Science Standards 101: Preparing for New Arkansas K12 Science Standards

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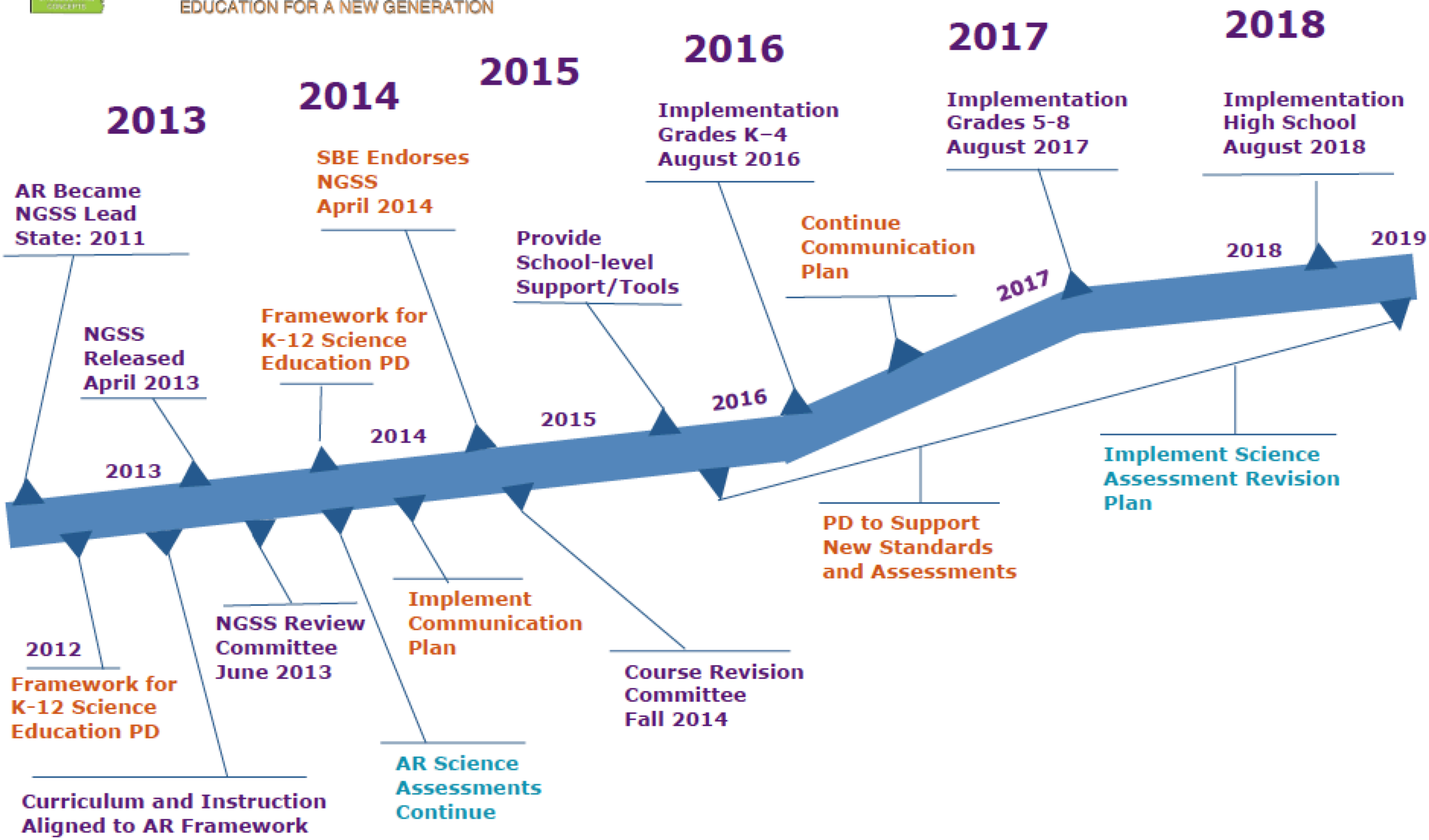
* https://plickers.com/liveview

