NEXT GENERATION SCIENCE

NGSS App

Or go to: http://www.nextgenscience.org/

Level of Familiarity with NGSS

A. Today is my first exposure to it.

B. I've heard about it, but don't know many details.

C. I've seen examples of it, and I know a few details.

D. I've attended one or more presentations about it and/or read about it in detail.

E. I participated in a lead state review or critical stakeholder review of one of the earlier drafts.

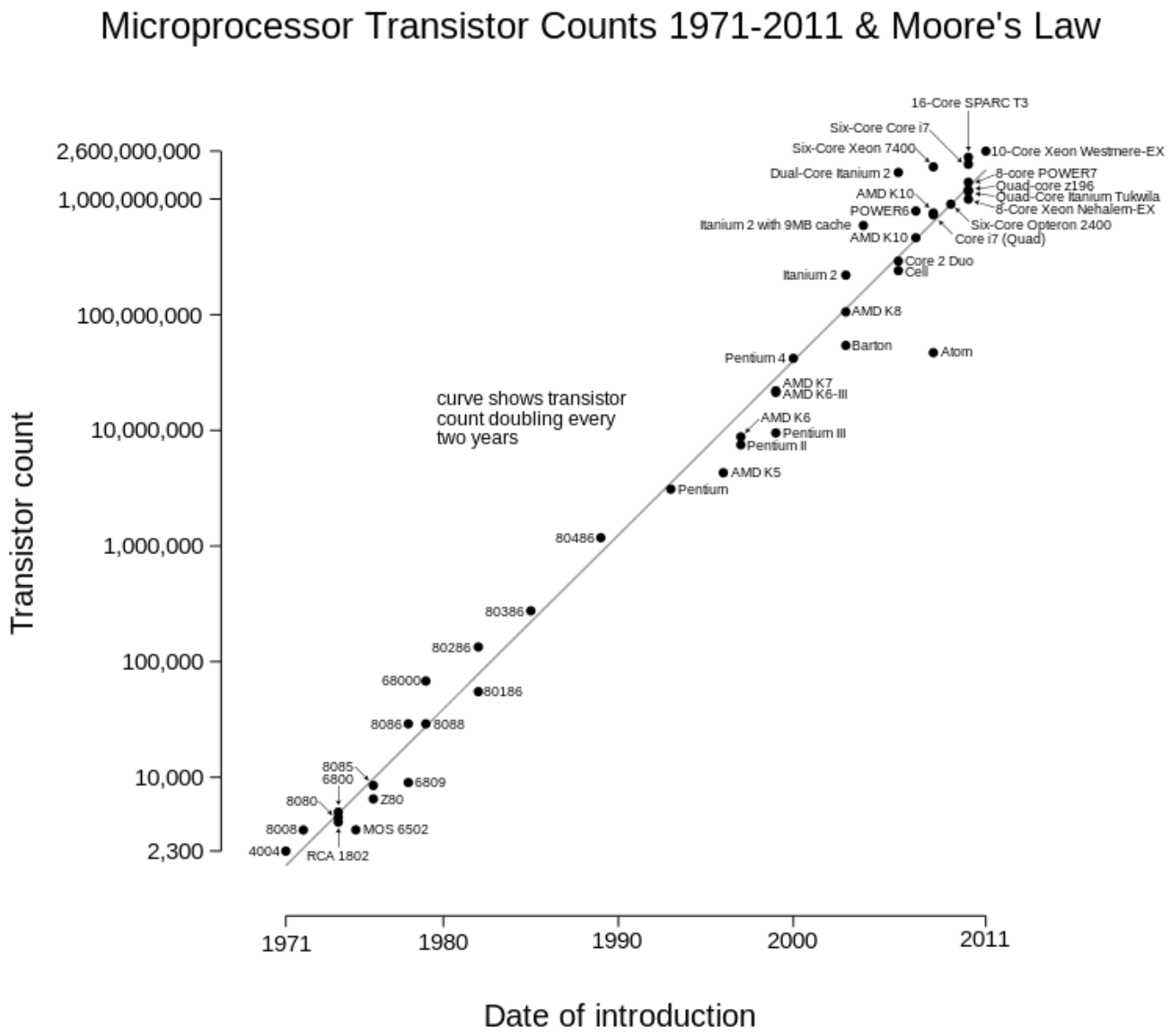
Poll page:

