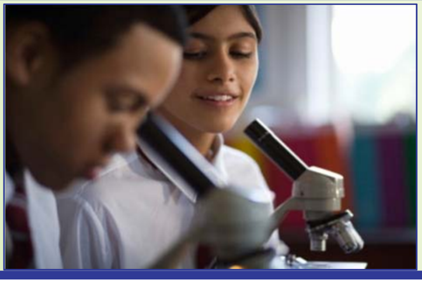
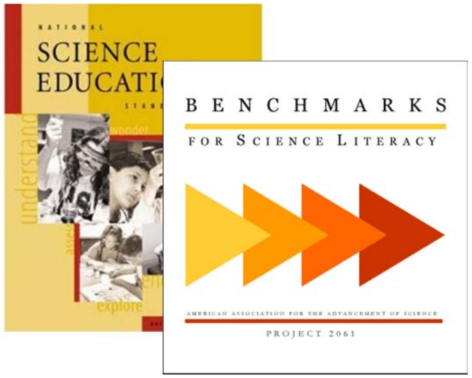
Next Generation Science Standards

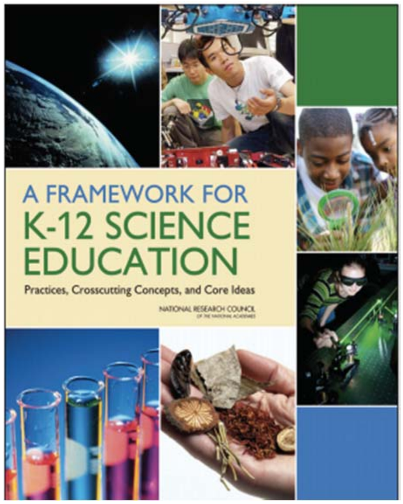
Building on the Past; Preparing for the Future





1990s

Phase I



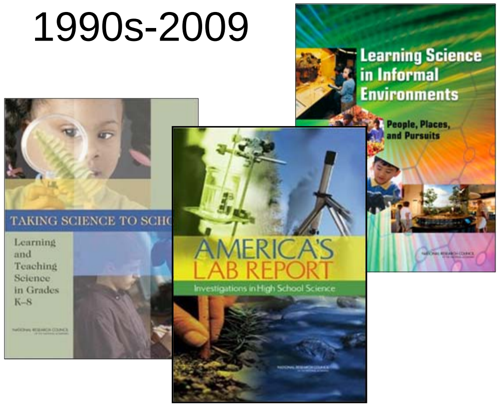
1/2010 - 7/2011

Phase II

NEXT GENERATION SCIENCE STANDARDS

7/2011 – 12/2012

1990s-2009



NEXT GENERATION SCIENCE STANDARDS

Digging Deeper into the *Framework for K – 12 Science Education*

Principles of the Framework

- Children are born investigators
- Understanding builds over time
- Science and Engineering require both knowledge and practice
- Connecting to students' interests and experiences is essential
- Focusing on core ideas and practices
- Promoting equity

NEXT GENERATION SCIENCE STANDARDS

Dimensions of the Framework

- Science and Engineering Practice
- Crosscutting Concepts
- Disciplinary Core Ideas

