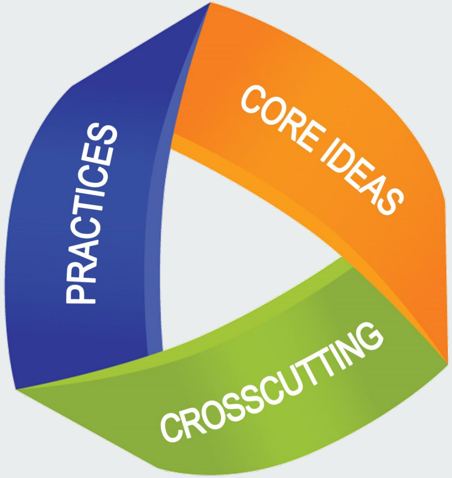
SHARING INSPIRATION 2019

THE POWER OF REALIZATION

Jessica Kohout
Reservoir High School, US
jessica_kohout@hcpss.org
@MrsKohout

Kevin Spry
Texas Instruments
kspry@ti.com
@kspry

Next Generation Science Standards
3 Dimensional Learning



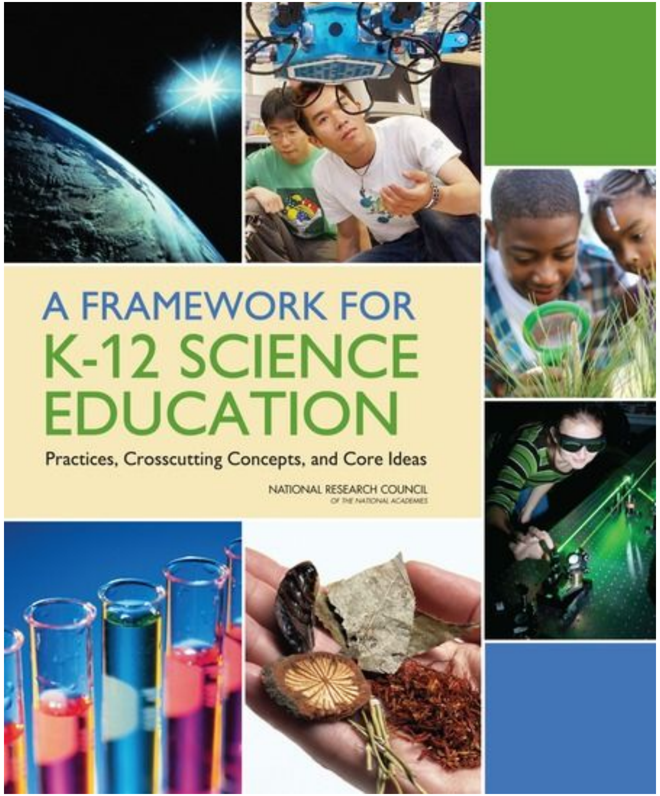
What do you already know about NGSS or science education in America?

The Vision:

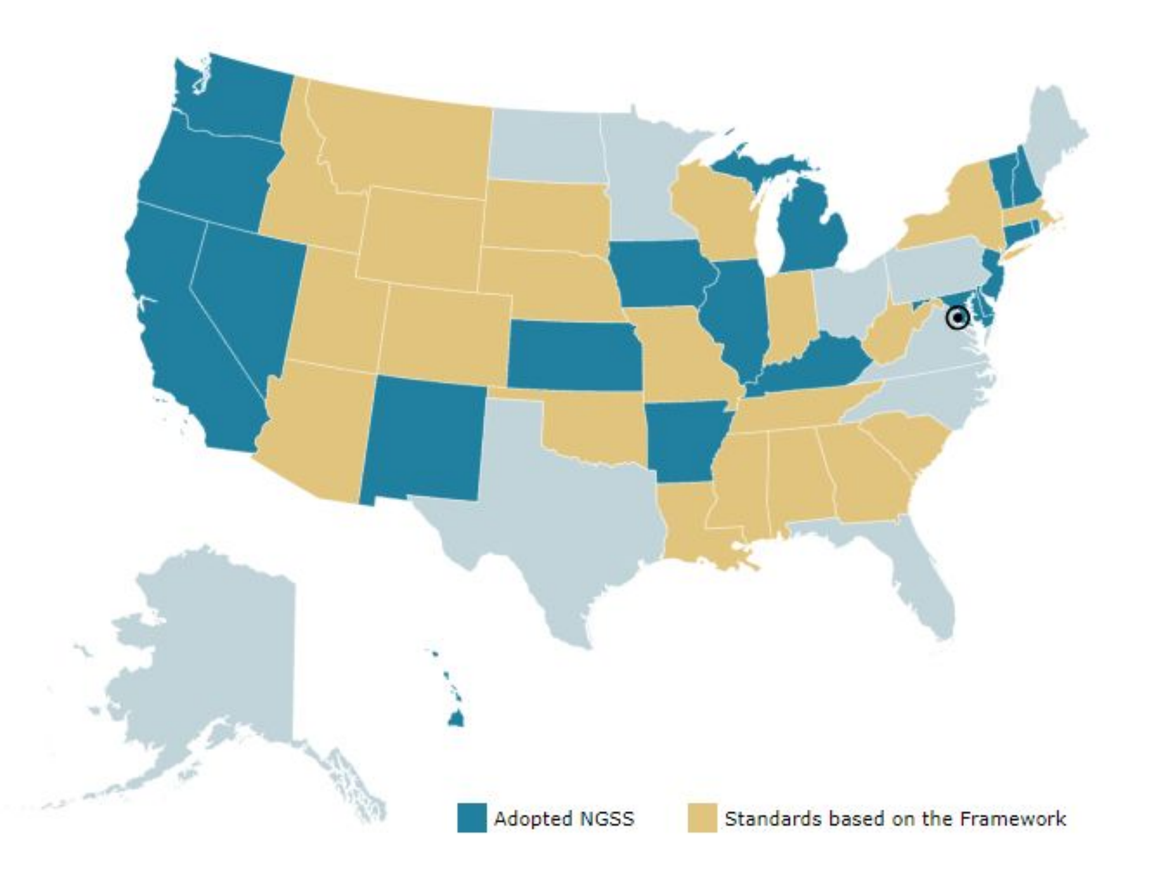
“By the end of the 12th grade, students should have gained sufficient knowledge of the practices, crosscutting concepts and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives.”

NGSS Development:

- Based on the National Research Council's 2012 document A Framework for K-12 Science Education.
- Developed by 26 states and a 40-member writing team composed of classroom teachers, working scientists, and education researchers.
- Each lead state assembled a team of educators, higher education faculty, scientists, and engineers to provide feedback on the draft standards.
- Two public review periods captured tens of thousands of comments during development that were used to revise each draft.