http://www.easypolls.net/poll.html?p=589a0524e4b0d85706c8dd08

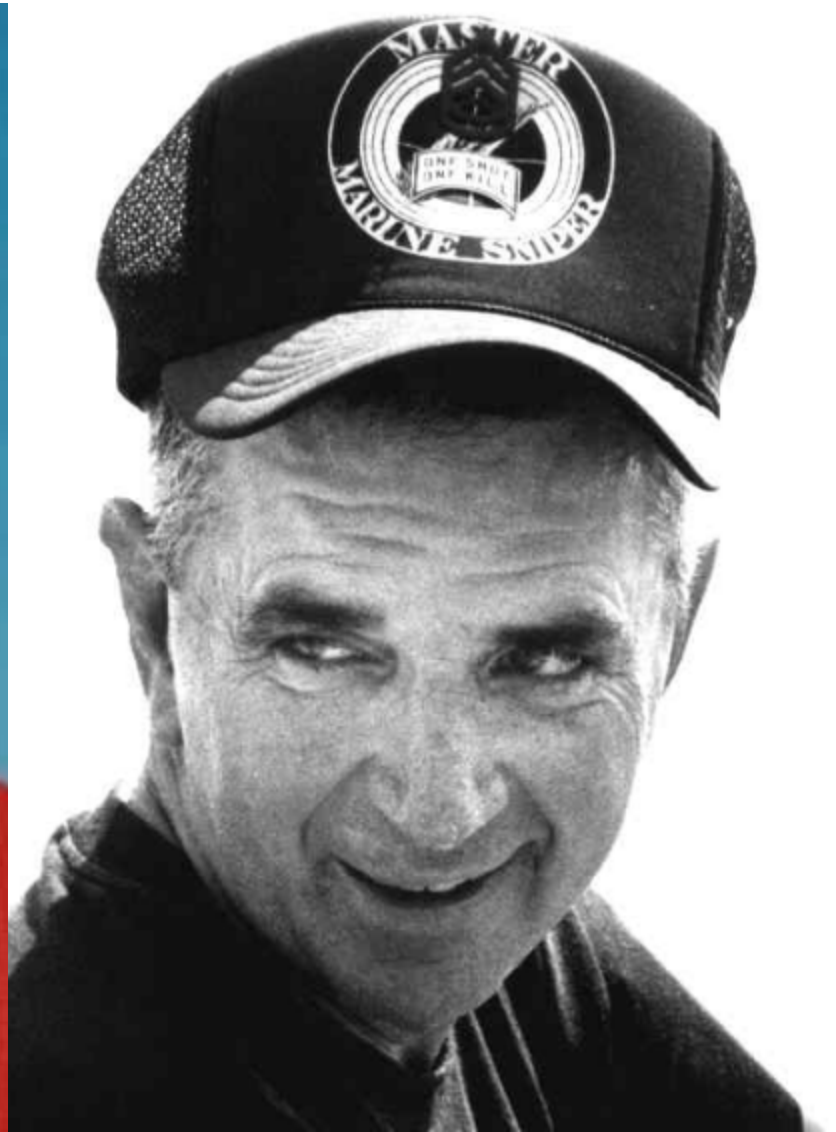
Brief History of NGSS

- Final standards released in April 2013.
- Based on the latest research in science teaching and learning.
- Integrates CCSS skills, College and Career Readiness Standards, and STEM.
- Many states and districts support the new standards and the methodology.
- Publishers identifying the best materials to support this instruction.
- http://ngss.nsta.org/conducting-assessments.aspx