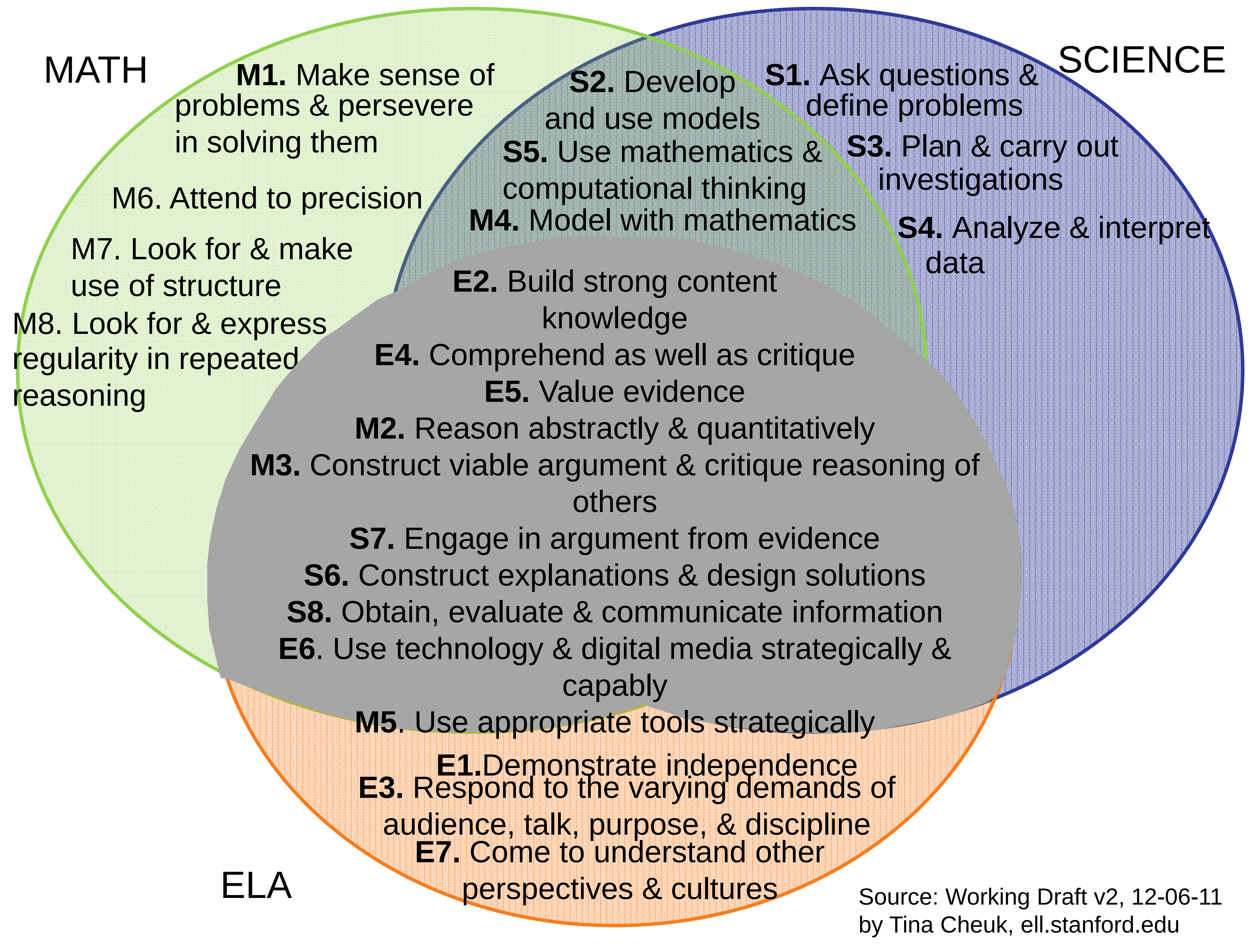
NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

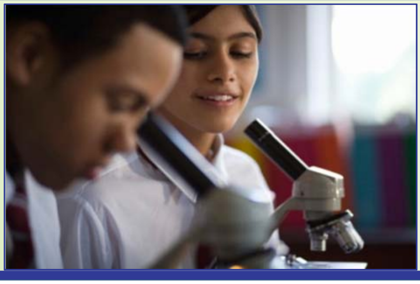
1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Framework 3-28 to 31

NEXT GENERATION SCIENCE STANDARDS


MATH
SCIENCE
ELA
M1. Make sense of problems & persevere in solving them
M6. Attend to precision
M7. Look for & make use of structure
M8. Look for & express regularity in repeated reasoning
S2. Develop and use models
S5. Use mathematics & computational thinking
M4. Model with mathematics
S1. Ask questions & define problems
S3. Plan & carry out investigations
S4. Analyze & interpret data
E2. Build strong content knowledge
E4. Comprehend as well as critique
E5. Value evidence
M2. Reason abstractly & quantitatively
M3. Construct viable argument & critique reasoning of others
S7. Engage in argument from evidence
S6. Construct explanations & design solutions
S8. Obtain, evaluate & communicate information
E6. Use technology & digital media strategically & capably
M5. Use appropriate tools strategically
E1.Demonstrate independence
E3. Respond to the varying demands of audience, talk, purpose, & discipline
E7. Come to understand other perspectives & cultures
Source: Working Draft v2, 12-06-11
by Tina Cheuk, ell.stanford.edu

