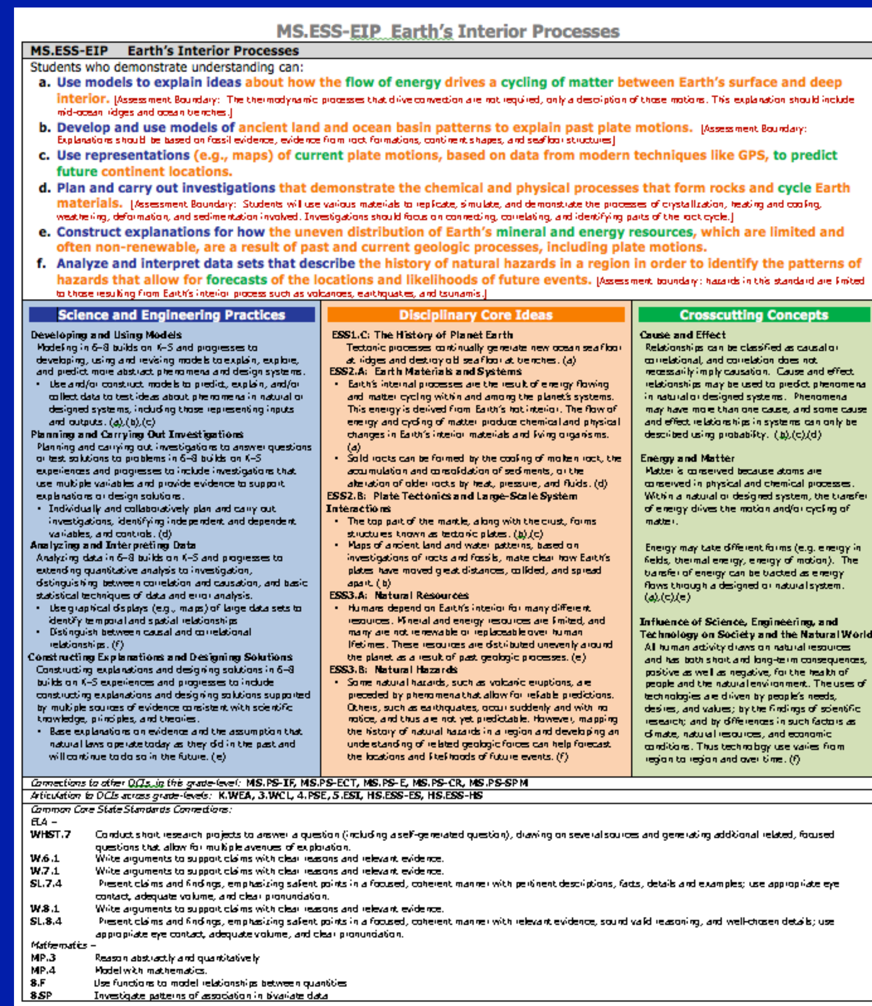
The Framework for new K-12 National Science Standards

The Next Generation Science Standards





MS.ESS-EIP Earth's Interior Processes

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Students who demonstrate understanding can:

a. **Use models to explain ideas about how the flow of energy drives a cycling of matter between Earth's surface and deep interior.** [Assessment Boundary: The thermodynamic processes that drive convection are not required, only a description of those motions. This explanation should include mid-ocean ridges and ocean trenches.]

b. **Develop and use models of ancient land and ocean basin patterns to explain past plate motions.** [Assessment Boundary: Explanations should be based on fossil evidence, evidence from rock formations, continent shapes, and seafloor structures]

c. **Use representations (e.g., maps) of current plate motions, based on data from modern techniques like GPS, to predict future continent locations.**

d. **Plan and carry out investigations that demonstrate the chemical and physical processes that form rocks and cycle Earth materials.** [Assessment Boundary: Students will use various materials to replicate, simulate, and demonstrate the processes of crystallization, heating and cooling, weathering, deformation, and sedimentation involved. Investigations should focus on connecting, correlating, and identifying parts of the rock cycle.]

e. **Construct explanations for how the uneven distribution of Earth's mineral and energy resources, which are limited and often non-renewable, are a result of past and current geologic processes, including plate motions.**

f. **Analyze and interpret data sets that describe the history of natural hazards in a region in order to identify the patterns of hazards that allow for forecasts of the locations and likelihoods of future events.** [Assessment boundary: hazards in this standard are limited to those resulting from Earth's interior process such as volcanoes, earthquakes, and tsunamis.]