* **How well do you know your standards?**

ARKANSAS K-12 SCIENCE STANDARDS

EDUCATION FOR A NEW GENERATION

Science Standards Timeline



Curriculum and Instruction Assessment Professional Development

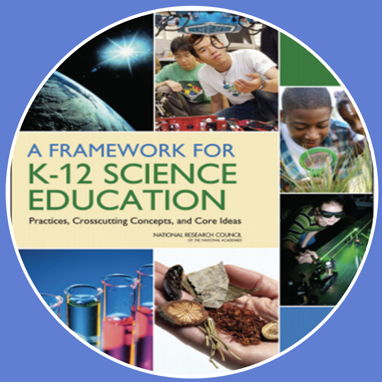
Next Steps in Arkansas

NGSS

Endorsed by SBE. AR K-12 Science Standards will be Written

ARKANSAS DEPARTMENT OF EDUCATION
LEADERSHIP SUPPORT SERVICE

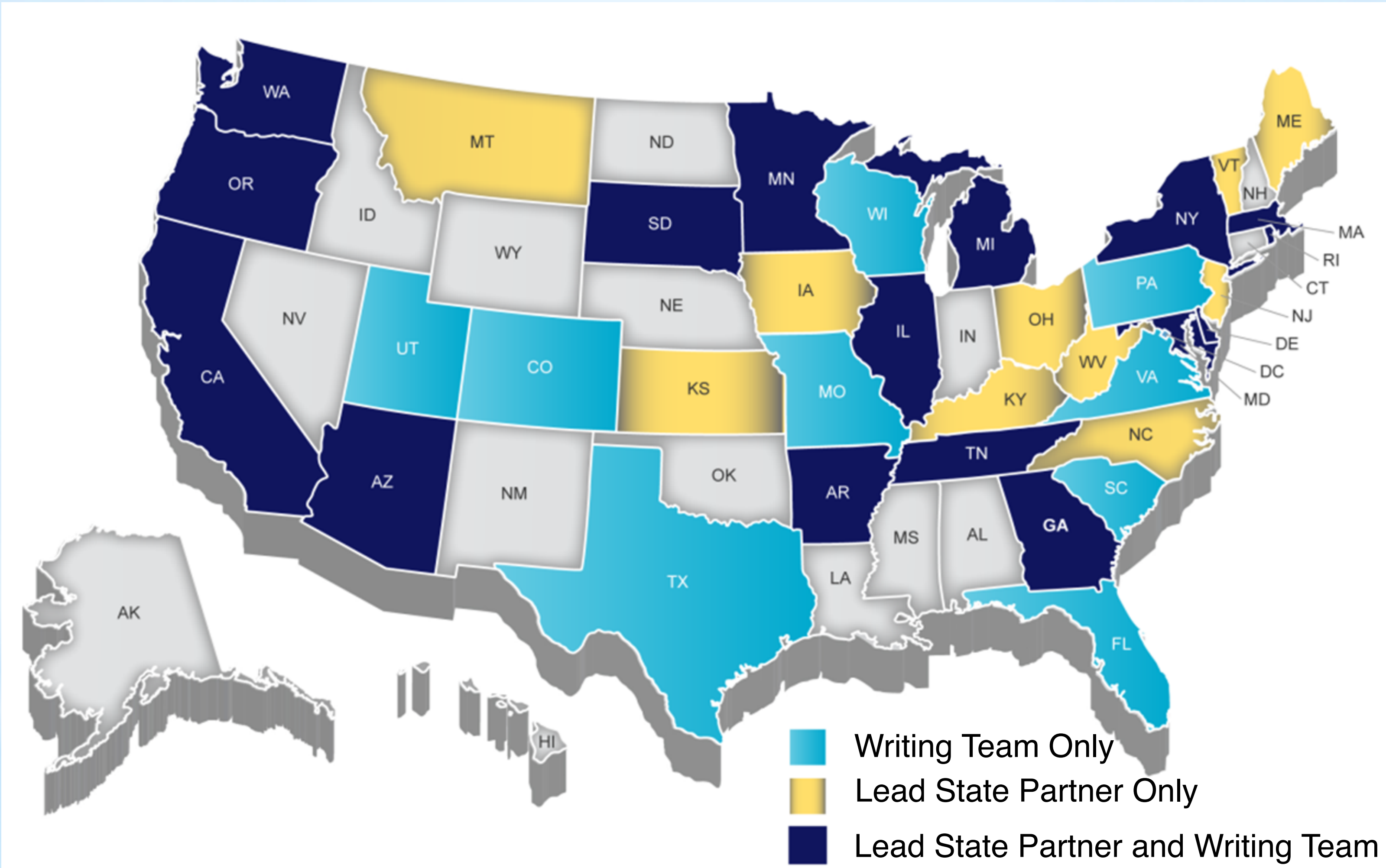
Continue to teach the Arkansas Science Curriculum Framework



Become familiar with the Practices and Crosscutting Concepts - NGSS@NSTA and PD

Begin to incorporate the Practices and Crosscutting Concepts into your curriculum

How was Arkansas Involved in the development of the NGSS?



- Introduce yourselves to each other. Read through the shifts in the envelope in your group.

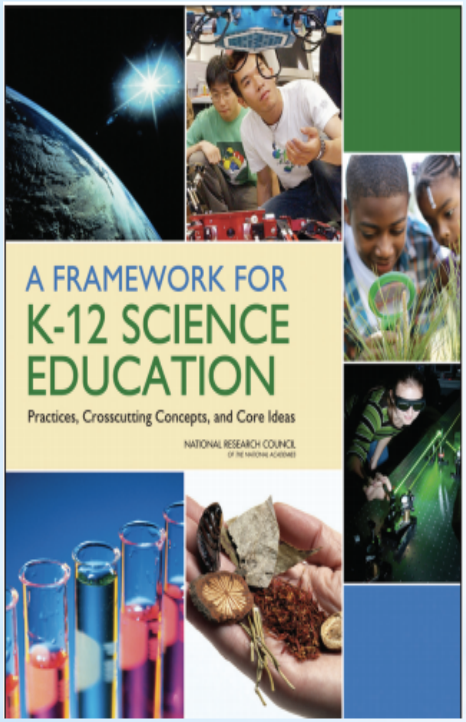
- As you read, discuss. . .

What are some big ideas you find especially important or pertinent? What implications are there for you in your classroom?

*NGSS Shifts

*Goals and Housekeeping

* Better understand the NRC *Framework* and the three dimensions of Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts.
* Be able to better support students participation in Science and Engineering Practices
* Be able to identify and better integrate Crosscutting Concepts into current curriculum
* Be able to successfully navigate and read new standards and supporting documents



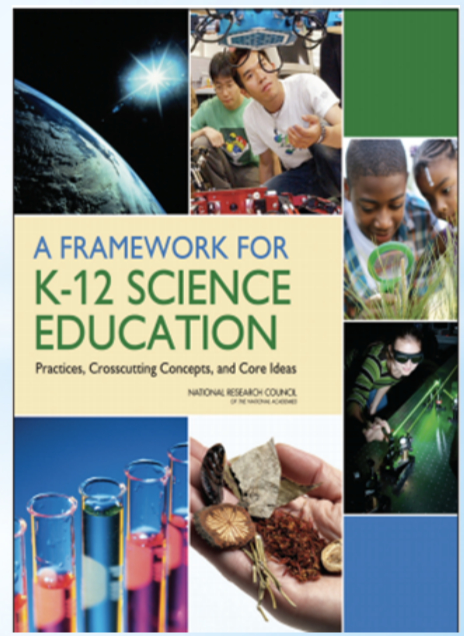
NEXT GENERATION SCIENCE STANDARDS

- Arkansas K-12 Science Standards
- Teacher support
- Instruction
- Curricula
- Assessment

