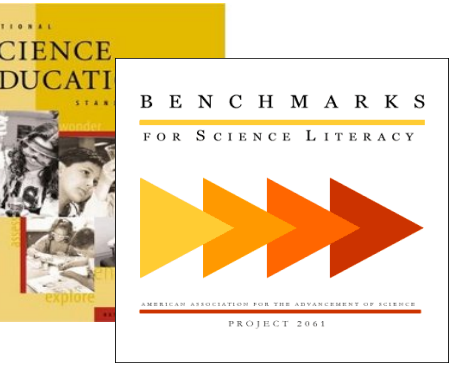
NEXT GENERATION
SCIENCE
STANDARDS
For States, By States

Next Generation Science Standards

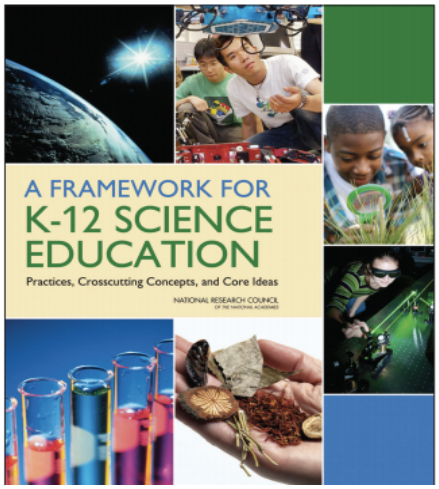
Building on the Past; Preparing for the Future



1990s

1990s-2009

Phase I



1/2010 - 7/2011

Phase II

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7/2011 – March 2013

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What's Different about the Next Generation Science Standards?

Conceptual Shifts in the NGSS

1. K-12 Science Education Should Reflect the Interconnected Nature of Science as it is Practiced and Experienced in the Real World.
2. The Next Generation Science Standards are student performance expectations – NOT curriculum.
3. The science concepts build coherently from K-12.
4. The NGSS Focus on Deeper Understanding of Content as well as Application of Content.
5. Science and Engineering are Integrated in the NGSS from K–12.
6. The NGSS are designed to prepare students for college, career, and citizenship.
7. The NGSS and Common Core State Standards (English Language Arts and Mathematics) are Aligned.

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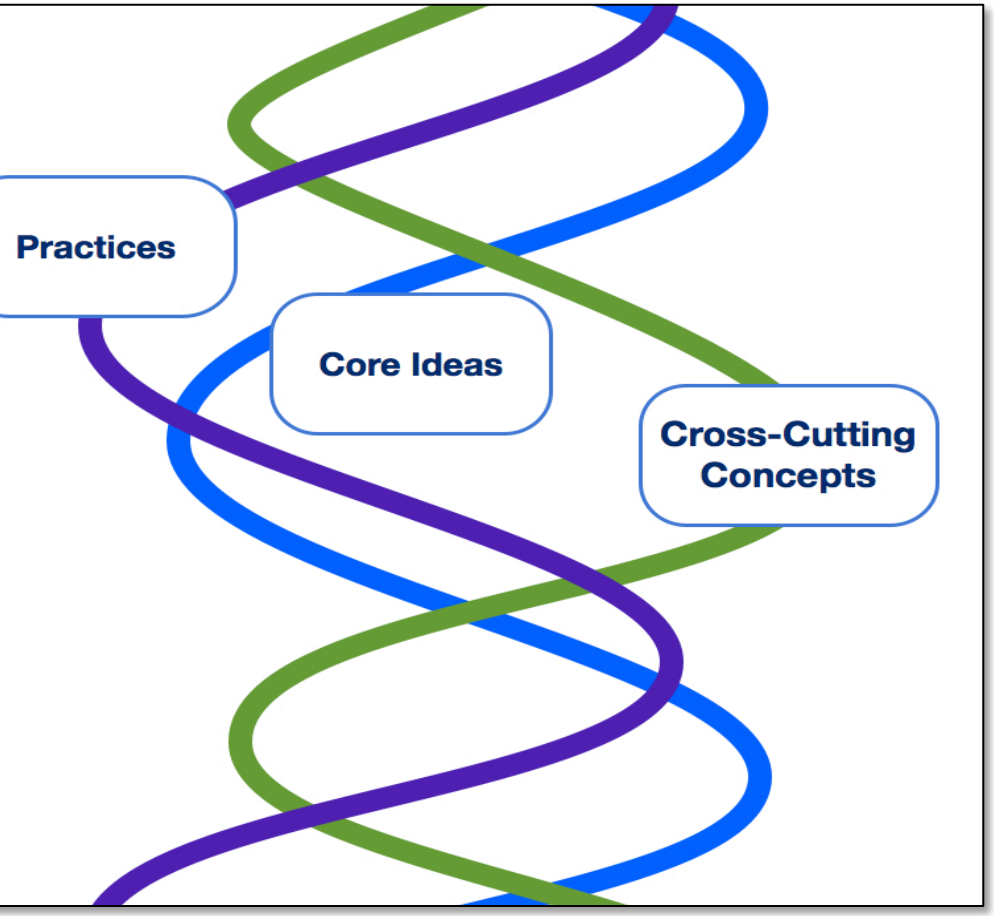
Three Dimensions Intertwined



- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.

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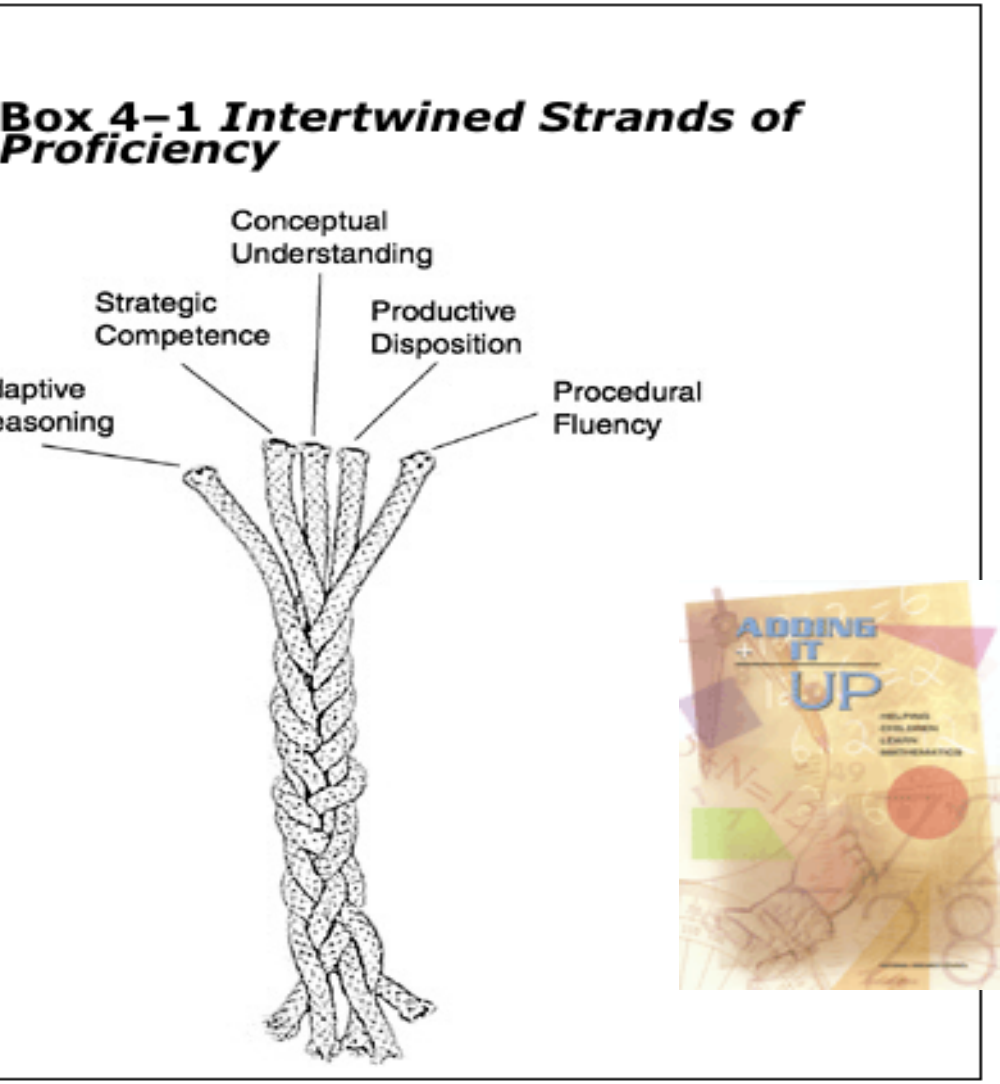
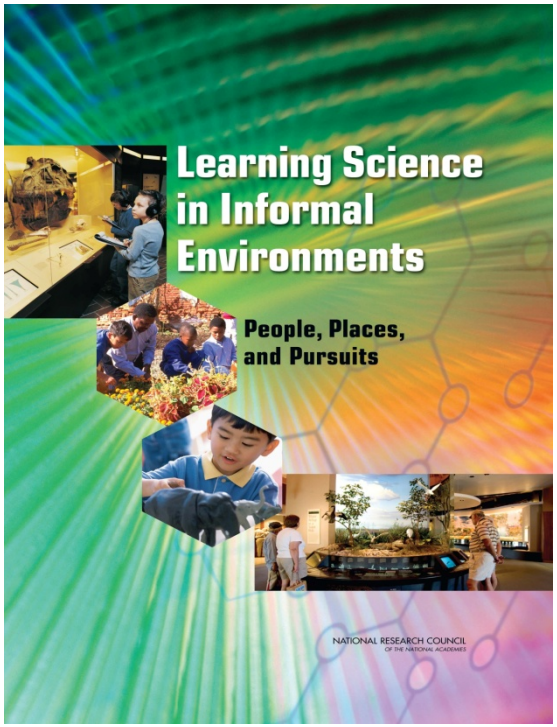
Weaving Practices with Content – Not Just the NGSS