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems.
- Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs. (a),(b),(c)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
- Individually and collaboratively plan and carry out investigations, identifying independent and dependent variables, and controls. (d)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigation, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Use graphical displays (e.g., maps) of large data sets to identify temporal and spatial relationships
- Distinguish between causal and correlational relationships. (f)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.
- 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. (e)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth
Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. (a)

ESS2.A: Earth Materials and Systems
- Earth's internal processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from Earth's hot interior. The flow of energy and cycling of matter produce chemical and physical changes in Earth's interior materials and living organisms. (a)
- Solid rocks can be formed by the cooling of molten rock, the accumulation and consolidation of sediments, or the alteration of older rocks by heat, pressure, and fluids. (d)

ESS2.B: Plate Tectonics and Large-Scale System Interactions
- The top part of the mantle, along with the crust, forms structures known as tectonic plates. (b),(c)
- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (b)

ESS3.A: Natural Resources
- Humans depend on Earth's interior for many different resources. Mineral and energy resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (e)

ESS3.B: Natural Hazards
- Some natural hazards, such as volcanic eruptions, are preceded by phenomena that allow for reliable predictions. Others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. However, mapping the history of natural hazards in a region and developing an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (f)

Crosscutting Concepts

Cause and Effect
Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (b),(c),(d)

Energy and Matter
Matter is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system. (a),(c),(e)

Influence of Science, Engineering, and Technology on Society and the Natural World
All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies are driven by people's needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (f)

Connections to other DCIs in this grade-level: **MS.PS-IF, MS.PS-ECT, MS.PS-E, MS.PS-CR, MS.PS-SPM**

Articulation to DCIs across grade-levels: **K.WEA, 3.WCL, 4.PSE, 5.ESI, HS.ESS-ES, HS.ESS-HS**

Common Core State Standards Connections:

ELA –

WHST.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
W.6.1	Write arguments to support claims with clear reasons and relevant evidence.
W.7.1	Write arguments to support claims with clear reasons and relevant evidence.
SL.7.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
W.8.1	Write arguments to support claims with clear reasons and relevant evidence.
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Mathematics –

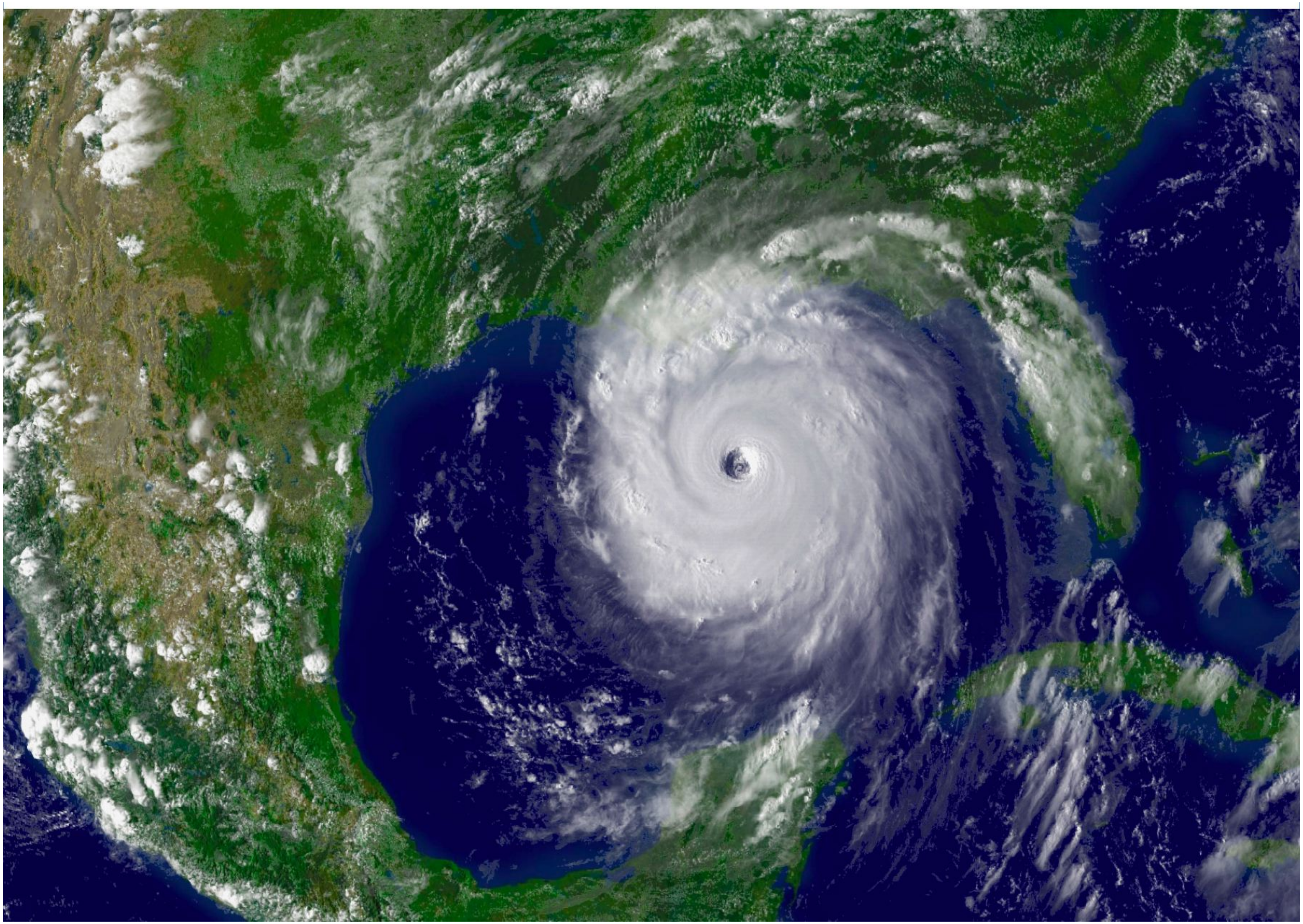
MP.3	Reason abstractly and quantitatively
MP.4	Model with mathematics.
8.F	Use functions to model relationships between quantities
8.SP	Investigate patterns of association in bivariate data

