



# ***Strengthening Delaware's Education System***

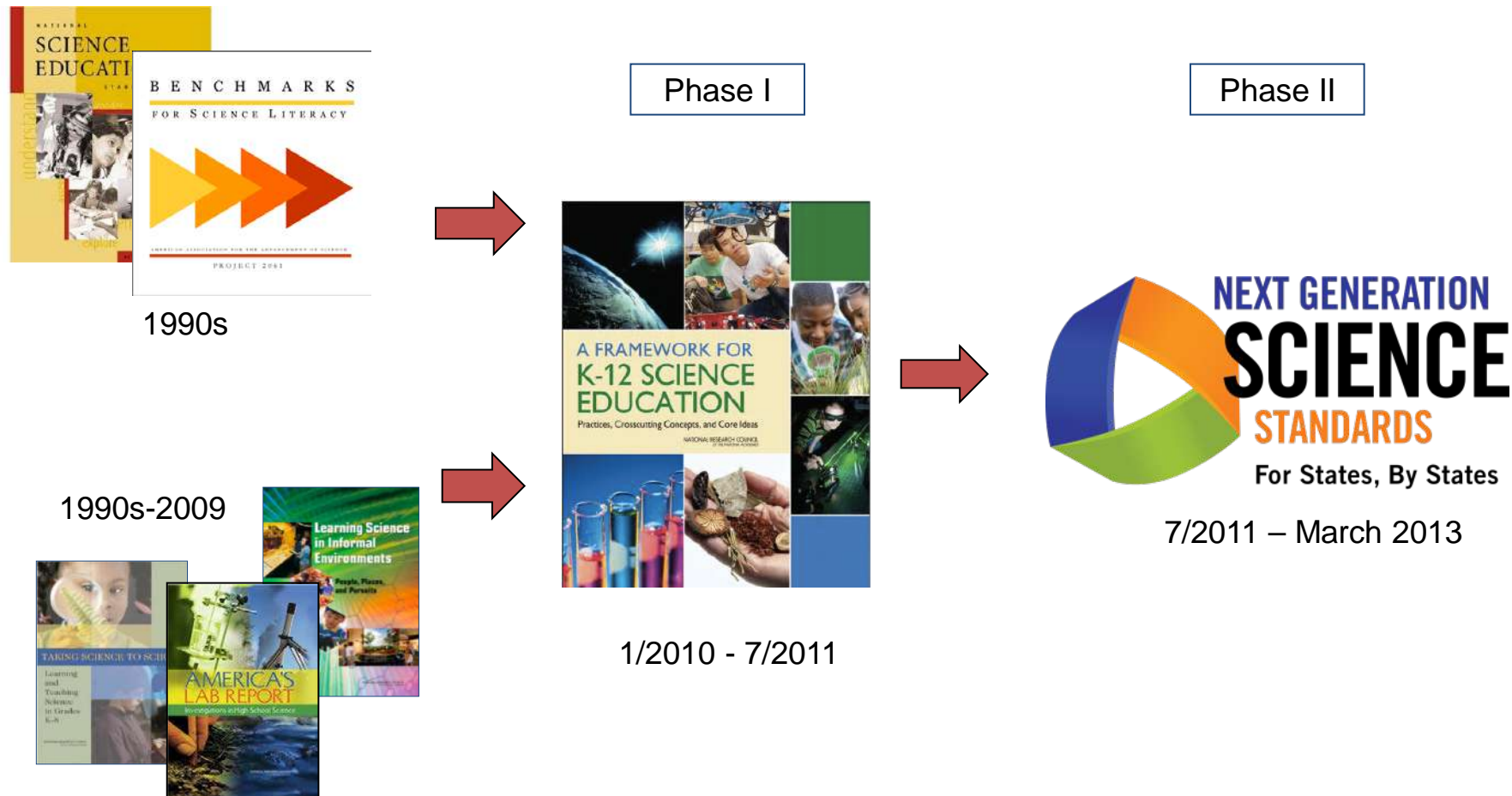
Enhancing Science Education with the  
*Next Generation Science Standards*



Public comment on the adoption of the standards  
accepted until September 5, 2013