- K-12 Science Education Framework
- New Advanced Placement Coursework and Assessment
- PISA 2015
- Vision and Change in Undergraduate Biology
- A New Biology for the 21st Century
- Scientific Foundations for Future Physicians

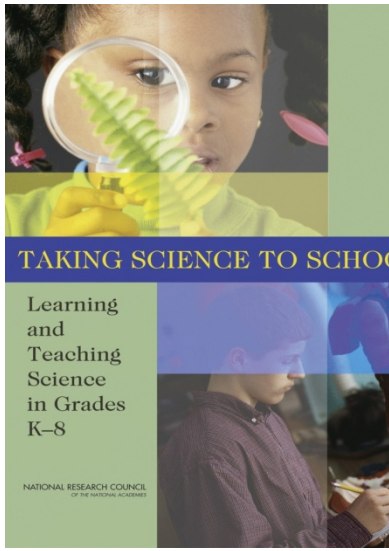
NEXT GENERATION SCIENCE STANDARDS

How do we know this approach works?





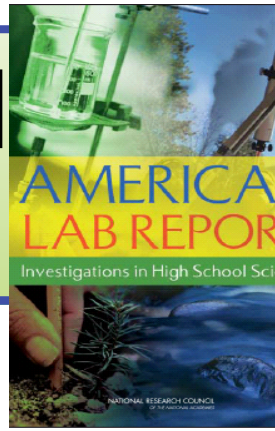
6 strands – incorporates affective domain



4 strands

Motivation a Engagement

Goals of Laboratory Experiences based on ALR Findings



- Mastery of subject matter.
- Developing scientific reasoning.
- Understanding the complexity and ambiguity of empirical work.
- Developing practical skills.
- Interest in science and science learning.