What's New in the "Conceptual Framework" (and therefore in the NGSS)

- Content that is shorter but deeper
- Fewer factoids; More process
- Greater integration across grade levels
- Greater integration among the sciences
- Greater integration with engineering and technology
- Greater integration of and focus on human-related content

Big Idea #7: Humans depend on Earth for resources.

Big Idea #8: Natural hazards pose risks to humans.



Big Idea #9: Humans significantly alter the Earth.

Statement of Task for "Conceptual Framework:"

- Identify a small set of (1) Core Ideas in each of the 4 areas.

Statement of Task for "Conceptual Framework:"

- Identify a small set of (1) Core Ideas in each of the 4 areas.
- Identify the key (2) Cross-Cutting Elements.

Cross-Cutting Elements

- Patterns
- Cause and Effect: Mechanism and Prediction
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter: Flows, Cycles, and Conservation
- Structure and Function
- Stability and Change
- Interdependence of Science, Engineering, and Technology
- Influence of Science, Engineering, and Technology on Society and the Natural World

Statement of Task for "Conceptual Framework:"

- Identify a small set of (1) Core Ideas in each of the 4 areas.
- Identify the key (2) Cross-Cutting Elements.
- Identify the major (3) Scientific and Engineering *Practices*.

Scientific and Engineering Practices

- **Asking Questions and Defining Problems**
- **Developing and Using Models**
- **Planning and Carrying Out Investigations**
- **Analyzing and Interpreting Data**
- **Using Mathematics and Computational Thinking**
- **Constructing Explanations and Designing Solutions**
- **Engaging in Argument from Evidence**
- **Obtaining, Evaluating, and Communicating Information**

The Practices (and Cross-Cutting Concepts) progress across Grade Bands:

Ex/ Developing and Using Models:

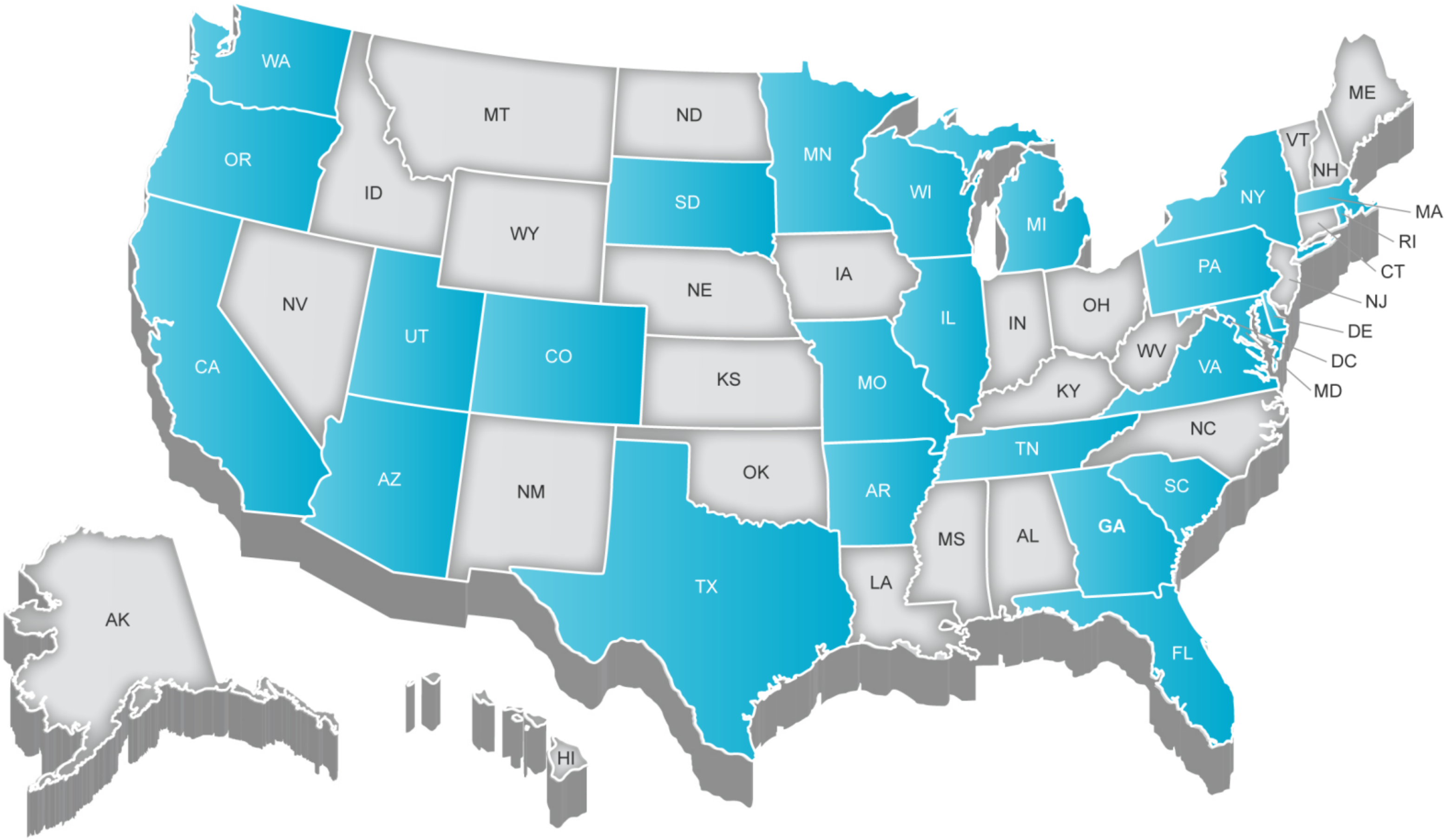
NGSS Science and Engineering Practices* (DRAFT 03/04/2012 Please Do Not Distribute)