Crosscutting Concepts



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

Framework 4-1

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas

A core idea for K-12 science instruction is a scientific idea that:

- Has broad importance across multiple science or engineering disciplines or is a key organizing concept of a single discipline
- Provides a key tool for understanding or investigating more complex ideas and solving problems
- Relates to the interests and life experiences of students or can be connected to societal or personal concerns that require scientific or technical knowledge
- Is teachable and learnable over multiple grades at increasing levels of depth and sophistication

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas: Physical Sciences

- PS1 Matter and its interactions
- PS2 Motion and stability: Forces and interactions
- PS3 Energy
- PS4 Waves and their applications in technologies for information transfer

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas:
Life Sciences

- LS1 From molecules to organisms: Structures and processes
- LS2 Ecosystems: Interactions, energy, and dynamics
- LS3 Heredity: Inheritance and variation of traits
- LS4 Biological evolution: Unity and diversity

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas: Earth and Space Sciences

- ESS1 Earth's place in the universe
- ESS2 Earth's systems
- ESS3 Earth and human activity

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas: Engineering, Technology and Applications of Science

- ETS1 Engineering design
- ETS2 Links among engineering, technology, science and society

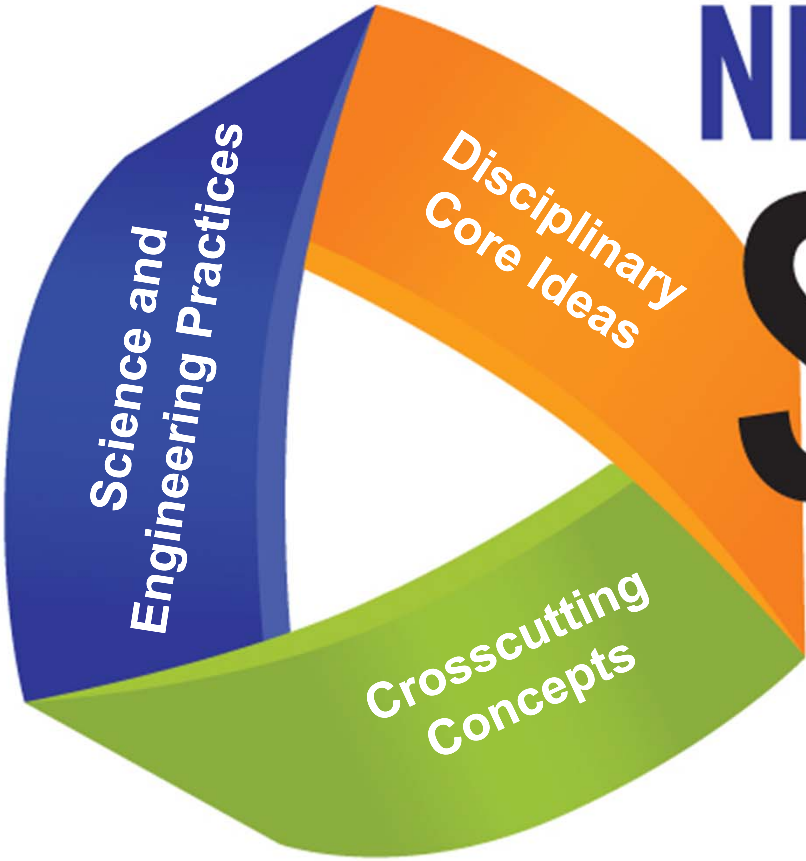
Process for Development of *Next Generation Science Standards*

States and other key stakeholders are engaged in the development and review of the new college and career ready science standards

