Louisiana Science Standards

Teacher leader June 8, 2017

Objectives:

- Explain the 4 components of the new Louisiana student standards for science
- Recognize the developmental process of how people adapt change
- Understand the conceptual and instructional shifts in the LSS for science
- Identify multiple instructional strategies for 3 dimensional learning
- Identify the need for professional development and instructional resources

Why New Standards?

- Standards provide the necessary foundation for local decisions around curriculum, assessments, and instruction.
- In 2007, a Carnegie Corporation of New York/Institute for Advanced Study commission of researchers and public and private leaders concluded that "the nation's capacity to innovate for economic growth and the ability of American workers to thrive in the modern workforce depend on a broad foundation of math and science learning, as do our hopes for preserving a vibrant democracy and the promise of social mobility that lie at the heart of the American dream."
- Unfortunately, science and mathematics achievement continues to lag compared to our international competitors, and this lag has already begun to impact the competitiveness of young Americans as well as the competitiveness of the U.S. in the global economy.

- Current Standards are out of date
  - Advances in science & technology
  - Advances in understanding of learning
- The U.S. ranked 17th in science and 25th in mathematics on the 2009 PISA assessment. Less than 10 percent of U.S. students scored at one of the top two of six performance levels.
- More than a third of eighth-graders scored below basic on the 2009 NAEP Science assessment.
- U.S. high-tech manufacturing industries continue to have a larger share of global output than any other economy, but the U.S. global share fell from 34% in 1998 to 28% in 2010.
- The U.S. share of global high tech exports dropped from 19% to 15% in 2010; at the same time China's share of global high tech goods exports more than tripled, from 6% in 1995 to 22% in 2010, making it the single largest exporting country for high tech products.

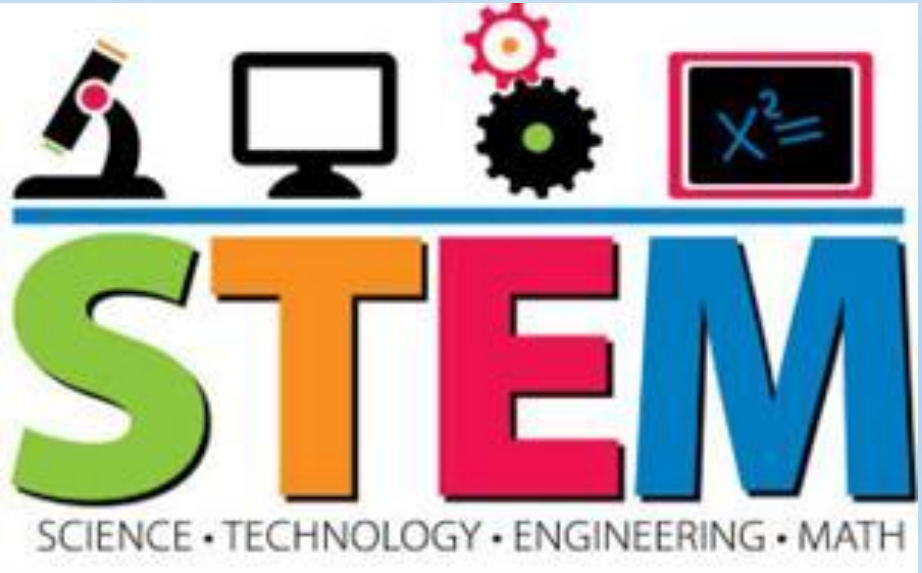
WHERE CAN I FIND THE NEW STANDARDS?

https://www.louisianabelieves.com/resources/library/academic-standards

Louisiana
STUDENT
STANDARDS
SCIENCE

Components of the Louisiana State Standards

1. Performance Expectations
2. Disciplinary Core Ideas
3. Science and Engineering Practices
4. Crosscutting Concepts



MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
Clarification Statement	**Physical Science:** Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Emphasis is on one-dimensional motion and macroscopic objects moving at non-relativistic speeds. **Physics:** Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Emphasis is on kinematics, one-dimensional motion, two-dimensional motion, and macroscopic objects moving at non-relativistic speeds.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. **Analyzing and interpreting data:** Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**FORCES AND MOTION** Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS.PS2.A.a)	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