Science Engineering Practices	K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
Developing and Using Models Science and engineering use and construct models. The models are used as helpful tools for thinking and representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.	Modeling in K–2 builds on prior experiences and progresses to include identifying, using, and developing models that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and/or use models (i.e., diagrams, drawings, or physical replicas) that represent amounts, relative scales (bigger, smaller) and patterns.	Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to elaborate on events and design solutions. • Collaboratively construct and revise models to measure frequent and regular events. • Construct a model using an analogy or abstract representation to explain a scientific principle or design solution. • Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. • Identify limitations of models.	Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems. • Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs. • Pose models to describe mechanisms at unobservable scales. • Modify models – based on their limitations – to increase detail or clarity, or to explore what will happen if a component is changed. • Use and construct models of simple systems with uncertain and less predictable factors.	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and constructing models to predict and explain relationships between systems and their components in the natural and designed world. • Represent and explain phenomena with multiple types of models and move flexibly between model types based on merits and limitations. • Construct, revise, and use models to predict and explain relationships between systems and their components. • Use models (including mathematical, computational) to generate data to explain and predict phenomena, analyze systems, and solve problems. • Design a test of a model to ascertain its reliability. • Examine merits and limitations of various models in order to select or revise a model that best fits the evidence or the design criteria.

Statement of Task for "Conceptual Framework:"

- Identify a small set of (1) Core Ideas in each of the 4 areas.
- Identify the key (2) Cross-Cutting Elements.
- Identify the major (3) Scientific and Engineering *Practices*.
- Identify how these core ideas, cross-cutting ideas, and practices intersect for 4 grade level bands.