Moore's Law

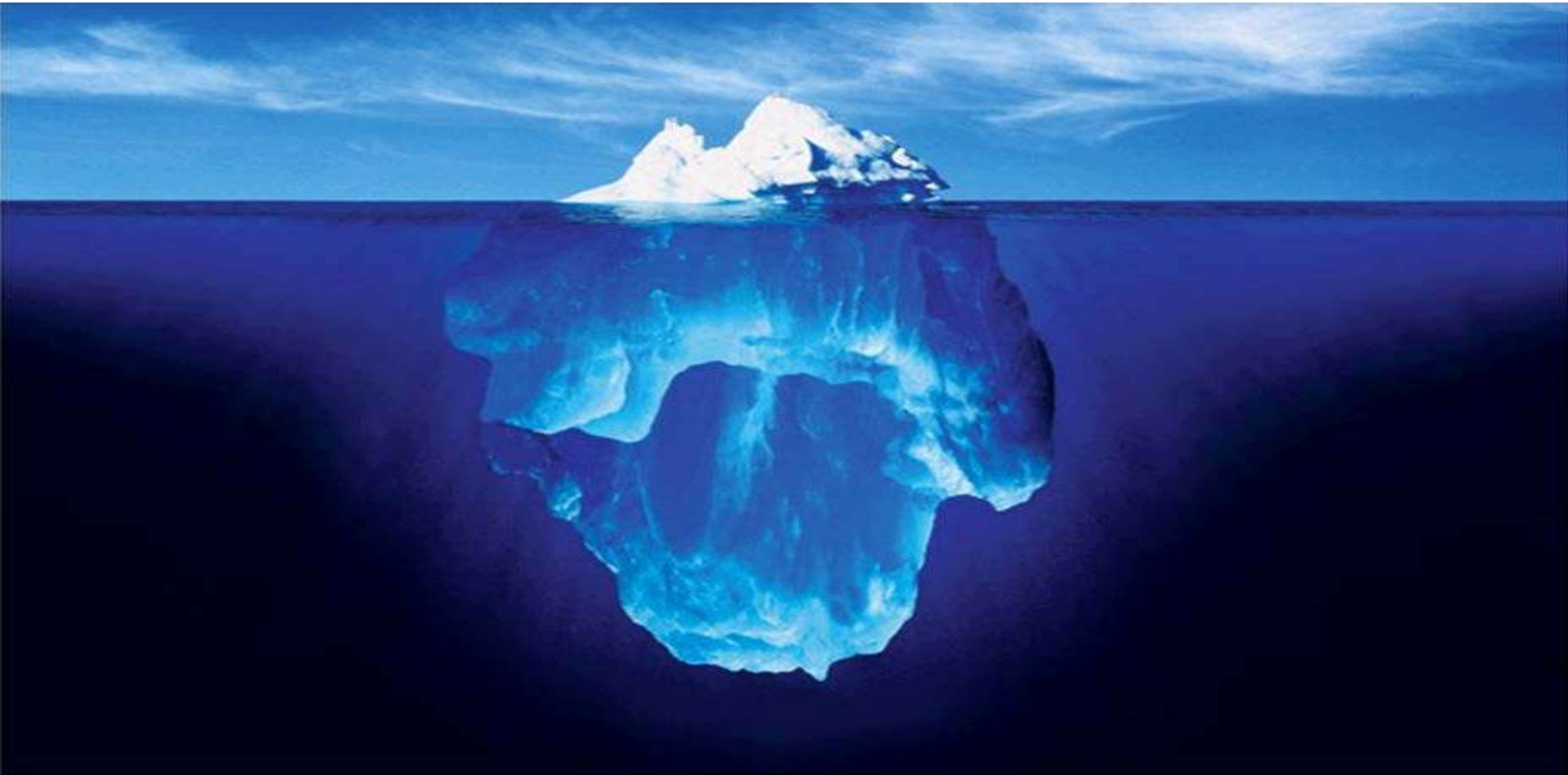

Microprocessor Transistor Counts 1971-2011 & Moore's Law
Transistor count
2,600,000,000
1,000,000,000
100,000,000
10,000,000
1,000,000
100,000
10,000
2,300
1971
1980
1990
2000
2011
Date of introduction
curve shows transistor count doubling every two years
16-Core SPARC T3
Six-Core Core i7
Six-Core Xeon 7400
10-Core Xeon Westmere-EX
Dual-Core Itanium 2
8-core POWER7
Quad-core z196
AMD K10
Quad-Core Itanium Tukwila
POWER6
8-Core Xeon Nehalem-EX
Itanium 2 with 9MB cache
Six-Core Opteron 2400
AMD K10
Core i7 (Quad)
Core 2 Duo
Cell
Itanium 2
AMD K8
Barton
Atom
Pentium 4
AMD K7
AMD K6-III
AMD K6
Pentium III
Pentium II
AMD K5
Pentium
80486
80386
80286
68000
80186
8086
8088
8085
6800
6809
8080
Z80
8008
MOS 6502
4004
RCA 1802

Credibility of sources



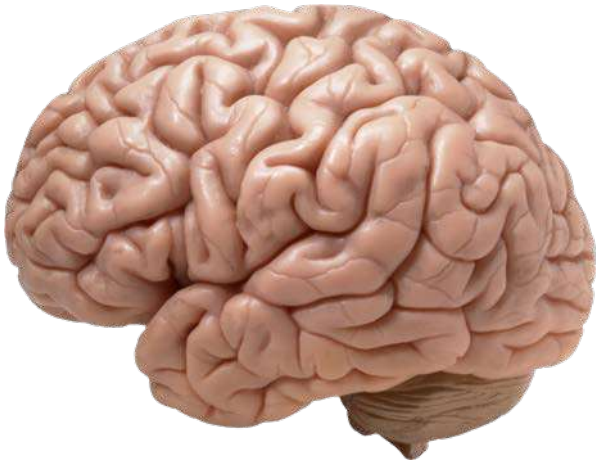
What's new in the NGSS "Framework"?

Content that is narrowed but deeper.



What's new in the NGSS "Framework"?

Fewer Factoids – More Process



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What's new in the NGSS "Framework"?