All of these components are the standard

Louisiana STUDENT STANDARDS SCIENCE

K

K-PS3-1

ENERGY

Performance Expectation	Make observations to determine the effect of sunlight on Earth's surface.
Clarification Statement	Sunlight heats Earth's natural surfaces including sand, soil, rocks, or water and the unnatural surfaces including man-made objects like plastics, asphalt, or concrete. Examples of observations could be relative changes in temperature of surfaces exposed to sunlight.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. **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. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**CONSERVATION OF ENERGY AND ENERGY TRANSFER** Sunlight warms Earth's surface. (LE.PS3B.a)	**CAUSE AND EFFECT** Events have causes that generate observable patterns.

ENERGY

Performance Expectation	Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
Clarification Statement	Examples of structures could include umbrellas, canopies, or tents that minimize the warming effect of the sun.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and computational thinking **6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**CONSERVATION OF ENERGY AND ENERGY TRANSFER** Sunlight warms Earth's surface. (LE.PS3B.a)	**CAUSE AND EFFECT** Simple tests can be designed to gather evidence to support or refute student ideas about causes.

MOTION AND STABILITY: FORCES AND INTERACTIONS

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Cooking Analogy

Preparing a Meal
Performance Expectations

Kitchen Tools & Techniques
Science & Engineering Practices

Basic Ingredients
Disciplinary Core Ideas

Herbs, Spices & Seasonings
Crosscutting Concepts

Performance Expectations:

- Assessable statements of what students should know and be able to do
- Represent the things students should know, understand, and be able to do to be proficient in science
- Performance expectations should not limit the curriculum
- Not a set of instructional or assessment tasks
- Statements of what students should be able to do after instruction

Clarification Statement

- Examples or additional clarification to the performance expectations
- Define boundaries within certain domains

Louisiana STUDENT STANDARDS SCIENCE

PS

HS-PS3-3

ENERGY

Performance Expectation	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
Clarification Statement	**Physical Science:** Emphasis is on qualitative evaluations of devices. Constraints could include use of renewable energy forms and efficiency. Emphasis is on devices constructed with teacher approved materials. Examples of devices can be drawn from chemistry or physics clarification statements below. **Chemistry:** Emphasis is on both qualitative and quantitative evaluations of devices. Constraints could include use of renewable energy forms and efficiency. Focus of quantitative evaluations is limited to total output for a given input. Emphasis is on devices constructed with teacher approved materials. Examples of devices in chemistry could include hot/cold packs and batteries. **Physics:** Emphasis is on both qualitative and quantitative evaluations of devices. Constraints could include use of renewable energy forms and efficiency. Focus of quantitative evaluations is limited to total output for a given input. Emphasis is on devices constructed with teacher approved materials. Examples of devices in physics could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and electric motors.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and computational thinking	**DEFINITIONS OF ENERGY** At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS.PS3A.b)	**ENERGY AND MATTER** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Science & Engineering Practices:

- Behaviors that scientists engage in as they investigate and build models and theories about the natural world
- Set of engineering practices that engineers use as they design and build models and systems ~ These include the following:
    1. Ask questions and define problems
    2. Develop and use models
    3. Plan and conduct investigations
    4. Analyze and interpret data
    5. Use mathematical and computational thinking
    6. Construct explanations and design solutions
    7. Engage in scientific argument from evidence
    8. Obtain, evaluate, and communicate information

Disciplinary Core Idea

- Disciplinary ideas are grouped in four domains
- Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline
- Provide a key tool for understanding or investigating more complex ideas and solving problems
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication

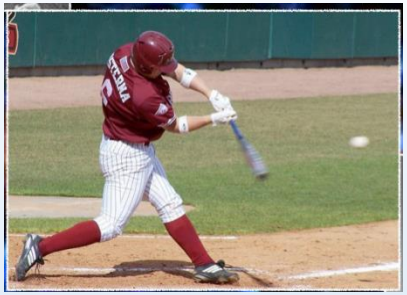
Five Disciplinary Core Domains		
Physical Science (PS)	Earth and Space Science (ESS)	Engineering, Technology, and Applications of Science (ETS)
Life Science (LS)	Environment Science (EVS)	

Crosscutting Concepts

- Have application across all domains of science
- Link across the domains in the Disciplinary Core Ideas

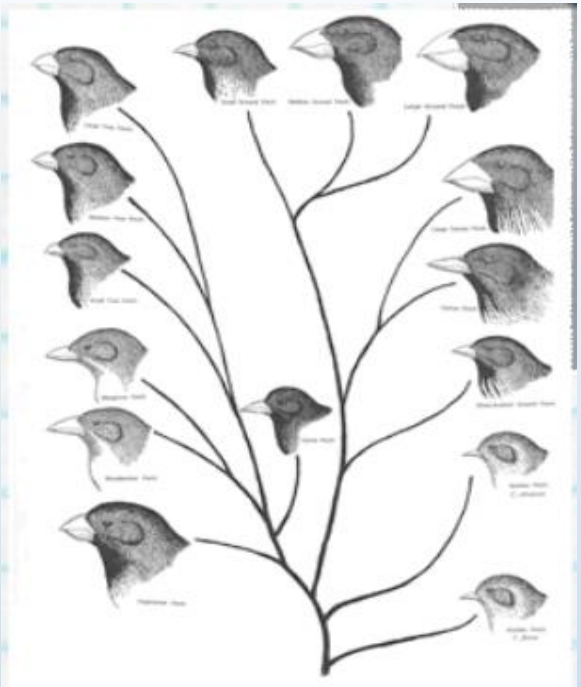
<u>Seven Concepts</u>

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



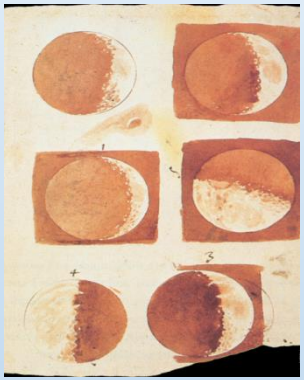
Cause and Effect

Structure and Function

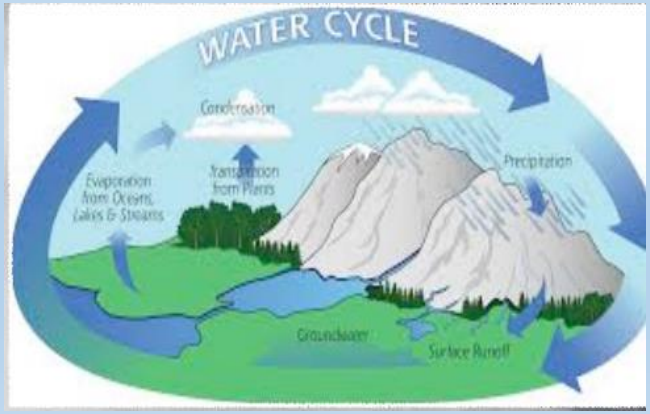


Stability and Change

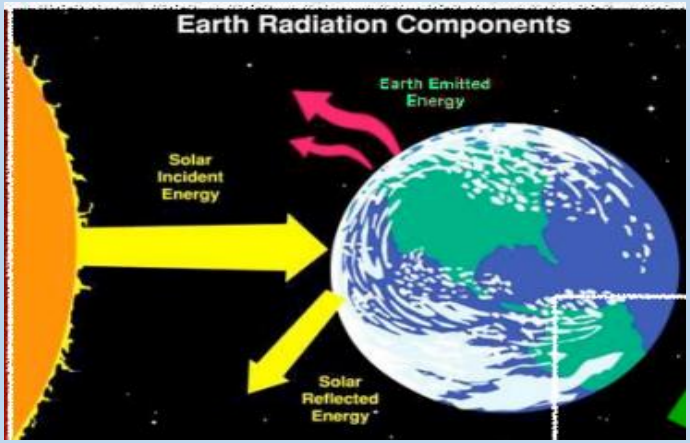
Scale



Patterns



Systems



Energy and Matter

“One of the greatest pains to human nature is the pain of a new idea. It...makes you think that after all, your favorite notions may be wrong, your firmest beliefs ill-founded... Naturally, therefore, common men hate a new idea, and are disposed more or less to ill-treat the original man who brings it.”

Walter Bagehot *Physics and Politics* 1872

Change Activity

Debriefing the Activity

How did you feel?

Different people respond to change differently.

How many took something off? Put something on?

People think of change as a loss – as having to give something up – rather than doing something to enhance what they are already doing.

Debriefing the Activity Continued

- How many exchanged something with somebody else?