NGSS Writing Team Members

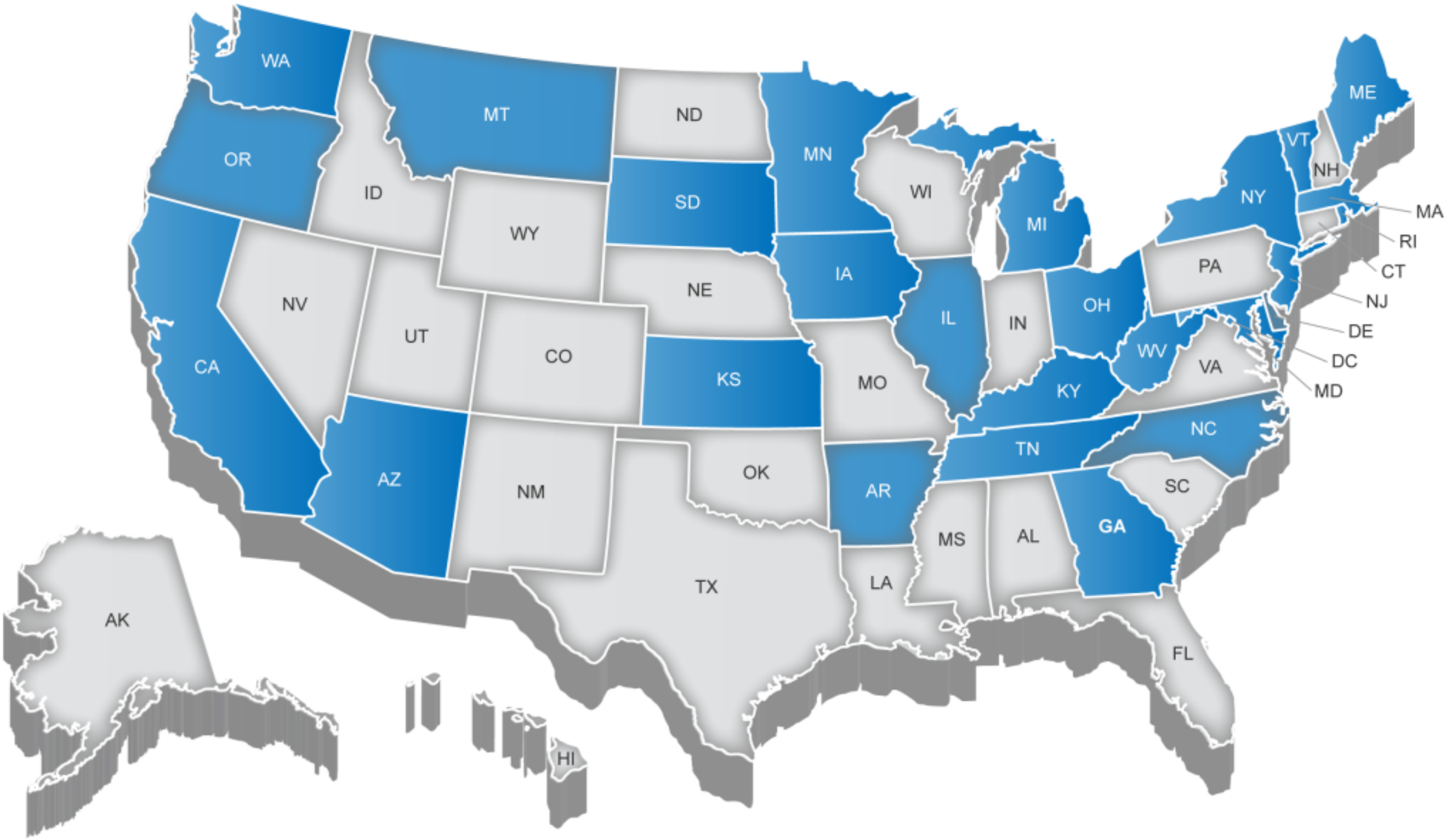


NEXT GENERATION
SCIENCE
STANDARDS

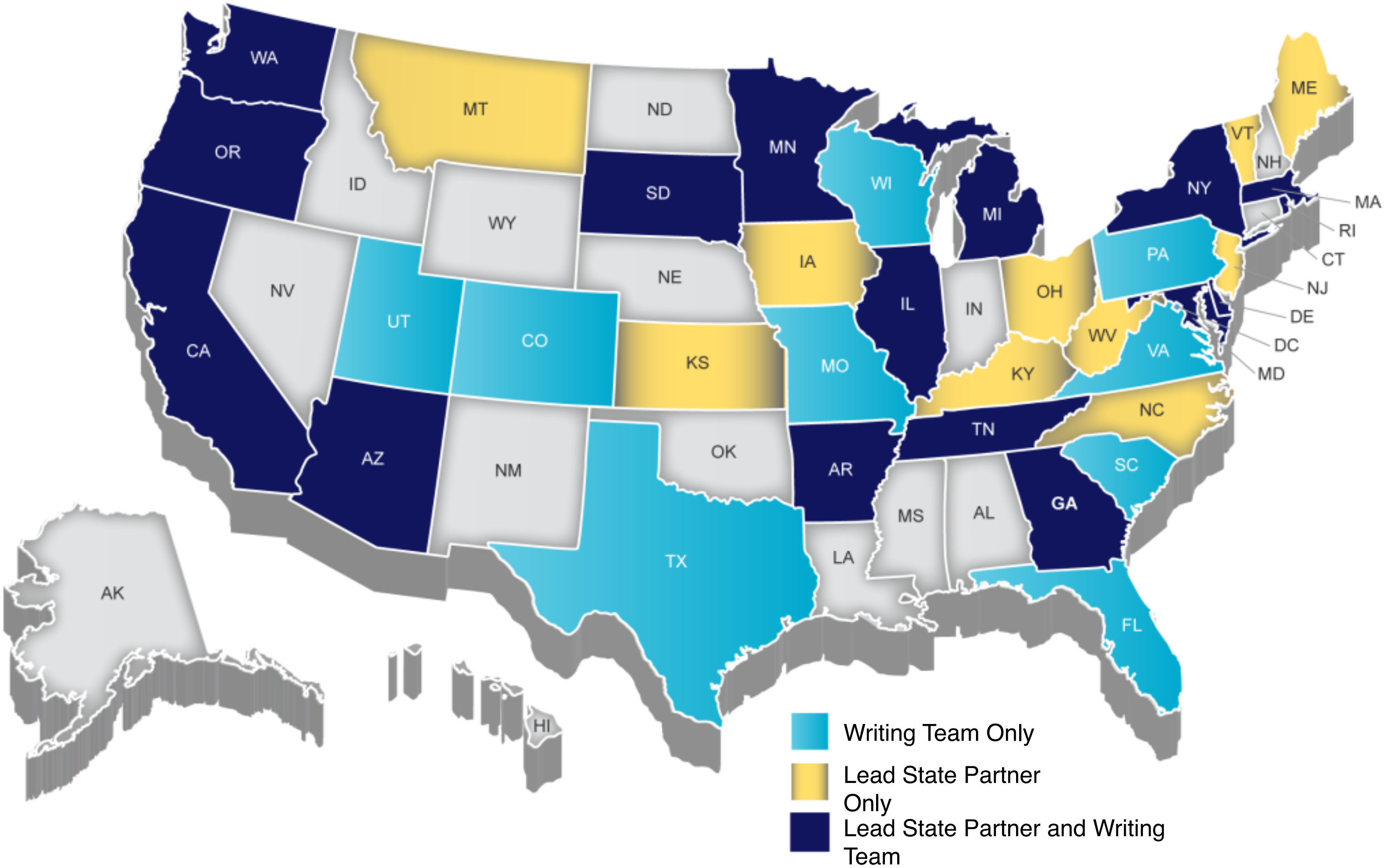
Lead State Partners

- Arizona
- Arkansas
- California
- Delaware
- Georgia
- Illinois
- Iowa
- Kansas
- Kentucky
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Montana
- New Jersey
- New York
- North Carolina
- Ohio
- Oregon
- Rhode Island
- South Dakota
- Tennessee
- Vermont
- Washington State
- West Virginia

Lead State Partners



Lead State Partners and NGSS Writing Team



Critical Stakeholders

The Critical Stakeholders are distinguished individuals and organizations that represent education, science, business and industry and who have interest in the Next Generation Science Standards. The members are drawn from all 50 states and have expertise in:

- –Elementary, middle and high school science from both urban and rural communities
- –Special education and English language acquisition
- –Postsecondary education
- –State standards and assessments
- –Cognitive science, life science, physical science, earth/space science, and engineering/technology
- –Mathematics and Literacy
- –Business and industry
- –Workforce development
- –Education policy

- The Critical Stakeholders will critique successive, confidential drafts of the standards and provide feedback to the writers and states, giving special attention to their areas of expertise.

NEXT GENERATION SCIENCE STANDARDS

Public Feedback

- The first public draft of the standards was available in May, 2012.
- The second public draft will come out in December, 2012.
- Target is to have final standards by March, 2013.

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Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigation, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Use graphical displays (e.g., maps) of large data sets to identify temporal and spatial relationships
- Distinguish between causal and correlational relationships. (f)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- 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. (e)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (a)

ESS2.A: Earth Materials and Systems

- Earth's internal processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from Earth's hot interior. The flow of energy and cycling of matter produce chemical and physical changes in Earth's interior materials and living organisms. (a)
- Solid rocks can be formed by the cooling of molten rock, the accumulation and consolidation of sediments, or the alteration of older rocks by heat, pressure, and fluids. (d)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The top part of the mantle, along with the crust, forms structures known as tectonic plates. (b),(c)
- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (b)

ESS3.A: Natural Resources

- Humans depend on Earth's interior for many different resources. Mineral and energy resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (e)

ESS3.B: Natural Hazards

- Some natural hazards, such as volcanic eruptions, are preceded by phenomena that allow for reliable predictions. Others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. However, mapping the history of natural hazards in a region and developing an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (f)

Crosscutting Concepts

Patterns