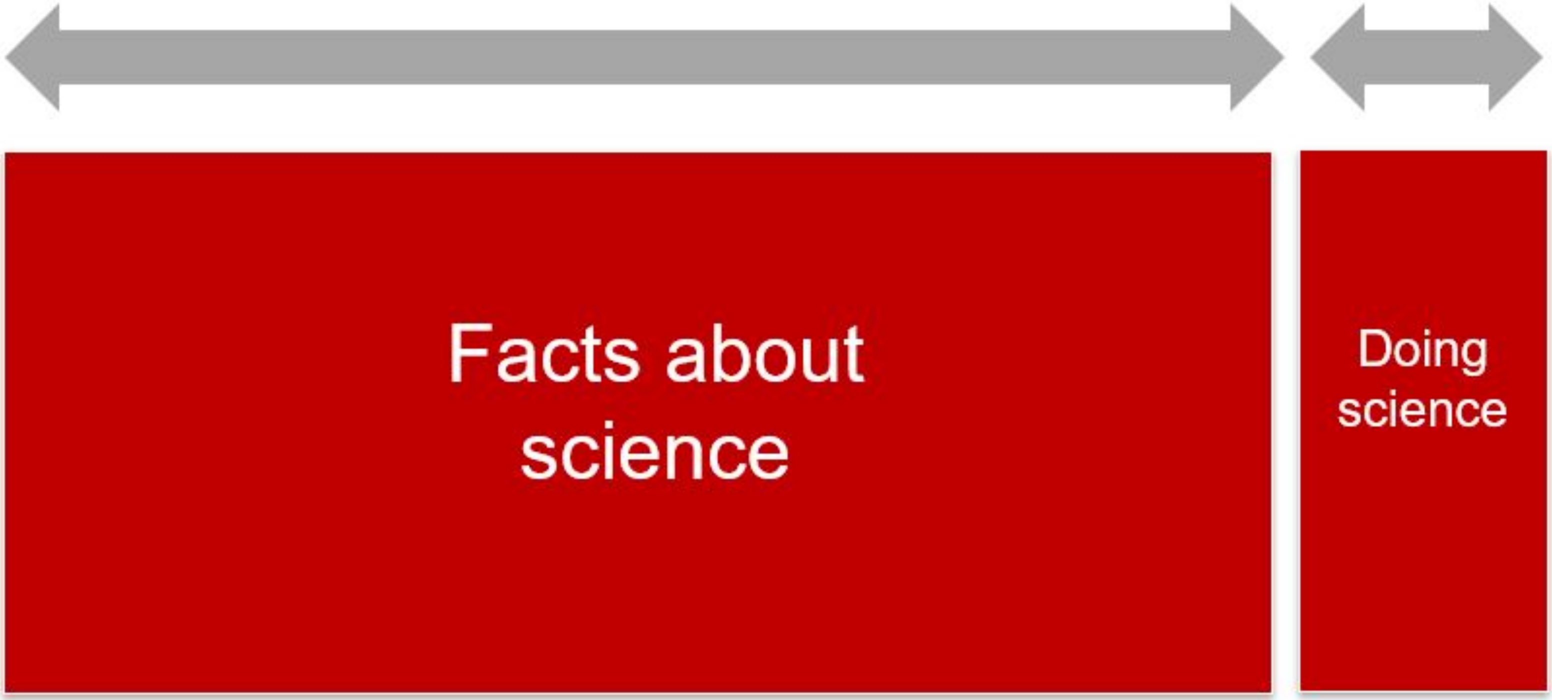


NGSS Adoption by State



National Association of Science Teachers: https://ngss.nsta.org/About.aspx

Before the Standards:



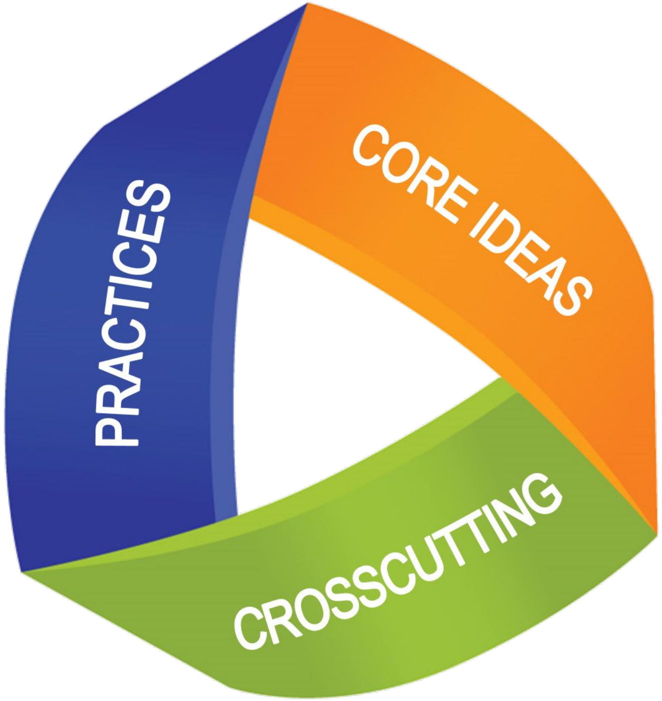
The Next Generation Science Standards (NGSS)

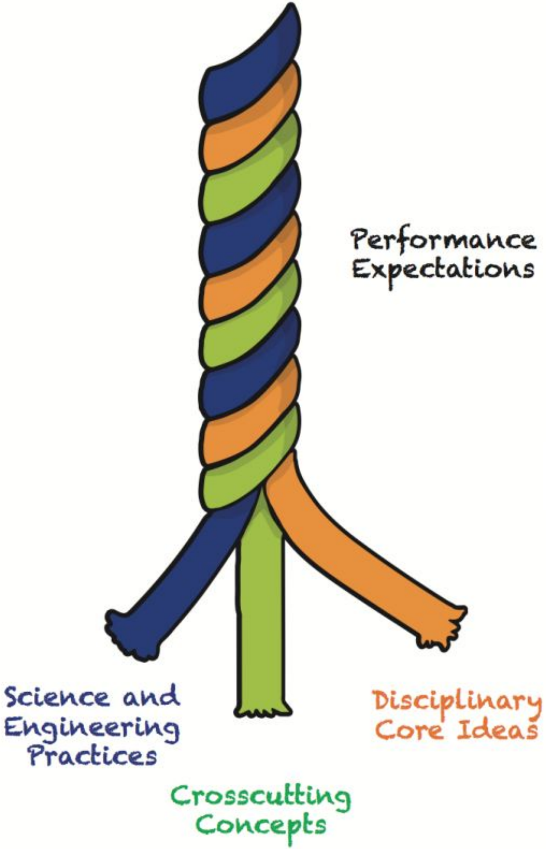
Science and Engineering Practices (doing science)