People think of change as something they have to do alone.

- How many ran out of things to change?

People think they never have enough resources.

Debriefing the Activity Continued

In what ways were the second changes you made different from the first?

People will often change superficially first; only when deep change is required and supported will it happen.

Does the second set of changes you made still exist?

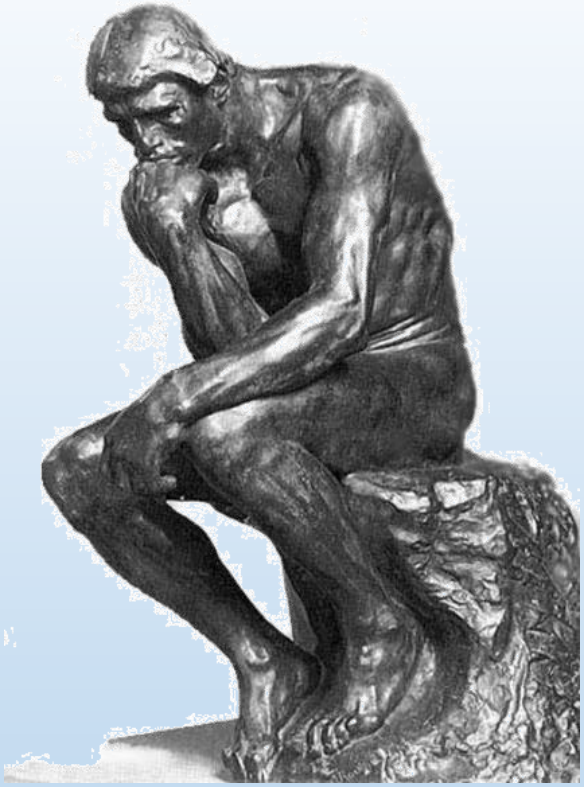
Change doesn't remain unless people pay attention to sustaining them.

Concerns-Based Adoption Model (CBAM)

A framework and set of tools for understanding and managing change in people.

Assumptions of the Concerns-Based Adoption Model (CBAM)

- Change is accomplished by individuals.
- Change is made by individuals first, then institutions.
- Change is a highly personal experience.
- Change involves developmental growth in feelings and skills.
- The focus of facilitation should be on individuals, innovations, and the context.
  - People first
  - Innovation second
- Change is an ongoing process, not a short-term event.
- People go through change at different rates and in different ways.



"The composite representation of the feelings, preoccupation, thought, and consideration given to a particular issue or task is called *concern*."

Hall & Hord, p. 61

STAGES OF CONCERN

Typical Expressions of Concern about the Innovation

*Innovation refers to any idea, program, product of process that requires different behaviors of the user.