- Patterns can be analyzed to develop explanations in natural and designed systems. (b) (e)

Cause and Effect

- Evidence is used to support claims about cause and effect relationships and their mechanisms. (d)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (c)

Energy and Matter in Systems

- Within a natural or designed system, the flow of energy drives the motion and/or cycling of matter. (a)

Interdependence of Science, Engineering, and Technology

- New discoveries in science have enabled the development of new technologies and in some cases, entirely new industries. (f)

HS.ESS-CC Climate Change

How to read the standards »

Go to the NGSS Survey

Views: Black and white / Practices and Core Ideas / Practices and Crosscutting Concepts / PDF

Students who demonstrate understanding can:

a. **Evaluate and communicate the climate changes that can occur when certain components of the climate system are altered. [Clarification Statement: For example, evaluate variations in incoming solar radiation as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems.]**

b. **Construct a scientific argument showing that changes to any one of many different Earth and Solar System processes can affect global and regional climates. [Clarification Statement: Examples of these processes include the sun's energy output, Earth's orbit and axis orientation, tectonic events, ocean circulation, volcanic activity, glacial activity, the biosphere, and human activities.] [*Assessment Boundary: Use evidence from the geologic record only.*]**

c. **Analyze geologic evidence that past climate changes have occurred over a wide range of time scales. [Clarification Statement: Examples of evidence are ice core data, the fossil record, sea level fluctuations, glacial features.]**

d. **Engage in critical reading of scientific literature about causes of climate change over 10s-100s of years, 10s-100s of thousands of years, or 10s-100s of millions of years. [Clarification Statement: Examples of causes are changes in solar output, ocean circulation, volcanic activity (10s-100s of years); changes to Earth's orbit and the orientation of its axis (10s-100s of thousands of years); or long-term changes in atmospheric composition (10s-100s of millions of years).]**

e. **Use global climate models in combination with other geologic data to predict and explain how human activities and natural phenomena affect climate, providing the scientific basis for planning for humanity's future needs. [Clarification Statement: For example, use global climate models together with topographic maps to investigate effects of sea level change or combine global climate models with precipitation maps to investigate locations where new water supplies will be needed.]**

f. **Apply scientific knowledge to investigate how humans may predict and modify their impacts on future global climate systems (e.g., investigating the feasibility of geoengineering design solutions to global temperature changes).**

g. **Use models of the flow of energy between the sun and Earth's atmosphere and surface to explain how different wavelengths of energy are absorbed and retained by various greenhouse gases in Earth's atmosphere, thereby affecting Earth's radiative balance. [Clarification Statement: Students will work with absorption spectra of different Earth materials.]**