Transitions in Science Education

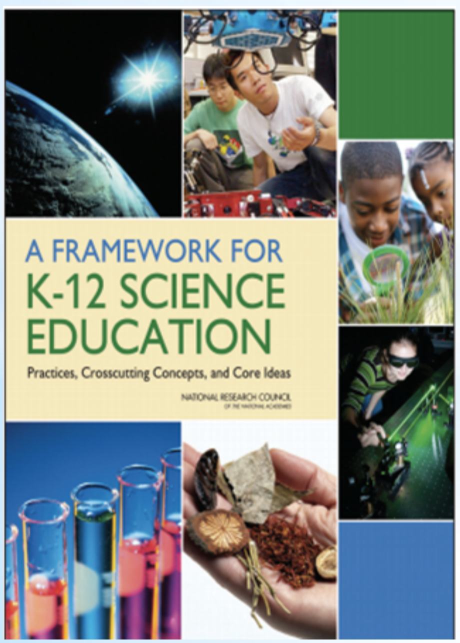
Students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

A Vision for K-12 Science Education



The main goal of the Framework is to ensure that by the end of high school all students have some appreciation of science, the ability to discuss and think critically about science-related issues, and the skills to pursue careers in science or engineering.

~Brian Reiser (2011)

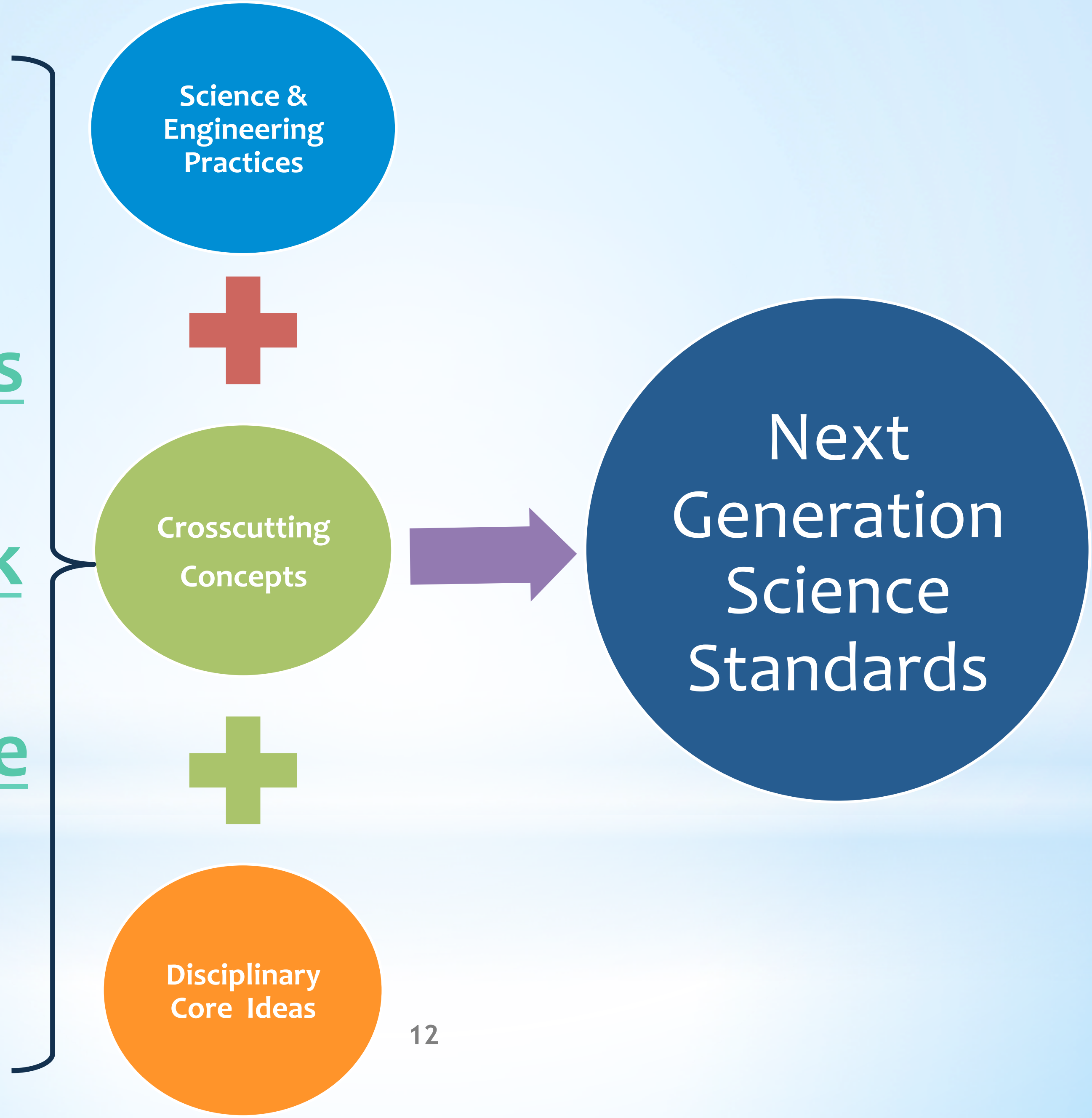


Goals for K-12 Science Education

What indicates a Chemical Change?