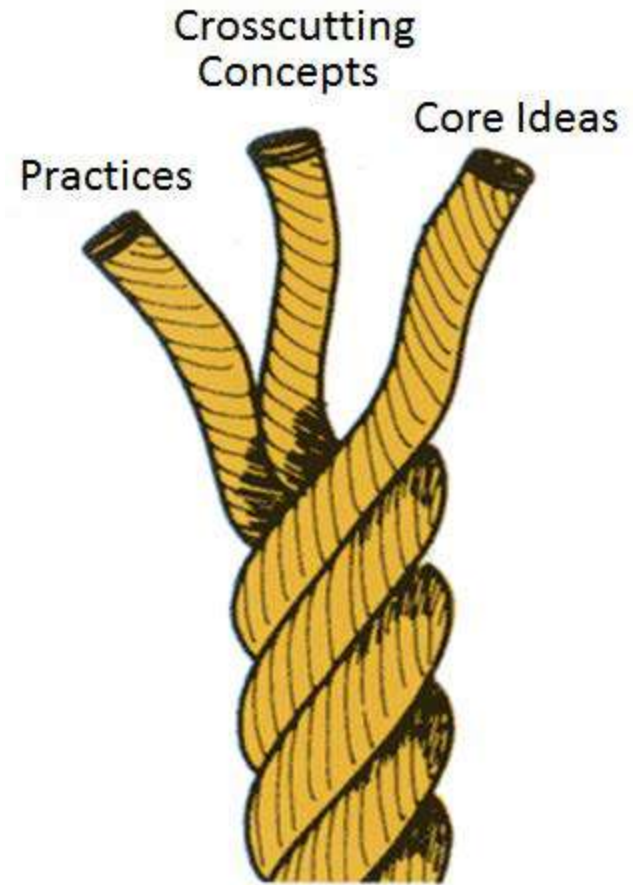
Send written comments to: Susan Haberstroh, Associate Secretary  
Education Supports & Innovative Practices, 401 Federal Street, Dover, DE 19901

# Building on the Past, Preparing for the Future, Leading to the NGSS



# Why Change to the NGSS?

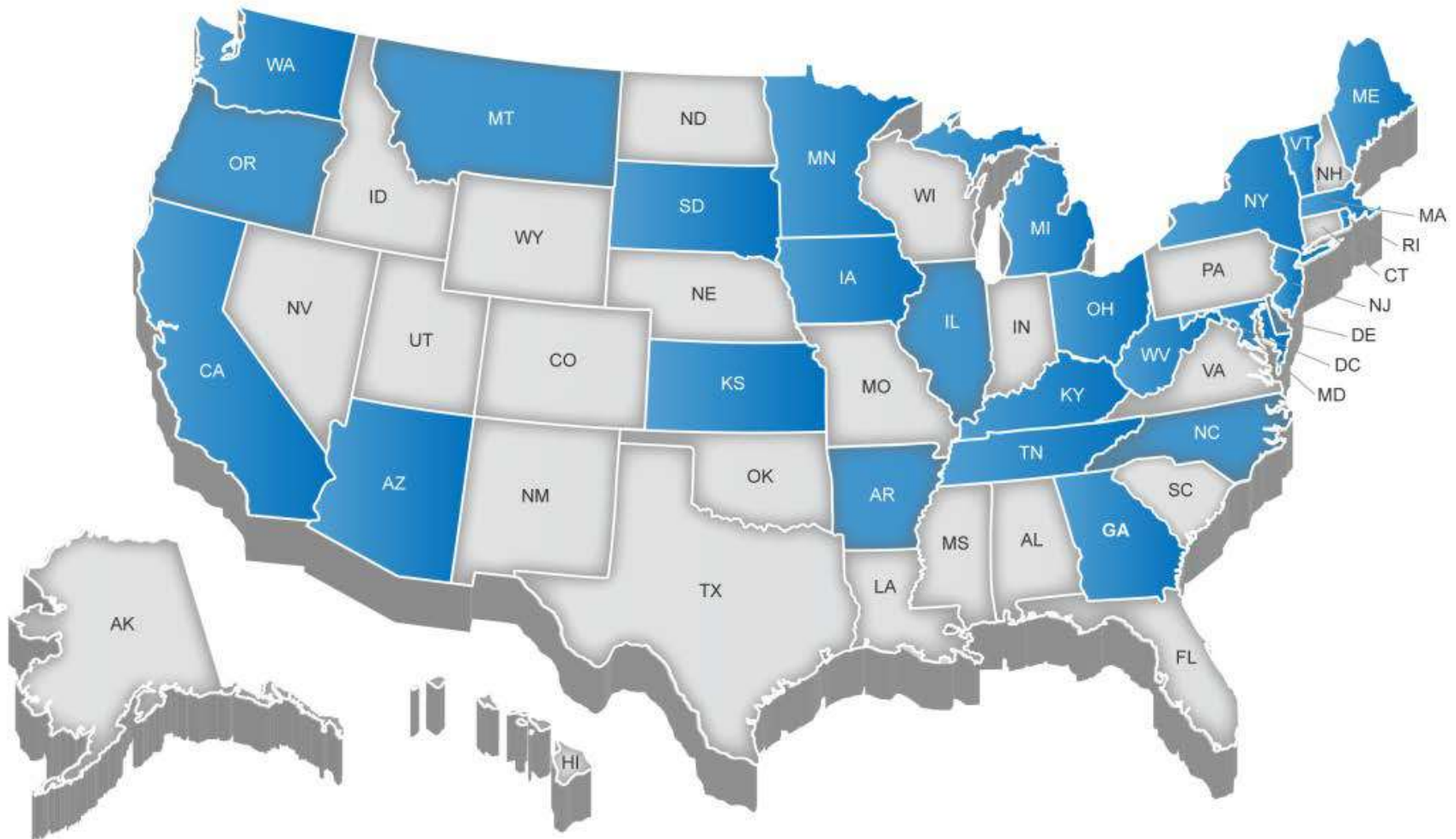
- Modest improvement in NAEP scores does not reflect the goals of Delaware science.
- Changes in science and in the understanding of how students learn have occurred over the past few decades.
- Emphasis on *Science and Engineering Practices* lacking in the current standards.
- Standards are performance expectations constructed by combining the *Practices*, *Cross-Cutting Concepts*, and *Core Ideas*.
- Standards provide for internationally benchmarked science education.
- Standards increase equity and opportunities for all students