- State Led Process
- Writing Teams
- Critical Stakeholder Team
- Achieve is managing the development process

NRC Study Committee members to check the fidelity of standards based on framework

NEXT GENERATION SCIENCE STANDARDS



NEXT GENERATION SCIENCE STANDARDS

Performance Expectations

MS.PS-SPM Structure and Properties of Matter

MS.PS-SPM Structure and Properties of Matter
Students who demonstrate understanding can: **a. Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.** [Clarification Statement: Examples of atoms combining can include Hydrogen (H_2) and Oxygen (O_2) combining to form hydrogen peroxide (H_2O_2) or water (H_2O).] [Assessment Boundary: Valence electrons and bonding energy are not addressed.]

NEXT GENERATION SCIENCE STANDARDS

MS.PS-SPM Structure and Properties of Matter

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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 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)	**PS1.A: Structure and Properties of Matter** ▪ All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (a) ▪ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (a)	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data. (a)

Foundation Boxes

Language was based on Framework and expanded into Matrices

NRC Framework language from Grade Band Endpoints

Language was based on Framework and expanded into Matrices

NEXT GENERATION SCIENCE STANDARDS

Performance Expectations

Foundation Boxes

Connection Boxes

MS.PS-SPM Structure and Properties of Matter

MS.PS-SPM Structure and Properties of Matter

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Connections to other DCIs in this grade-level: **MS.ESS-ESP, MS.ESS-SS, MS.LS-MEOE**

Articulation of DCIs across grade-levels: **3.IF, 5.SPM, HS.PS.SPM, HS.PS-NP, HS.PS-E**

Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]

ELA –

W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

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.5.4 Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

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.

WHST.6-8.1 Write arguments focused on discipline-specific content.

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Mathematics –

MP.4 Model with mathematics.

MP.8 Look for and express regularity in repeated reasoning.

6.SP Develop understanding of statistical variability

Summarize and describe distributions

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices Matrix

Science Engineering Practices	K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
Constructing Explanations and Designing Solutions *The products of science are explanations and the products of engineering are solutions.* The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence in constructing explanations and designing solutions. • Use information from observations to construct explanations about investigations. • Use tools and materials provided to design a solution to a specific problem.	Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions. • Use quantitative relationships to construct explanations for observed events. • Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. • Distinguish evidence-based explanations from non-evidence based explanations. • Apply scientific knowledge to solve design problems.	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. • Use qualitative and quantitative relationships between variables to construct explanations for phenomena. • Apply scientific reasoning to link evidence to claims and show why the data is adequate for the explanation or conclusion. • Generate and revise causal explanations from data (e.g., observations, sources of reliable information) and relate these explanations to current knowledge. • 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. • Undertake design projects, engaging in the design cycle, to construct and implement a solution that meets specific design criteria and constraints. • Apply scientific knowledge to explain real-world examples or events and solve design problems. • Construct explanation from models or representations.	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent sources of evidence consistent with scientific knowledge, principles, and theories. • Make quantitative claims regarding the relationship between dependent and independent variables. • Apply scientific reasoning, theory, and models to link evidence to claims and show why the data is adequate for the explanation or conclusion. • Construct and revise explanations and arguments based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories) and peer review. • Base casual explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. • Apply scientific knowledge to solve design problems by taking into account possible unanticipated effects.

NEXT GENERATION SCIENCE STANDARDS

Crosscutting Concepts Matrix

2. *Cause and Effect: Mechanism and Prediction* – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.			
K-2 Crosscutting Statements	**3-5 Crosscutting Statements**	**6-8 Crosscutting Statements**	**9-12 Crosscutting Statements**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes.	Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship.	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.	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 equal effects.

3. *Scale, Proportion, and Quantity* – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.			
K-2 Crosscutting Statements	**3-5 Crosscutting Statements**	**6-8 Crosscutting Statements**	**9-12 Crosscutting Statements**
Relative scales allow objects to be compared and described (e.g. bigger and smaller; hotter and colder; faster and slower). Standard units are used to measure length.	Natural objects and observable phenomena exist from the very small to the immensely large. Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. The observed function of natural and designed systems may change with scale. Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. Scientific relationships can be represented through the use of algebraic expressions and equations.	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Patterns observable at one scale may not be observable or exist at other scales. Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g. linear growth vs. exponential growth).