Stages of Concern	Expressions of Concern	
6 Refocusing	I have some ideas about something that would work even better.	Impact Concerns
5 Collaboration	I am concerned about relating what I am doing with what other instructors are doing.	
4 Consequence	How is my use affecting kids?	
3 Management	I seem to be spending all my time in getting material ready.	Task Concerns
2 Personal	How will using it affect me?	Self Concerns
1 Informational	I would like to know more about it.	
0 Awareness	I am not concerned about it (the innovation).	

Hall, Gene, (1979), *Implementing Innovations is Schools: A concerns-Based Approach*, p.6

Levels of Use of the Innovation:

Typical Behaviors

Levels of Use	Behavioral Indices of Level
VI. Renewal	The user is seeking more effective alternatives to the established use of the innovation.
V. Integration	The user is making deliberate efforts to coordinate with others in using the innovations.
IVB. Refinement	The user is making changes to increase outcomes.
IVA. Routine	The user is making few or no changes and has an established pattern of use.
III. Mechanical Use	The user is using the innovation in a poorly coordinated manner and is making user-oriented changes.
II. Preparation	The user is preparing to use the innovation.
I Orientation	The user is seeking out information about the innovation.
0. Nonuse	No action is being taken with respect to the innovation.

Hall, Gene, (1979), *Implementing Innovations is Schools: A concerns-Based Approach*, p.7

The Six Conceptual Shifts

1. The standards reflect how science is done in the real world by intertwining three dimensions: scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

2. The standards are student performance expectations.
   The standards are **NOT** curriculum

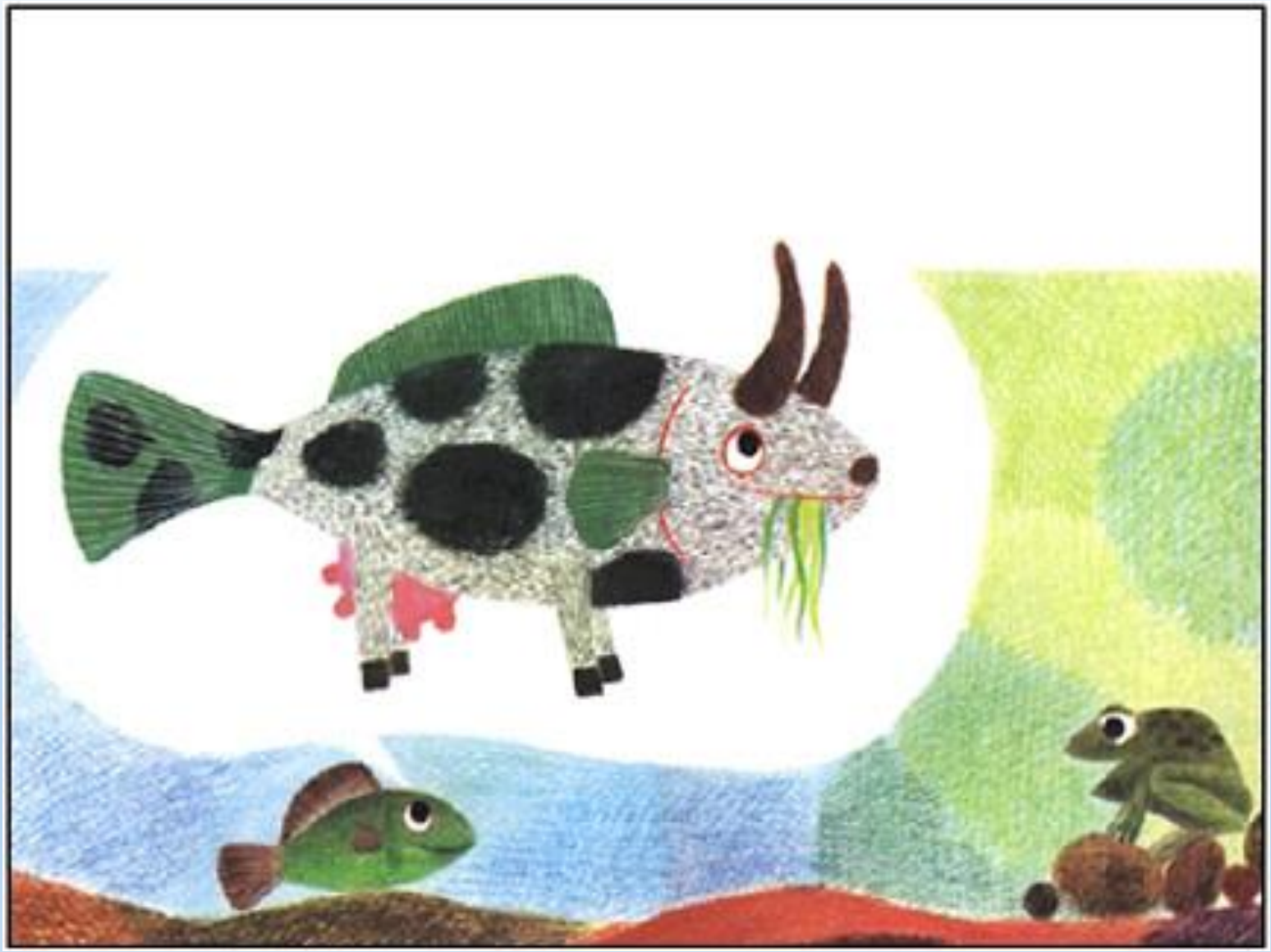
3. The standards build coherently from grades K through 12.