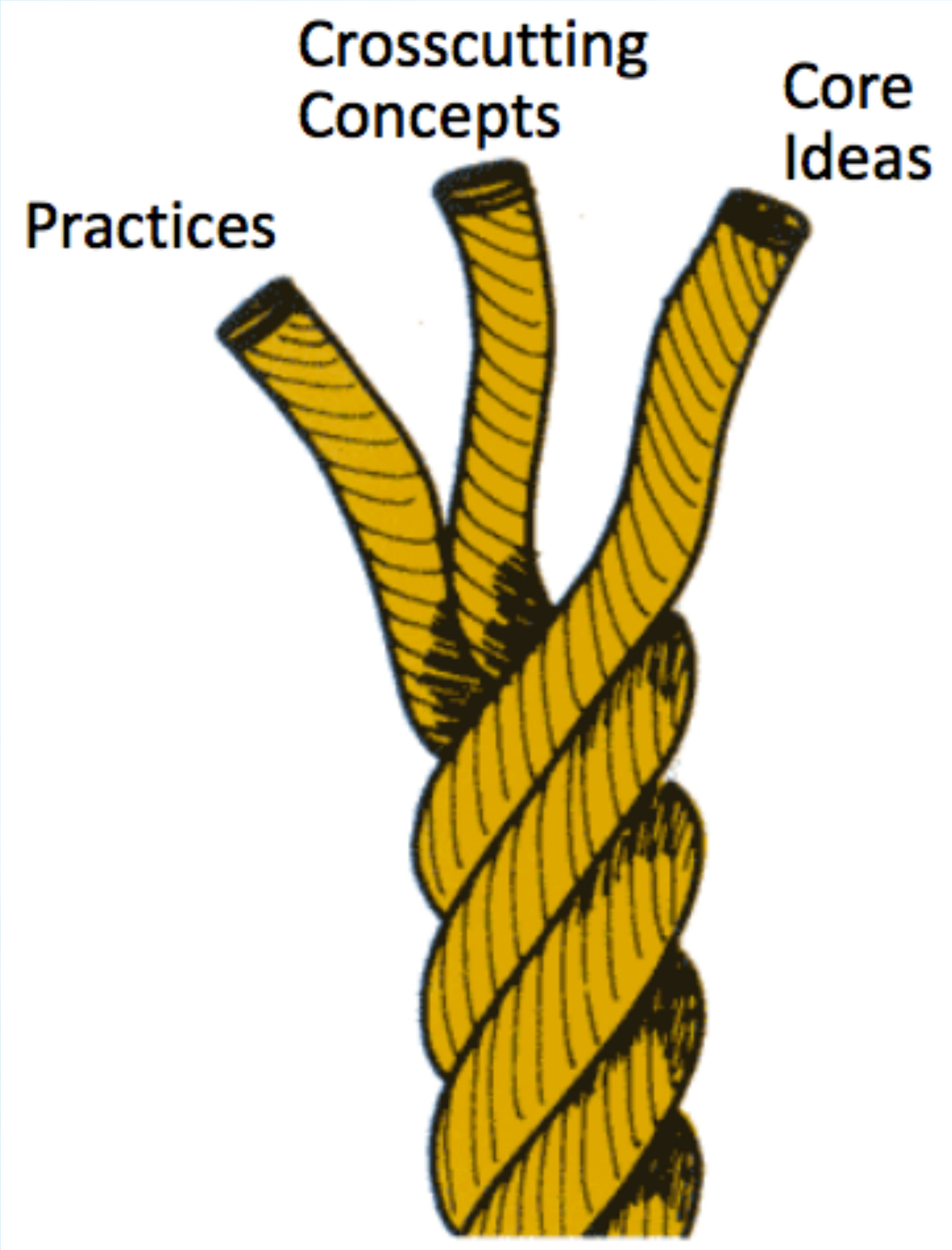
Borrowed from Institute for Inquiry - Exploratorium

Three Dimensions of the Framework for K-12 Science Education



NGSS is Different

- Standards expressed as Performance Expectations.
- Combine core ideas, practices, and crosscutting concepts into a single statement of ***what is to be assessed***.
- Performance Expectations are not instructional strategies or objectives for a lesson.



*What goes into a Performance Expectation aka Standard?

Disciplinary Core Ideas

K-12 Core Ideas

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

Arkansas K-12 Science Standards Matrix Organized by Disciplinary Core Ideas

		Life Science	Earth & Space Science	Physical Science	Engineering
Elementary School	K	K-LS1 From Molecules to Organisms: Structures and Processes	K-ESS2 Earth's Systems K-ESS3 Earth and Human Activity	K-PS2 Motion and Stability: Forces and Interactions K-PS3 Energy	K-2-ETS1 Engineering Design
	1	1-LS1 From Molecules to Organisms: Structures and Processes 1-LS3 Heredity: Inheritance and Variation of Traits	1-ESS1 Earth's Place in the Universe	1-PS4 Waves and Their Applications in Technologies for Information Transfer	
	2	2-LS2 Ecosystems: Interactions, Energy, and Dynamics 2-LS4 Biological Evolution: Unity and Diversity	2-ESS1 Earth's Place in the Universe 2-ESS2 Earth's Systems	2-PS1 Matter and Its Interactions	
	3	3-LS1 From Molecules to Organisms: Structures and Processes 3-LS2 Ecosystems: Interactions, Energy, and Dynamics 3-LS3 Heredity: Inheritance and Variation of Traits 3-LS4 Biological Evolution: Unity and Diversity	3-ESS2 Earth's Systems 3-ESS3 Earth and Human Activity	3-PS2 Motion and Stability: Forces and Interactions	3-5-ETS1 Engineering Design
	4	4-LS1 From Molecules to Organisms: Structures and Processes	4-ESS1 Earth's Place in the Universe 4-ESS2 Earth's Systems 4-ESS3 Earth and Human Activity	4-PS3 Energy 4-PS4 Waves and Their Applications in Technologies for Information Transfer	
	5	5-LS1 From Molecules to Organisms: Structures and Processes 5-LS2 Ecosystems: Interactions, Energy, and Dynamics	5-ESS1 Earth's Place in the Universe 5-ESS2 Earth's Systems 5-ESS3 Earth and Human Activity	5-PS1 Matter and Its Interactions 5-PS2 Motion and Stability: Forces and Interactions 5-PS3 Energy	
Middle School	6	6-LS1 From Molecules to Organisms: Structures and Processes 6-LS3 Heredity: Inheritance and Variation of Traits	6-ESS2 Earth's Systems 6-ESS3 Earth and Human Activity	6-PS3 Energy	MS-ETS1 Engineering Design
	7	7-LS1 From Molecules to Organisms: Structures and Processes 7-LS2 Ecosystems: Interactions, Energy, and Dynamics	7-ESS2 Earth's Systems 7-ESS3 Earth and Human Activity	7-PS1 Matter and Its Interactions	
	8	8-LS3 Heredity: Inheritance and Variation of Traits 8-LS4 Biological Evolution: Unity and Diversity	8-ESS1 Earth's Place in the Universe	8-PS2 Motion and Stability: Forces and Interactions 8-PS3 Energy 8-PS4 Waves and Their Applications in Technologies for Information Transfer	
High School		HS-LS1 From Molecules to Organisms: Structures and Processes HS-LS2 Ecosystems: Interactions, Energy, and Dynamics HS-LS3 Heredity: Inheritance and Variation of Traits HS-LS4 Biological Evolution: Unity and Diversity	HS-ESS1 Earth's Place in the Universe HS-ESS2 Earth's Systems HS-ESS3 Earth and Human Activity	HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer	HS-ETS1 Engineering Design