Connections to Engineering, Technology, and Applications of Science Matrix

1. Interdependence of Science, Engineering, and Technology –The fields of science and engineering are mutually supportive. Advances in science offer new capabilities, new materials, or new understandings that can be applied through engineering to produce advances in technology. Advances in technology by engineers, in turn, provide scientists with new capabilities to probe the natural world.			
K-2 Crosscutting Statements	**3-5 Crosscutting Statements**	**6-8 Crosscutting Statements**	**9-12 Crosscutting Statements**
Science and engineering involve the use of tools to observe and measure things.	Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.	Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. Science and technology drive each other forward.	Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

2. Influence of Engineering, Technology, and Science on Society and the Natural World – Advances in science and engineering have influenced the ways in which people interact with one another and with their surrounding natural and designed environments. Society's decisions about technology (whether made through market forces or political processes) influence the work of scientists and engineers.			
K-2 Crosscutting Statements	**3-5 Crosscutting Statements**	**6-8 Crosscutting Statements**	**9-12 Crosscutting Statements**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Taking natural materials to make things impacts the environment.	People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.	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. Technology use varies over time and from region to region.	Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

NEXT GENERATION SCIENCE STANDARDS

Conceptual Shifts in the NGSS

1. K–12 Science Education Should Reflect the Real World Interconnections in Science
2. Science and Engineering Practices and Crosscutting Concepts should not be taught in a vacuum; they should always be integrated with multiple core concepts throughout the year.
3. Science concepts build coherently across K-12
4. The NGSS Focus on Deeper Understanding and Application of Content
5. Integration of science and engineering
6. Coordination with Common Core State Standards

NEXT GENERATION SCIENCE STANDARDS

Standards Comparison: Structure and Properties of Matter

Current State Middle School Science Standard

a. Distinguish between atoms and molecules.
b. Describe the difference between pure substances (elements and compounds) and mixtures.
c. Describe the movement of particles in solids, liquids, gases, and plasmas states.
d. Distinguish between physical and chemical properties of matter as physical (i.e., density, melting point, boiling point) or chemical (i.e., reactivity, combustibility).
e. Distinguish between changes in matter as physical (i.e., physical change) or chemical (development of a gas, formation of precipitate, and change in color).
f. Recognize that there are more than 100 elements and some have similar properties as shown on the Periodic Table of Elements.
g. Identify and demonstrate the Law of Conservation of Matter.

NGSS Middle School Sample

a. Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.
b. Plan investigations to generate evidence supporting the claim that one pure substance can be distinguished from another based on characteristic properties.
c. Use a simulation or mechanical model to determine the effect on the temperature and motion of atoms and molecules of different substances when thermal energy is added to or removed from the substance.
d. Construct an argument that explains the effect of adding or removing thermal energy to a pure substance in different phases and during a phase change in terms of atomic and molecular motion.

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NEXT GENERATION SCIENCE STANDARDS

Public Review of the DRAFT Next Generation Science Standards

Details about the Public Release

Goal: To distribute and receive feedback from interested stakeholders; to create a transparent process

- The standards opened for review May 11, 2012.
- The standards and the survey can be accessed at www.nextgenscience.org
- The review period ends on June 1, 2012.

NEXT GENERATION SCIENCE STANDARDS

Organization of the NGSS

Organized by Disciplinary Content

- Physical Science
- Life Science
- Earth-Space Science
- Engineering

K-5

- Grade By Grade
- Engineering concepts are integrated into performance expectations

6-8

- Grade Banded
- Model Pathways to follow the second public draft

9-12

- Grade Banded
- Model Pathways to follow the second public draft

NEXT GENERATION SCIENCE STANDARDS

www.nextgenscience.org

NEXT GENERATION SCIENCE STANDARDS

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CURRENT PHASE

1 2 3

The draft standards are ready for public review

Click here to review the NGSS draft and provide feedback

4 5 6 7 8 9

About NGSS

Next Generation Science Standards for Today's Students and Tomorrow's Workforce: Through a collaborative, state-led process managed by Achieve, new K–12 science standards are being developed that will be rich in content and practice, arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked science education. The NGSS will be based on the *Framework for K–12 Science Education* developed by the National Research Council.