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 9–12 builds on K–8 and progresses to using, synthesizing, and constructing models to predict and explain relationships between systems and their components in the natural and designed world. • Use models (including mathematical and computational) to generate data to explain and predict phenomena, analyze systems, and solve problems. (g)	**ESS2.D: Weather and Climate** • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Climate change can occur when certain parts of these systems are altered. (a) • The geological record shows that changes to global and regional climate can be caused by	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. Systems can be designed to cause a desired effect. Changes in systems may have various causes that may not have

What's New for Earth Science?

- New Content, based on Community Literacy Frameworks

Earth and Space Sciences

CORE IDEA 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

CORE IDEA 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

CORE IDEA 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

What's New for Earth Science?

- New Content, based on Community Literacy Frameworks
- Closer Integration with Engineering and Technology

What's New for Earth Science?

- New Content, based on Community Literacy Frameworks
- Closer Integration with Engineering and Technology
- One full year of instruction in *EACH* of Middle School and High School (*There may be different models for how this happens*)

Elementary Standards, Grades K - 5

Instructions: The grades K - 5 standards are listed below by topic. Each topic name is a hyperlink to the interactive display of this standard on the NGSS website. To view a standard online, click on the highlighted text.

To review and provide feedback on standards, check the box(es) next to the topic name(s) shown in the list below that you would like to review. You may select one or multiple topic names. Once you've made your selection, click the "NEXT" button on the bottom right of the screen just outside the window. Use the "NEXT" and "PREVIOUS" buttons on the bottom right of the screen to move forward and backward through the feedback pages. When you have finished providing feedback, follow the directions at the End of Survey to submit your answers.

Grades K - 2

- ☐ K.OTE Organisms and Their Environments
- ☐ K.SPM Structure and Properties of Matter
- ☐ K.WEA Weather
- ☐ 1.SF Structure and Function
- ☐ 1.LS Light and Sound
- ☐ 1.PC Patterns and Cycles
- ☐ 2.ECS Earth's Changing Surface
- ☐ 2.SPM Structures, Properties and Interactions of Matter
- ☐ 2.IOS Interdependence of Organisms and Their Surroundings
- ☐ 2.PP Pushes and Pulls

Grade 3

- ☐ 3.WCI Weather, Climate and Impacts
- ☐ 3.EIO Environmental Impacts on Organisms
- ☐ 3.SFS Structure, Function and Stimuli
- ☐ 3.IF Interactions of Forces

Grade 4

- ☐ 4.LCT Life Cycles and Traits
- ☐ 4.PSE Processes that Shape the Earth
- ☐ 4.E Energy
- ☐ 4.WAV Waves

Grade 5

- ☐ 5.SPM Structures, Properties and Interactions of Matter
- ☐ 5.MEE Matter and Energy in Ecosystems
- ☐ 5.ESI Earth's Systems and Their Interactions
- ☐ 5.SSS Stars and the Solar System

Middle School Standards, Grades 6 - 8

Instructions: The grades 6 - 8 standards are listed below by topic. Each topic name is a hyperlink to the interactive display of this standard on the NGSS website. To view a standard online, click on the highlighted text.

To review and provide feedback on standards, check the box(es) next to the topic name(s) shown in the list below that you would like to review. You may select one or multiple topic names. Once you've made your selection, click the "NEXT" button on the bottom right of the screen just outside the window. Use the "NEXT" and "PREVIOUS" buttons on the bottom right of the screen to move forward and backward through the feedback pages. When you have finished providing feedback, follow the directions at the End of Survey to submit your answers.