This matrix from NSTA was modifed for Arkansas grade level standards May 2015

Learning Progression of Ideas Across Time

ESS1.C The history of planet Earth

K-2

Some events on Earth occur very quickly; others can occur very slowly

Grade 3-5

Certain features on Earth can be used to order events that have occurred in a landscape

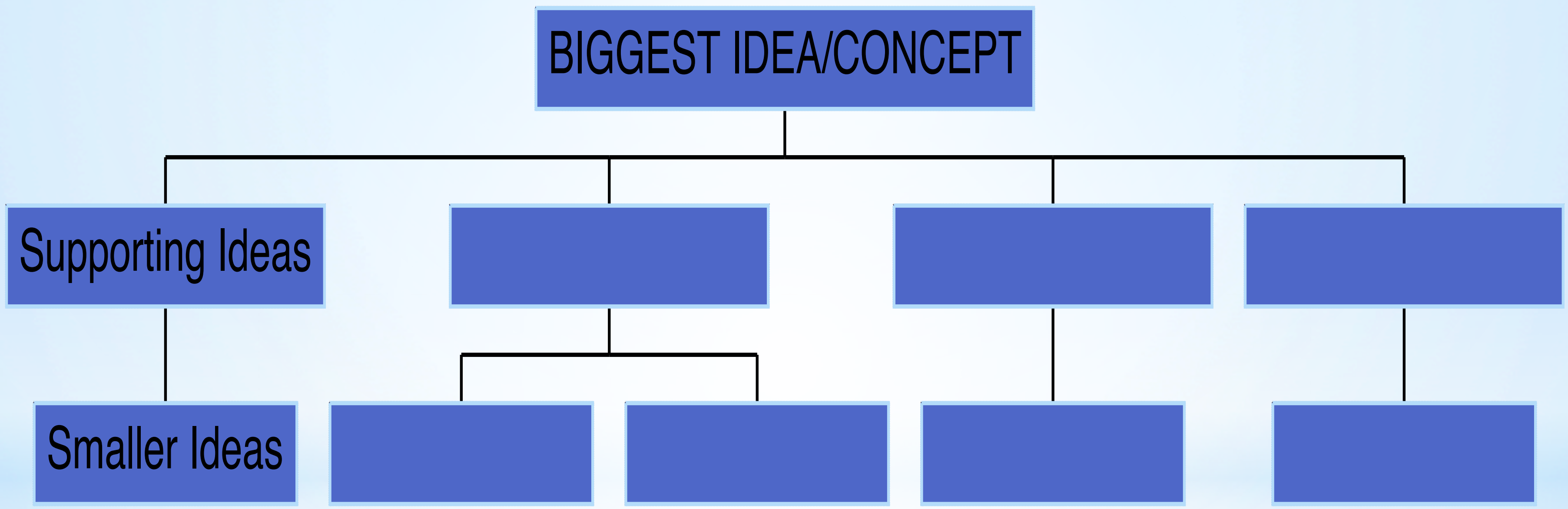
Grade 6-8

Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history

Grade 9-12

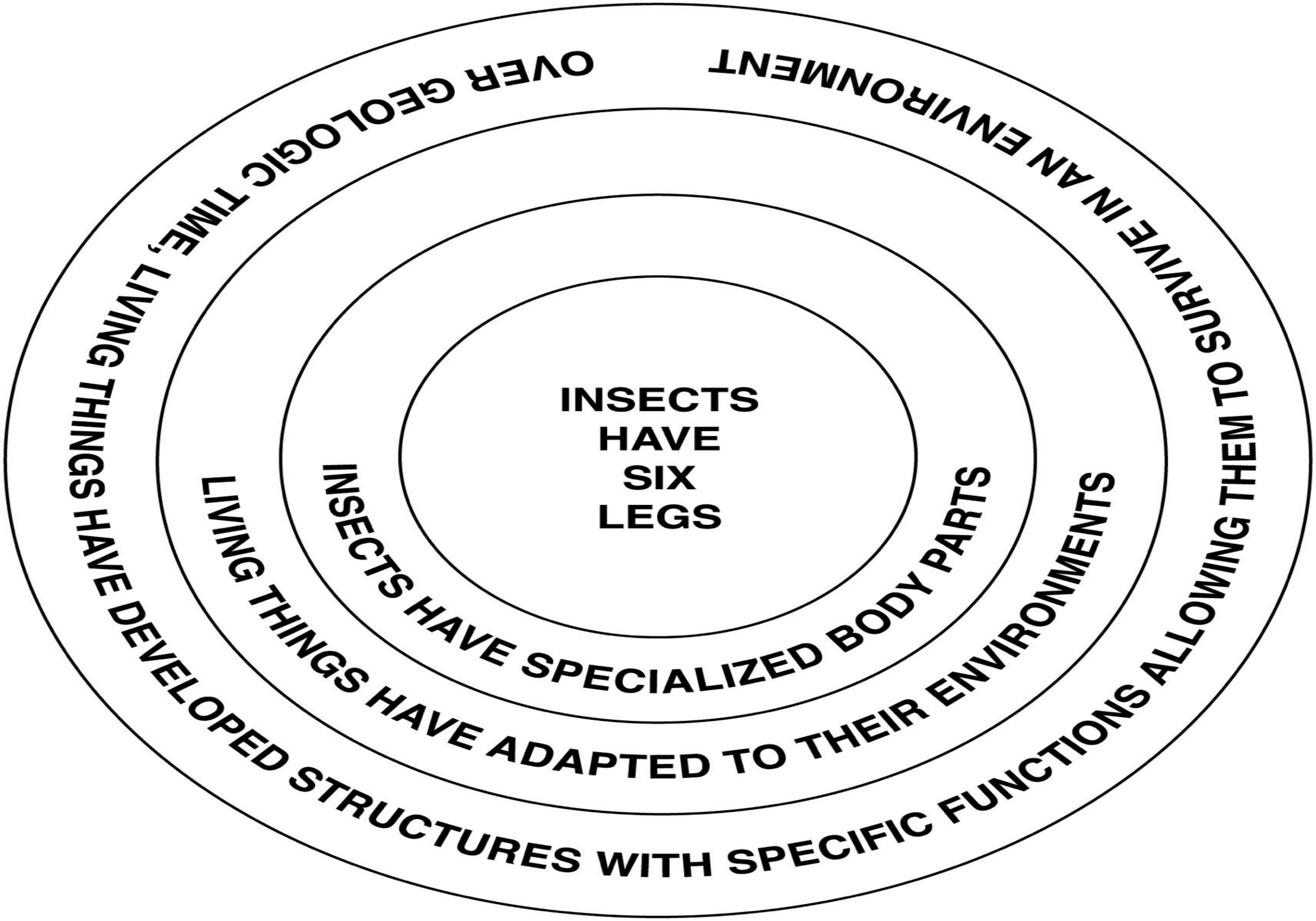
The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations

Conceptual Flow



Conceptual Flow Developed by the K-12 Alliance/WestEd

Factoid to Overarching Idea: Nesting



How well do you know your practices?

Analysis of ELA/Math/Science Practices

ELA Capacities	Mathematical Practices	Scientific and Engineering Practices
Demonstrate independence	Make sense of problems and persevere in solving them	Asking questions (for science) and defining problems (for engineering)
Build strong content knowledge	Reason abstractly and quantitatively	Developing and using models
Respond to the varying demands of audience, task, purpose, and discipline	Construct viable arguments and critique the reasoning of others	Planning and carrying out investigations
Comprehend as well as critique	Model with mathematics	Analyzing and interpreting data
Value evidence	Use appropriate tools strategically	Using mathematics, information and computer technology, and computational thinking
Use technology and digital media strategically and capably	Attend to precision	Constructing explanations (for science) and designing solutions (for engineering)
Come to understand other perspectives and cultures	Look for and make use of structure	Engaging in argument from evidence
	Look for and express regularity in repeated reasoning	Obtaining, evaluating, and communicating information

Science & Engineering Practices

Eight Practices

"Note that in doing science or engineering, the practices are used iteratively and in combination; they are not linear steps to be taught in order"

*Read Article, Discuss,

Post to Padlet

http://padlet.com/vrhame/SciEng

Science & Engineering Practices

Eight Practices - Appendix F

1. Asking questions (science) and defining problems (engineering)
2. Design and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations (science) and designing solutions (engineering)
7. Engaging in argument
8. Obtaining, evaluating, and communicating information

Science & Engineering Practices

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world(s) works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify ideas.

NGSS@NSTA

K–2 Condensed Practices	3–5 Condensed Practices	6–8 Condensed Practices	9–12 Condensed Practices
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, clarify arguments and models.	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
• Ask questions based on observations to find more information about the natural and/or designed world(s).	• Ask questions about what would happen if a variable is changed.	• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument. • Ask questions to determine relationships between independent and dependent variables and relationships in models.. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.	• Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. • Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model, an explanation, or an engineering problem.
• Ask and/or identify questions that can be answered by an investigation.	• Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	• Ask questions that require sufficient and appropriate empirical evidence to answer. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	• Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
		• Ask questions that challenge the premise(s) of an argument or the interpretation of a data set.	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design.
• Define a simple problem that can be solved through the development of a new or improved object or tool.	• Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.

Crosscutting Concepts

Seven Crosscutting Concepts -Appendix G

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

> "Crosscutting Concepts help students organize and make sense of science."
>
> Brett Moulding

*Using Crosscutting Concepts

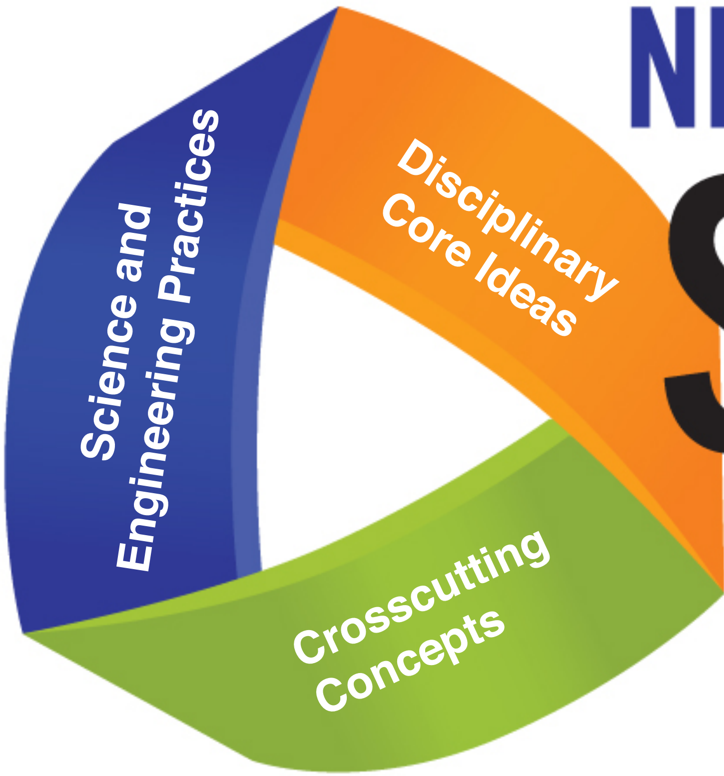
Across Disciplines

Life	Earth	Physical
Photosynthesis	Earthquakes	Electricity
←	ENERGY	→

Within a Discipline

	Life Science	
Cells	Organ Systems	Ecosystems
	SCALE	

← →



NEXT GENERATION SCIENCE STANDARDS

Three-Dimensional Learning

* 7-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

Three-Dimensional Learning Dissected

7-LS2-1 Analyze and interpret data to provide evidence for

the effects of

resource availability on organisms and populations of organisms in an ecosystem.