Disciplinary Core Ideas (facts)

Crosscutting Concepts (connecting science)

3 Dimensional Learning





Science and Engineering Practices (SEP)

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Cross Cutting Concepts (CCC)

- Patterns
- Cause and Effect: Mechanism and Explanation
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter: Flow, Cycle, and Conservation
- Structure and Function
- Stability and Change

Disciplinary Core Ideas (DCI)

Physical Science:
PS1: Matter and its Interactions
PS2: Motion and Stability: Forces and Interactions
PS3: Energy
PS4: Waves and Their Application in Technologies for Information Transfer

Life Science
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

Earth and Space Science:
ESS1: Earth's Place in the Universe
ESS2: Earth's Systems
ESS3: Earth and Human Activity

Engineering, Technology, and the Application of Science:
ETS1: Engineering Design

Science education will involve less:

1. Learning of ideas disconnected from questions about phenomena
2. Teachers providing information to the whole class
3. Teachers posing questions with only one right answer
4. Student reading textbooks and answering questions at the end of each chapter
5. Worksheets
6. Oversimplification of activities for students who are perceived to be "less able" to do science and engineering

Science education will involve more:

1. Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned
2. Students conducting investigations, solving problems, and engaging in discussions with teacher guidance
3. Students discussing open-ended questions that focus on the strength of the evidence used to generate claims
4. Students reading multiple sources and developing summaries of information
5. Student writing of journals, reports, posters, and media presentations that offer explanations and arguments
6. Provision of supports so that *all* students can engage in sophisticated science and engineering practices

What is Phenomena?

- An observable event or a real-world problem that can drive instructions
- Students can develop their own questions about the phenomena
- Students develop ways to figure out a solution or understand what is happening by applying the Science and Engineering Practices, Disciplinary Core Ideas and Cross Cutting Concepts.
- The phenomenon links the learning goals to the purpose of building knowledge.

Performance Expectation

HS-LS1-2

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Evidence Statements:

Observable features of the student performance by the end of the course:		
1	Components of the model	
	a	Students develop a model in which they identify and describe* the relevant parts (e.g., organ system, organs, and their component tissues) and processes (e.g., transport of fluids, motion) of body systems in multicellular organisms.
2	Relationships	
	a	In the model, students describe* the relationships between components, including:
		i. The functions of at least two major body systems in terms of contributions to overall function of an organism;
		ii. Ways the functions of two different systems affect one another; and
		iii. A system's function and how that relates both to the system's parts and to the overall function of the organism.
3	Connections	
	a	Students use the model to illustrate how the interaction between systems provides specific functions in multicellular organisms.
	b	Students make a distinction between the accuracy of the model and actual body systems and functions it represents.

Resources

- The Next Generation Science Standards: https://www.nextgenscience.org/
- STEM Teaching Tools: http://stemteachingtools.org/
- Achieve: https://www.achieve.org/
- Next Generation Science Storylines: http://www.nextgenstorylines.org/

NGSS Lesson Example using TI Technology

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

Driving Question: How can nanotechnology be used to help treat cancer?

NGSS Lesson Example using TI Technology

- Gold Nanoparticles (AuNP) are being used as a possible cancer therapy.
- AuNPs accumulate in tumor cells and are reactive to light.
- As light heats up the AuNP, the cancer cells are destroyed.
- This phenomena can be used to make connections with
  - cell structure
  - cell growth
  - transport through body systems.

NGSS Lesson

Gathering:

- Introduce students to phenomena of Gold Nanoparticles
- Students develop their own questions about the phenomena
- Use Science Nspired - Exploring Diffusion to investigate process of diffusion
- Model Osmosis and Diffusion through Science Nspired - Diffusion Data Collection Lab

Reasoning:

- Calculate rate of diffusion of different salt concentrations movement into the “cell”
- Discuss how model represents phenomena and its limitations

Communicating:

- Use UV sensitive beads as analogs to AuNP to create a model of how they accumulate in tumor cells and how light triggers cancer cell destruction

Documents and Info:

Access to Documents: http://bit.ly/SI19NGSS

Jessica Kohout
Email: jessica_kohout@hcpss.org
Twitter: @MrsKohout

Kevin Spry
Email: kspry@ti.com
Twitter: @kspry