4. The standards focus on deeper understanding of content and applications of content.

5. The standards integrate science, technology, and engineering throughout grades K through 12.

6. The standards correlate to the Louisiana Standards in English Language Arts (ELA) and Mathematics.

Fish is Fish Activity – Illustration 1



Fish is Fish Activity – Illustration 2

Fish is Fish Activity – Illustration 3

Fish is Fish by Leo Lionni

Watch the video of the book Fish is Fish by Leo Lionni

NANA'S
STORY TIME

Progressions

- Provide a map of the routes to mastery
- Describe how understanding matures over time
- Provide instructional supports and experiences that are needed to make progress

SEP Progressions

• Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.	• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

• Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

DCI Progressions

Earth Space Science Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
ESS1.A The universe and its stars	Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted.	Stars range greatly in size and distance from Earth and this can explain their relative brightness.	The solar system is part of the Milky Way, which is one of many billions of galaxies.	Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion, and short-term solar variations cause space weather and insolation changes that significantly affect humanity. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory.
ESS1.B Earth and the solar system		The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.	Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Changes in Earth's tilt and orbit cause climate changes such as Ice Ages.

Progression Activity

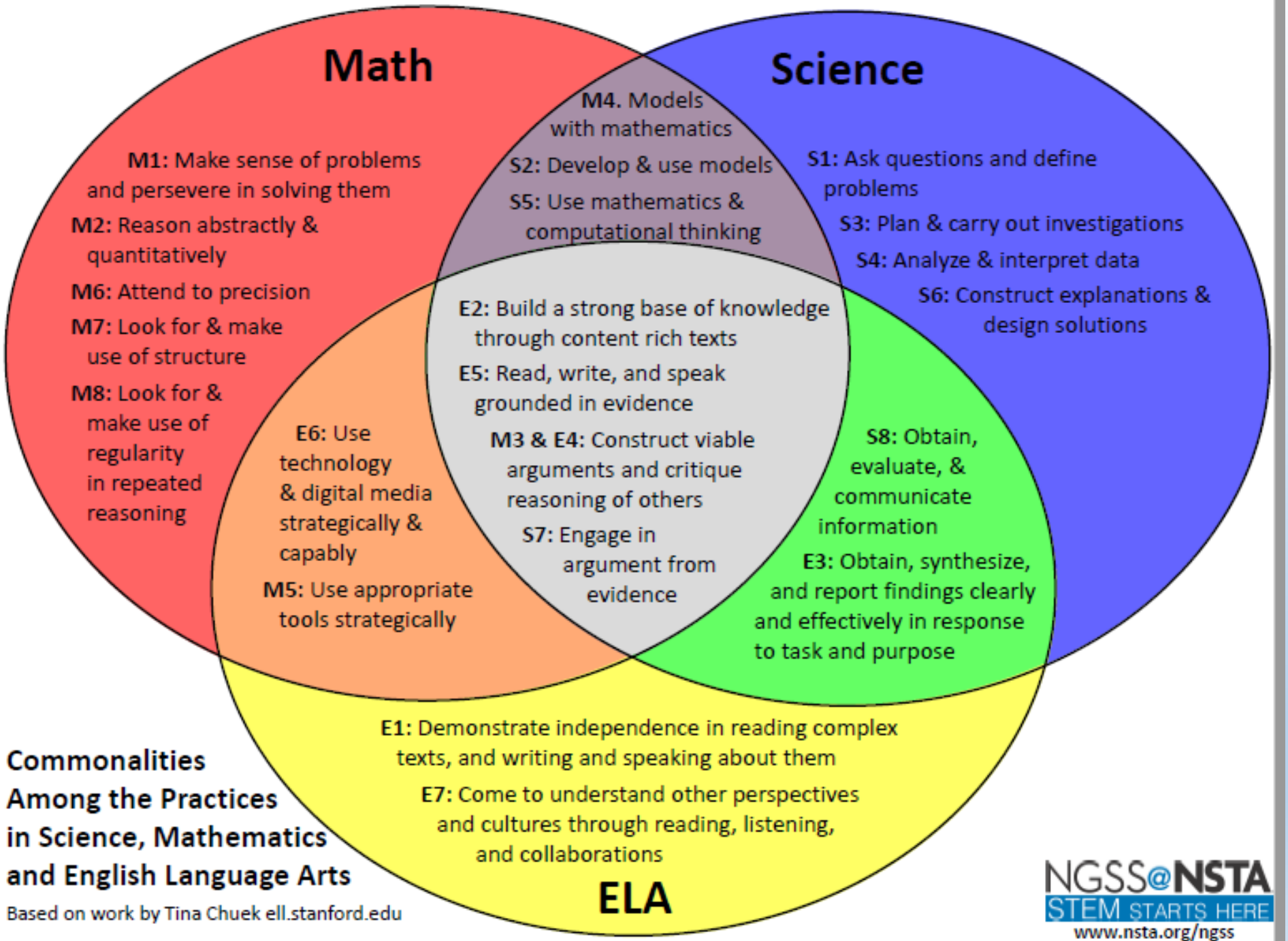
Kagan Line-Ups

Practices in Mathematics, Science, and English Language Arts*

Math	Science	English Language Arts
M1. Make sense of problems and persevere in solving them.	**S1.** Asking questions (for science) and defining problems (for engineering).	**E1.** They demonstrate independence.
M2. Reason abstractly and quantitatively.	**S2.** Developing and using models.	**E2.** They build strong content knowledge.
M3. Construct viable arguments and critique the reasoning of others.	**S3.** Planning and carrying out investigations.	**E3.** They respond to the varying demands of audience, task, purpose, and discipline.
M4. Model with mathematics.	**S4.** Analyzing and interpreting data.	**E4.** They comprehend as well as critique.
M5. Use appropriate tools strategically.	**S5.** Using mathematics, information and computer technology, and computational thinking.	**E5.** They value evidence.
M6. Attend to precision.	**S6.** Constructing explanations (for science) and designing solutions (for engineering).	**E6.** They use technology and digital media strategically and capably.
M7. Look for and make use of structure.	**S7.** Engaging in argument from evidence.	**E7.** They come to understanding other perspectives and cultures.
M8. Look for and express regularity in repeated reasoning.	**S8.** Obtaining, evaluating, and communicating information.	

* The Common Core English Language Arts uses the term "student capacities" rather than the term "practices" used in Common Core Mathematics and the Next Generation Science Standards.