Performance Expectation

2.Structure and Properties of Matter
Students who demonstrate understanding can: **2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative properties is limited to number or length.]

Foundation Boxes

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

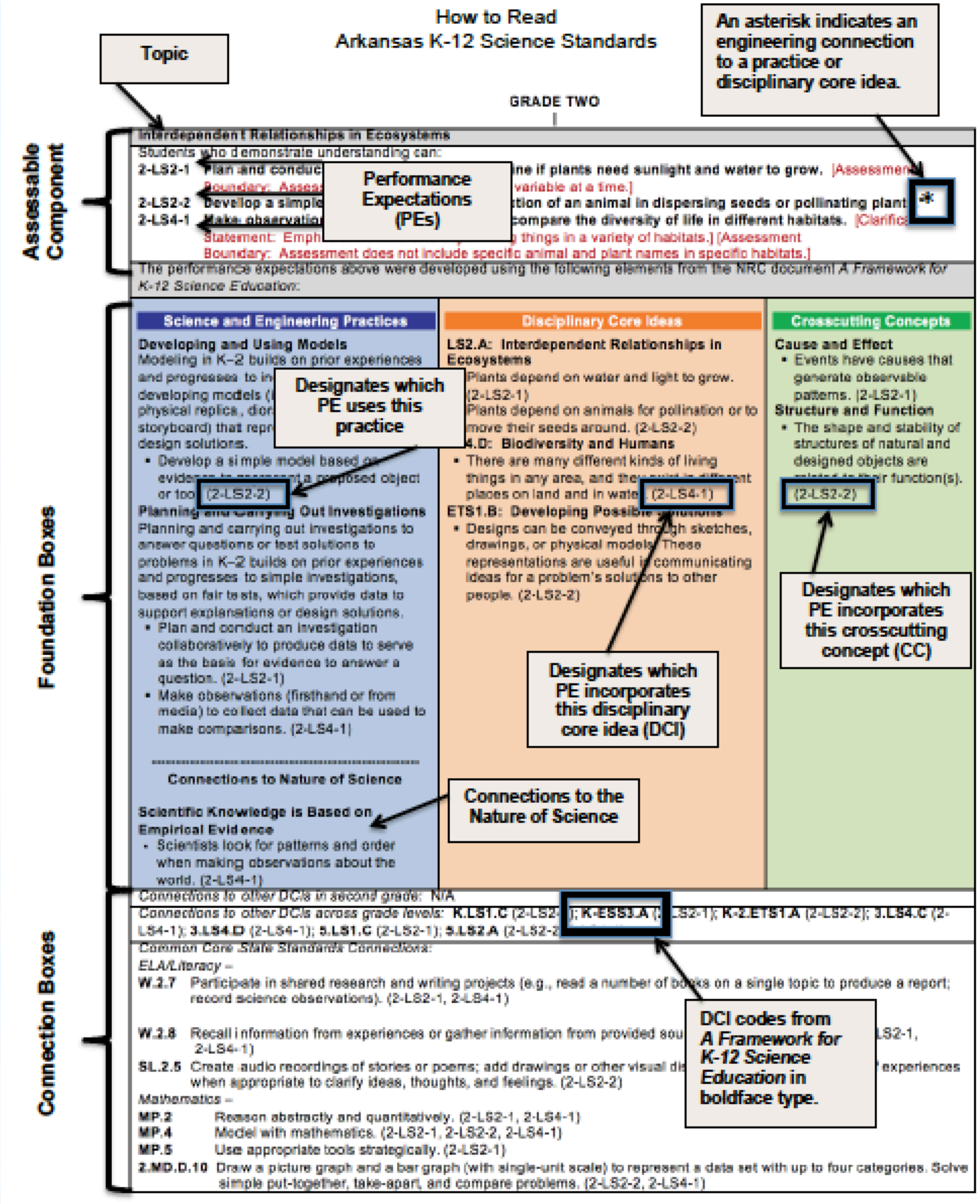
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)	**PS1.A: Structure and Properties of Matter** • Different properties are suited to different purposes. (2-PS1-2)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2) ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** • Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. (2-PS1-2)

Connection Boxes

Connections to other DCIs in this grade-level: will be available on or before April 26, 2013.

Articulation of DCIs across grade-levels: will be available on or before April 26, 2013.