# Delaware

*A Lead State in the Development of the NGSS*



## MS.PS-CR Chemical Reactions

Views: [Black and white](#) / [Practices and Core Ideas](#) / [Practices and Crosscutting Concepts](#) / [PDF](#)

Students who demonstrate understanding can:

- Develop representations how atoms regroup during chemical reactions to account for the conservation of mass. [Assessment Boundary: Representations should not involve bonding energy or valence electrons. Balancing equations are also not employed here]**
- Generate and revise explanations from the comparison of the physical and chemical properties of reacting substances to the properties of new substances produced through chemical reactions to show that new properties have emerged. [Assessment Boundary: Comparison and analysis should not involve statistical techniques]**
- Construct explanations linking evidence to claims that when combining simpler molecules (e.g.,  $H_2O$  and  $CO_2$ ) into complex molecules (e.g.,  $C_6H_{12}O_6$  in photosynthesis) or breaking down complex molecules to simpler molecules, energy can be stored or released. [Assessment Boundary: Further details of the photosynthesis process are not addressed]**
- Develop a model to represent the movement of matter and energy in the cycling of carbon (e.g. carbon in the atmosphere and carbon in living things). [Assessment Boundary: Further details of the photosynthesis process are not addressed]**

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

### Science and Engineering Practices

#### Developing and Using Models

- 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. (d)
- Pose models to describe mechanisms at unobservable scales. (a)

#### Constructing Explanations and Designing Solutions

- Generate and revise causal explanations from data (e.g., observations, sources of reliable information) and relate these explanations to current knowledge. (b)
- Apply scientific reasoning to link evidence to claims and show why the data is adequate for the explanation or conclusion. (c)

### Disciplinary Core Ideas

#### PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (a) (b)
- The total number of each type of atom is conserved, and thus the mass does not change. (a), (c)
- Some chemical reactions release energy, others store energy. (c)

#### PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (c)(d)
- Both the burning of fuel and cellular digestion in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (d)

### Crosscutting Concepts

#### 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. (b)
- (rationale for a: comparing properties is a search for patterns; finding a change in pattern indicates a new substance)

#### 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. (a),(d)
- 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. (c)



# Delaware Science Education

## *Building From a Firm Foundation*

- A well-established DE Science Coalition exists, consisting of key stakeholder groups including all public school districts and the majority of the state's charter schools. The membership meets monthly.
- A state-wide professional development program is currently in place. Institutions of higher education are key partners in this program.





**For More Information, Visit the NGSS Website**  
**<http://www.nextgenscience.org>**



The BIG Picture - 1



Instructional Shifts - 2

## Breakout Sessions

Assessment - 3



DE Labor Landscape - 4





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