Latest News

The First Public Draft of the NGSS is Ready for Your Review
May 11, 2012

New Poll Shows Strong Support for Improving Science Education
March 30, 2012

Final Print Version of A Framework for K-12 Science Education is Now Available
March 07, 2012

Resources

Watch a webinar about the NGSS

Contact Us | Press | Site Map

The Next Generation Science Standards

The first public draft of the Next Generation Science Standards is available from May 11 to June 1. We welcome and appreciate your feedback.

How to Read the Standards

NGSS May Draft Front Matter

Go to the NGSS Survey / PDF

What's different about the NGSS:

- **Conceptual Shifts in the NGSS**
- **Engineering, Technology, and Applications of Science in the NGSS**
- **The Nature of Science in the NGSS**

College- and Career-Readiness and the NGSS

Diversity and Equity in the NGSS: All Standards, All Students

Public Attitudes Toward Science Standards

Video: Why NGSS?

Practices and Crosscutting Progression Matrices

The NGSS have been written as student performance expectations grouped by topics, and can be viewed in the topical groupings or individually. The draft performance expectations are composed of the three dimensions from the NRC Framework. These draft performance expectations describe how students will demonstrate their understanding. Click on the links to the left to learn more about the standards, and choose one of the buttons below to explore and provide comments on the standards.

Feedback collected during the comment period will be organized and shared with the leading states and writing team members. After the feedback is considered, a feedback report will be issued that will explain how feedback was handled and why.

Search by topic

Search individual perfomance expectations

What's New?

The First Public Draft is Ready for Review!

Click here to read and provide comments on the first of two public drafts of the NGSS

Search by Topics

You can also search for individual performance expectations.

Download a PDF of all performance expectations grouped by topic, or select criteria below to search for individual topic groupings. You can Ctrl+click (cmd+click on Macs) to select or de-select multiple criteria. Note that adding criteria from both categories narrows your results.

Grades

K-2
K
1
2
3-5
3
4
5
Middle School (6-8)

Discipline

Earth and Space Sciences
Engineering, Technology, and Applications of Science
Life Sciences
Physical Sciences

Search

Performance Expectations by Topic

Click on a topic to view associated performance expectations.

Elementary **K-5 Storylines: K-2 3-5**

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 Structure, Properties, and Interactions of Matter
2.IOS Interdependence of Organisms and their Surroundings
2.PP Pushes and Pulls
3.WCI Weather, Climate, and Impacts
3.EIO Environmental Impacts on Organisms
3.SFS Structure, Function, and Stimuli
3.IF Interactions of Forces
4.LCT Life Cycles and Traits
4.PSE Processes that Shape the Earth
4.E Energy
4.WAV Waves
5.SPM Structure, Properties, and Interactions of Matter
5.MEE Matter and Energy in Ecosystems
5.ESI Earth Systems and Their Interactions
5.SSS Stars and the Solar System

Search Performance Expectations

You can also search by topics.

All performance expectations are listed below. To narrow the list displayed, select search criteria. You can Ctrl+click (cmd+click on Macs) to select or de-select multiple criteria. Note that adding criteria from multiple categories narrows your results.