Common Core State Standards Connections: will be available on or before April 26, 2013.
ELA/Literacy –
Mathematics –



How to Read
Arkansas K-12 Science Standards
Topic
An asterisk indicates an engineering connection to a practice or disciplinary core idea.
GRADE TWO
Assessable Component
Interdependent Relationships in Ecosystems
Students who demonstrate understanding can:
2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable at a time.]
2-LS2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*
2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in a variety of habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]
Performance Expectations (PEs)
The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:
Foundation Boxes
Science and Engineering Practices
Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.
• Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)
Designates which PE uses this practice
Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)
• Make observations (firsthand or from media) to collect data that can be used to make comparisons. (2-LS4-1)
Connections to Nature of Science
Scientific Knowledge is Based on Empirical Evidence
• Scientists look for patterns and order when making observations about the world. (2-LS4-1)
Connections to the Nature of Science
Disciplinary Core Ideas
LS2.A: Interdependent Relationships in Ecosystems
• Plants depend on water and light to grow. (2-LS2-1)
• Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)
LS4.D: Biodiversity and Humans
• There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)
ETS1.B: Developing Possible Solutions
• Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (2-LS2-2)
Designates which PE incorporates this disciplinary core idea (DCI)
Crosscutting Concepts
Cause and Effect
• Events have causes that generate observable patterns. (2-LS2-1)
Structure and Function
• The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)
Designates which PE incorporates this crosscutting concept (CC)
Connection Boxes
Connections to other DCIs in second grade: N/A
Connections to other DCIs across grade levels: K.LS1.C (2-LS2-1); K-ESS3.A (2-LS2-1); K-2.ETS1.A (2-LS2-2); 3.LS4.C (2-LS4-1); 3.LS4.D (2-LS4-1); 5.LS1.C (2-LS2-1); 5.LS2.A (2-LS2-2)
Common Core State Standards Connections:
ELA/Literacy –
W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1, 2-LS4-1)
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1, 2-LS4-1)
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-LS2-2)
DCI codes from A Framework for K-12 Science Education in boldface type.
Mathematics –
MP.2 Reason abstractly and quantitatively. (2-LS2-1, 2-LS4-1)
MP.4 Model with mathematics. (2-LS2-1, 2-LS2-2, 2-LS4-1)
MP.5 Use appropriate tools strategically. (2-LS2-1)
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems. (2-LS2-2, 2-LS4-1)

*NGSS Dissection Task

Identify and Highlight the

- Practice in the PE in blue
- DCI in the PE in orange
- CCC in the PE in green

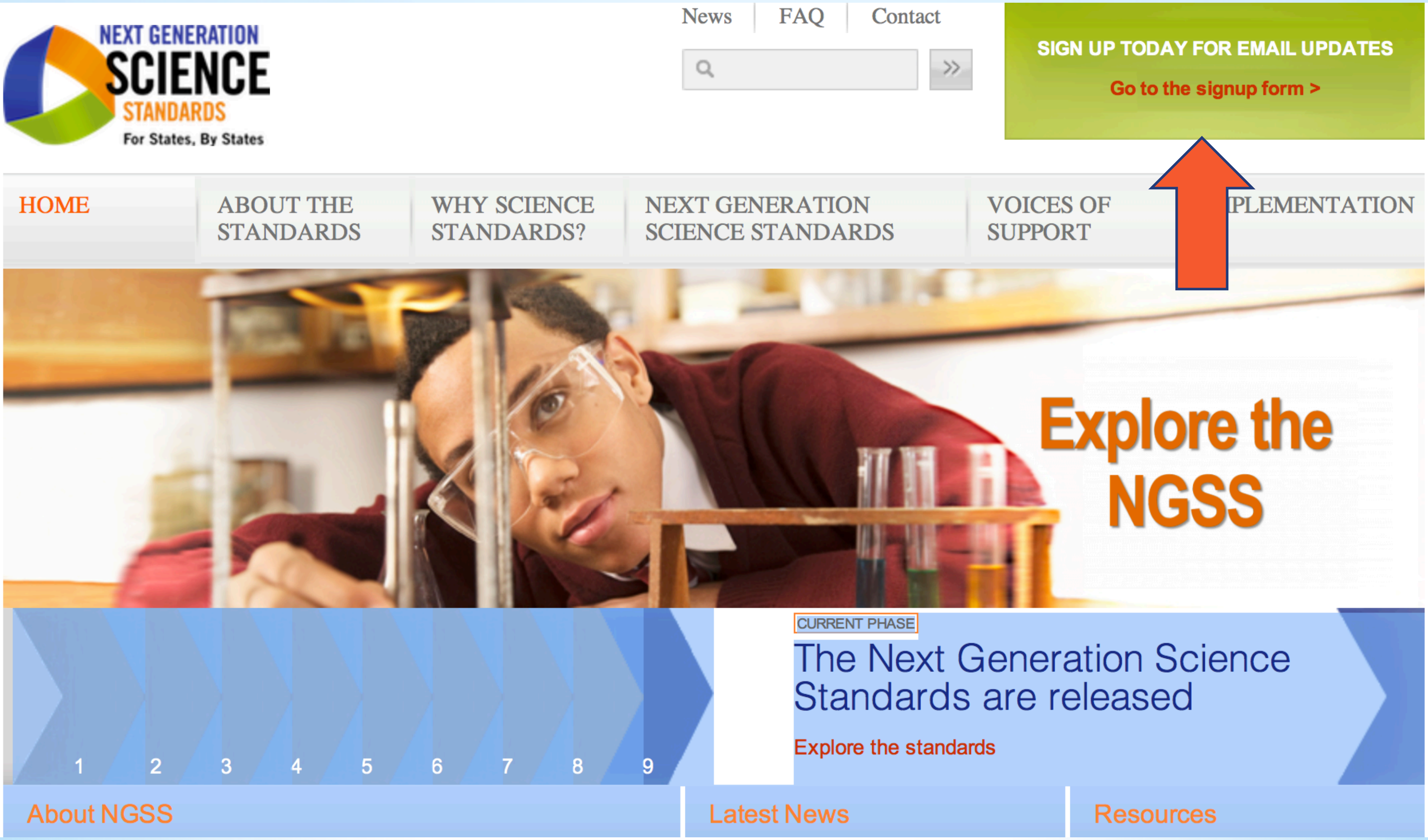
Identify and Underline the

- Clarification statement

Identify and Circle

- Assessment Boundary

http://www.nextgenscience.org



Transitioning Activity

- Examine your grade/grade band standards.
- Complete the Transition Handout in your packet.
- Share your plan with your group.

Find a partner

Stand face-to-face

The intent of the Framework is to change how we teach science so that it is more like how scientists work.

- **What shifts will be necessary in your instruction or curriculum?**
- **What questions do you have?**

Final Thoughts