NGSS@NSTA
STEM STARTS HERE



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

NGSS@NSTA
STEM STARTS HERE
www.nsta.org/ngss

Understanding the conceptual shifts

Understanding the conceptual shifts

So…what can you expect conceptually?

Let’s try a sorting activity…

Understanding the conceptual shifts

Things that scientists typically do	Things that science students in K-12 classrooms typically do
Rather than strictly follow a prescribed “scientific method,” a wide array of methods are developed and used to pursue questions.	They use a universally accepted scientific method to define the process for pursuing questions.

Understanding the conceptual shifts

Your turn…

As you sort the cards, talk with the group about your reasoning for each sort.

Understanding the conceptual shifts

What does this card sort tell you about the roles of scientists and K-12 science students?

How are they similar?

How are they different?

Understanding the conceptual shifts

BIG Idea/Take Away…

Orchestra students are musicians; students on the basketball team are athletes; do our students have an opportunity to be scientists?

Instructional Shifts

From	To
Rote memorization of facts	Facts and terminology learned while developing explanations and designing solutions supported by evidence-based arguments and reasoning
Learning of ideas disconnected from questions about phenomena	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned phenomena
Techers providing information to the whole class	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance
Teachers posing questions with only one right answer	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims

Understanding the Instructional shifts

So…what can you expect instructionally?

Let’s try another sorting activity…

Understanding the Instructional shifts

LSS designed lessons will look *less* like this:	LSS designed lessons will look *more* like this:
Explaining phenomena and designing solutions are not a part of student learning or are presented separately from "learning time" (i.e. used only a "hook" or engagement tool; used only for enrichment or reward after learning; only loosely connected to a DCI.	The purpose and focus of the lesson are to support students in making sense of phenomena and/or designing solutions to problems. The entire lesson drives toward this goal.

Understanding the instructional shifts

Your turn…

As you sort the cards, talk with the group about your reasoning for each sort.

Understanding the instructional shifts

What does this card sort tell you about how newly designed lessons should look based on the new standards?

How are they similar to your current lessons?

How are they different from your current lessons?

Instructional Strategies for 3D Learning

5E Instructional Cycle

Problem Based Learning (PBL)

Argument Driven Inquiry (ADI)

Teacher Talk Moves

Discrepant Events

Case Studies

Science and Engineering Notebooks

5 E's Model

Framework for developing an integrated and coherent instructional sequence

- **Engage**: Activities capture the students' attention, connect their thinking to the situation, and help them access current knowledge.
- **Exploration**: Students investigate initial ideas and solutions in meaningful contexts. The begin developing science core ideas, crosscutting concepts and science practices.
- **Explanation**: Based on an analysis of the exploration, students develop an explanation for the concept and practices. Their understanding is clarified and modified through the teacher's formal labels, descriptions and definitions and explanations.
- **Elaboration**: Students have opportunity to expand and apply their understanding of the concepts within new context and situations, real world application.
- **Evaluation**: Students assess their understanding of the concepts, and teachers have the opportunity to assess student learning.

What does it look like?

Elementary https://www.teachingchannel.org/videos/claims-evidence-science-lesson-achieve

Middle https://www.teachingchannel.org/videos/engineering-weight-design-challenge-boeing

High https://www.teachingchannel.org/videos/cross-discipline-lesson-achieve

Additional Questions To Be Considered…

- What additional resources will be needed?
- How will we accomplish mastery of understanding?
- How will science be assessed at the state level?
- What professional development will be needed and where will teachers get it?
- Can the curriculum be pruned to get at the core ideas?
- What scope and sequence will be followed?

Professional Development Priorities

- Education on the Framework and NGSS
- New content knowledge
- Time for planning
- Adaptation of existing instructional resources
- Guidance to use new teaching resources
- Model lessons, particularly to demonstrate science and engineering practices
- Vertical articulation and producing one coherent K thru 12 science program
- Integration with instruction of language arts and mathematics, where appropriate
- Instruction on guiding student questioning and experimentation

Questions

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