Views: Black and white / Practices and Core Ideas / Practices and Crosscutting Concepts / Print this page

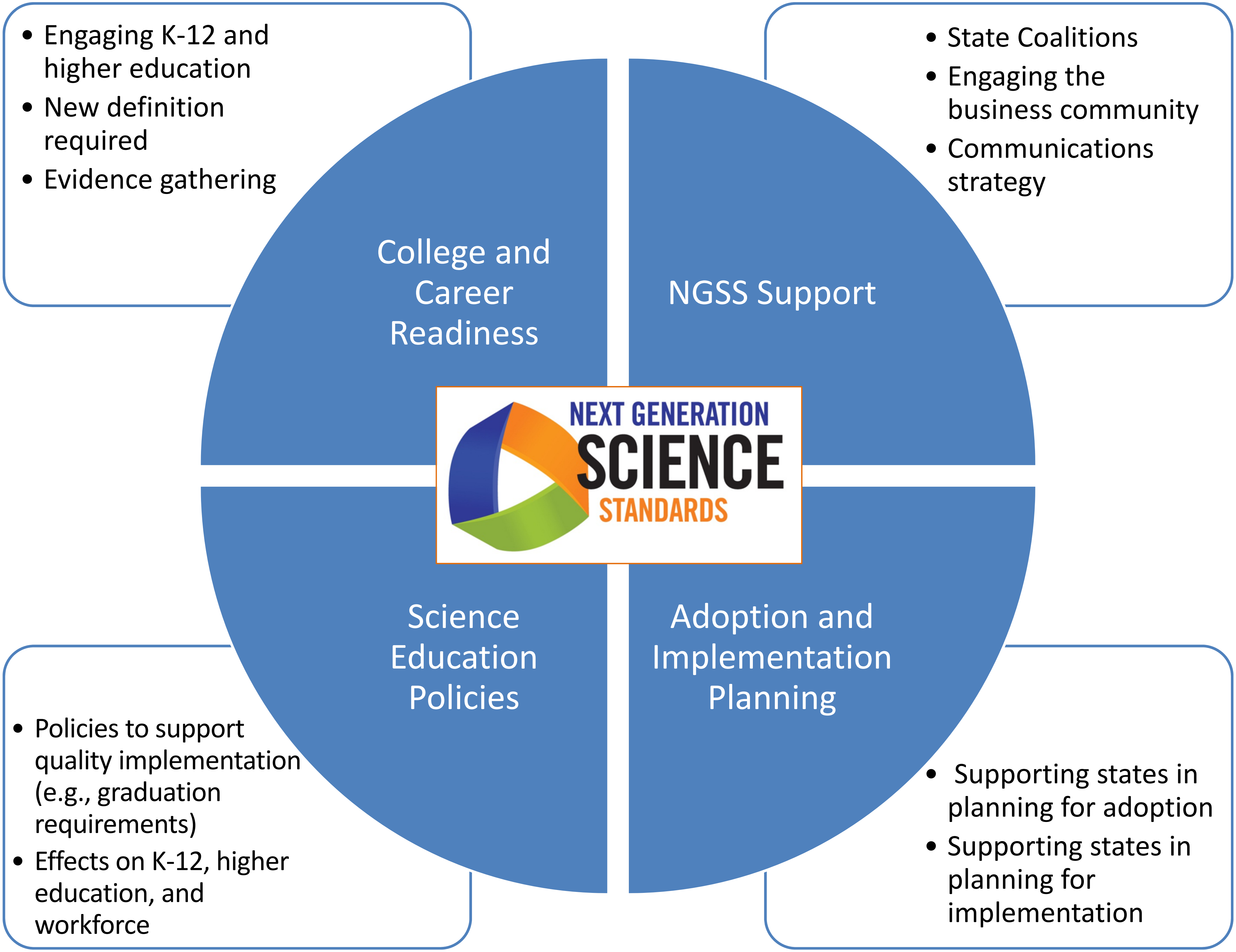
- Grade Band/Level
- Practices
- Cross Cutting Concepts
- Disciplinary Core Ideas

Search   Reset criteria

How to read the standards »
Related Content »

Go to the NGSS Survey

Views: PDF



• Engaging K-12 and higher education
• New definition required
• Evidence gathering
• State Coalitions
• Engaging the business community
• Communications strategy
College and Career Readiness
NGSS Support
NEXT GENERATION SCIENCE STANDARDS
Science Education Policies
Adoption and Implementation Planning
• Policies to support quality implementation (e.g., graduation requirements)
• Effects on K-12, higher education, and workforce
• Supporting states in planning for adoption
• Supporting states in planning for implementation

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