Currently, research indicates significant numbers of students do not have quality opportunities to engage in science and engineering practices

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Findings from ALR

Typical Lab Practice

- Content Mastery
  - No better or worse than other modes of instruction.
- Scientific Reasoning
  - Aids development of *some* aspects
- Interest in Science
  - *Some* evidence of increased interest.

Integrated Dimensions

- Content Mastery
  - Increased mastery of subject matter compared to other modes of instruction.
- Scientific Reasoning
  - Aids development of *more sophisticated* aspects
- Interest in Science
  - *Strong* evidence of increased interest.

Current State Science Standard Sample

Inquiry Standards

a. Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
b. Students will use standard safety practices for all classroom laboratory and field investigations.
c. Students will have the computation and estimation skills necessary for analyzing data and following scientific explanations.
d. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities utilizing safe laboratory procedures.
e. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.
Students will communicate scientific ideas and activities clearly.
g. Students will question scientific claims and arguments effectively.

Content Standards

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.

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Standards Comparison: Structure and Properties of Matter

Current State Middle School Science Standard

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g. **Identify and demonstrate** the Law of Conservation of Matter.

Standards Comparison: Structure and Properties of Matter

NGSS Middle School Sample

1. Develop models to describe the atomic composition of simple molecules and extended structures.
2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
4. Develop a model that predicts and describes changes in atomic motion, temperature, and stat of a pure substance when thermal energy is added or removed.
5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

Standards Comparison: Structure and Properties of Matter

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MS-PS1 Matter and Its Interactions

S-PS1 Matter and Its Interactions

udents who demonstrate understanding can:

S-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examp of extended structures could include sodium chloride or diamond. Examples of molecular-level models could include drawings, 3D ball and stick structures or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

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

veloping and Using Models

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

- Develop a model to predict and/or describe phenomena. (MS-PS1-1)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Substances are made from 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. (MS-PS1-1)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)

Crosscutting Concepts

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can observed at various scales using models t study systems that are too large or too sn (MS-PS1-1)

nections to other topics in this grade-level: will be added in future version.

culation across grade-levels: will be added in future version.

mmon Core State Standards Connections:

/Literacy –

T.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-4)
T.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, mod graph, or table). (MS-PS1-4),(MS-PS1-5),(MS-PS1-6)
8.3	Analyze how a text makes connections among and distinctions between individuals, ideas, or events (e.g., through comparisons, analogies, or categories). (MS-PS1
8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building or others' ideas and expressing their own clearly. (MS-PS1-4)
7.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-PS1-a)*

hematics –

.2	Reason abstractly and quantitatively. (MS-PS1-2)
.5	Use appropriate tools strategically. (MS-PS1-6)
.9	Look for and express regularity in repeated reasoning. (MS-PS1-5)
E	Represent and analyze quantitative relationships between dependent and independent variables. (MS-PS1-2)
P	Develop understanding of statistical variability (MS-PS1-2), (MS-PS1-4)

Appendix D: All Standards, All Students

The chapter highlights practicality and utility of implementation strategies that are grounded in theoretical or conceptual frameworks. It consists of three parts.

- First, it discusses both *learning opportunities and challenges* that NGSS presents for student groups that have traditionally been underserved in science classrooms.
- Second, it describes effective strategies for *implementation* of NGSS in the science classroom, school, home, and community.
- Finally, it provides the *context* of student diversity by addressing changing demographics, persistent science achievement gaps, and educational policies affecting non-dominant student groups.

Appendix D: All Standards, All Students

In identifying student diversity, the Group starts with accountability groups defined in No Child Left Behind (NCLB) Act :

- economically disadvantaged students, students from major racial and ethnic groups, students with disabilities, and students with limited English proficiency.

The Group extends student diversity by adding three groups:

- gender, students in alternative education programs, and gifted and talented students.

Contact Information

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