Physical Sciences

- ☐ MS.PS-SPM Structure and Properties of Matter
- ☐ MS.PS-CR Chemical Reactions
- ☐ MS.PS-FM Forces and Motion
- ☐ MS.PS-IF Interactions of Forces
- ☐ MS.PS-E Energy
- ☐ MS.PS-WER Waves and Electromagnetic Radiation

Life Sciences

- ☐ MS.LS-SFIP Structure, Function and Information Processing
- ☐ MS.LS-GDRO Growth, Development and Reproduction of Organisms
- ☐ MS.LS- MEOE Matter and Energy in Organisms and Ecosystems
- ☐ MS.LS-IRE Interdependent Relationships in Ecosystems
- ☐ MS.LS-NSA Natural Selection and Adaptations

Earth and Space Sciences

- ☐ MS.ESS-SS Space Systems
- ☐ MS.ESS-HE History of Earth
- ☐ MS.ESS-EIP Earth's Interior Processes
- ☐ MS.ESS-ESP Earth's Surface Processes
- ☐ MS.ESS-WC Weather and Climate
- ☐ MS.ESS-HI Human Impacts

Engineering, Technology and Applications of Science

- ☐ MS.ETS-ED Engineering Design
- ☐ MS.ETS-ETSS Links Among Engineering, Technology, Science and Society

NEXT GENERATION SCIENCE STANDARDS

Directions for Navigating Between This Survey and External Websites

This survey contains links to external websites with relevant information (i.e., the NRC *Framework for K - 12 Science Education* and the NGSS website). Keep the webpage for this survey open while you are actively providing feedback. To return to this survey after viewing other websites, click the tab at the top of the browser for this page, or close the pages to the other websites.

High School Standards, Grades 9 - 12

Instructions: The grades 9 - 12 standards are listed below by topic. Each topic title is a hyperlink to the interactive display of this standard on the NGSS website. To view a standard online, click on the highlighted text.

To review and provide feedback on standards, check the box(es) next to the topic name(s) shown in the list below that you would like to review. You may select one or multiple topic names. Once you've made your selection, click the "NEXT" button on the bottom right of the screen just outside the window. Use the "NEXT" and "PREVIOUS" buttons on the bottom right of the screen to move forward and backward through the feedback pages. When you have finished providing feedback, follow the directions at the End of Survey to submit your answers.

Physical Sciences

- ☐ HS.PS-SPM Structure and Properties of Matter
- ☐ HS.PS-CR Chemical Reactions
- ☐ HS.PS-NP Nuclear Processes
- ☐ HS.PS-FM Forces and Motion
- ☐ HS.PS-IF Interactions of Forces
- ☐ HS.PS-E Energy
- ☐ HS.PS-FE Forces and Energy
- ☐ HS.PS-W Waves
- ☐ HS.PS-ER Electromagnetic Radiation

Life Sciences

- HS.LS-SFIP Structure, Function and Information Processing
- HS.LS-IVT Inheritance and Variation of Traits
- HS.LS- MEOE Matter and Energy in Organisms and Ecosystems
- HS.LS-IRE Interdependent Relationships in Ecosystems
- HS.LS-NSE Natural Selection and Evolution

Earth and Space Sciences

- HS.ESS-SS Space Systems
- HS.ESS-HE History of Earth
- HS.ESS-ES Earth's Systems
- HS.ESS-CC Climate Change
- HS.ESS-HS Human Sustainability

Engineering, Technology and Applications of Science

- HS.ETS-ED Engineering Design
- HS.ETS-ETSS Links Among Engineering, Technology, Science and Society

Click on the button below to close this section of the survey without submitting your responses.

Close

Survey Completion

0% 100%

How to Read the Next Generation Science Standards

NGSS Survey Table of Contents

NGSS Survey - Feedback on Individual High School Standards, Grades 9 - 12

NEXT

Challenges:

- Greater emphasis on integration of science practices with science content → ***Assessment***

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Challenges:

- Greater emphasis on integration of science practices with science content → ***Assessment***
- New content (e.g., greater emphasis on human connections, engineering, and technology; greater emphasis on integration between sciences (i.e., *cross-cutting concepts*) and with math and ELA) → ***Professional Development***
- Inclusion of a year of Earth & Space Science in high school → ***Number of years of high school science***

Number of Years of High School Science Required:

	1987	1996	2006	2008
Local Decision	6	7	6	6
1 – 2 Years	40	33	16	13
3 Years	3	8	27	27
4 Years	0	2	1	4

Local decision means that graduation requirements are set by local districts and may vary within a state.

In 2008, all states with statewide requirements required ≥2 years of mathematics courses; only one state (Illinois) required 1 year of science.

NOTES: Data include Washington, DC. Column totals do not add to 51 because certain states did not participate in Council of Chief State School Officers (CCSSO) survey that year or used a different credit reporting system. (1987 – leaves off Vermont and Arkansas, which both required 5 total math or science years; 1996 – still leaves off Vermont for the same reason; includes DC)

SOURCES: CCSSO, Key State Education Policies on PK-12 Education: 2008 (2009); Snyder TD, Digest of Education Statistics 1988, NCES 88-600 (1988); and Snyder TD, Digest of Education Statistics 1998, NCES 1999-036 (1999).

Challenges:

- Greater emphasis on integration of science practices with science content → ***Assessment***
- New content (e.g., greater emphasis on human connections, engineering, and technology; greater emphasis on integration between sciences (i.e., *cross-cutting concepts*) and with math and ELA) → ***Professional Development***
- Inclusion of a year of Earth & Space Science in high school → ***Number of years of high school science***
- Question as to how to handle Earth & Space Science in high school → ***Separate course, modules within Bio/Chem/Phys, or Integrated Science Curriculum***