Greater Integration Among the Sciences

Physical

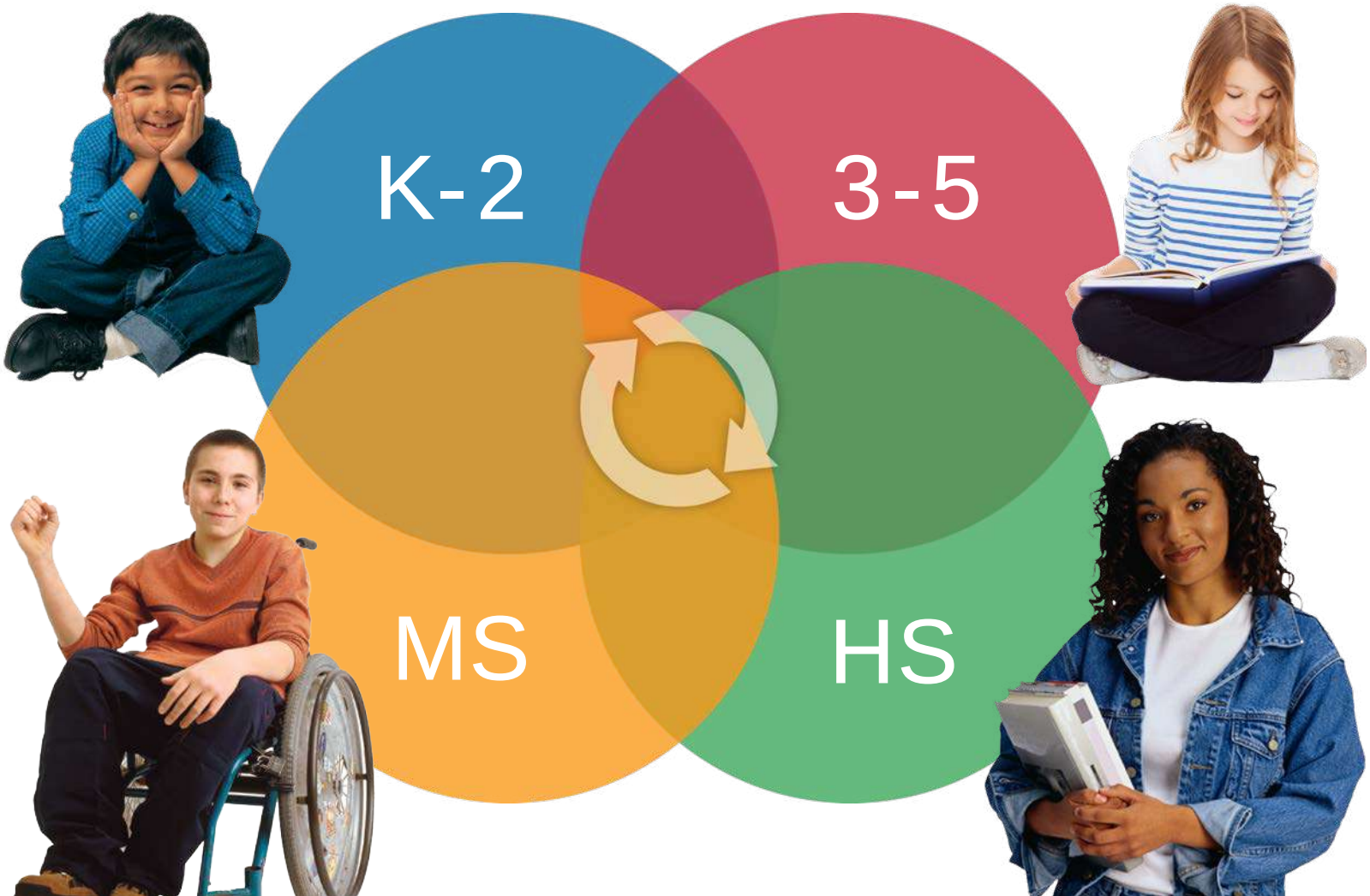
Engineering

Earth-Space

Life

What's new in the NGSS "Framework"?

Greater Integration Across Grade Levels



Integration Across Grade Levels

	Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Life Science				
LS1: From Molecules to Organisms: Structures and Processes				
LS1.A: Structure and Function	• All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)	• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	• All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MSLS3-2) • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)	• Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (secondary to HS-LS3-1) • 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. (HS-LS1-2) • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

http://ngss.nsta.org/AccessStandardsByDCI.aspx

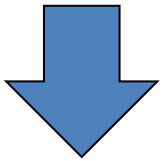
Development of NGSS

K-12 Science Framework (NRC)

DCI – Disciplinary Core Ideas – Content

SEP – Science and Engineering Practices – Inquiry and Design Skills

CCC – Crosscutting Concepts - Themes



Next Generations Science Standards = Performance Expectations

Old Vs New

Old Typical State Standard: Explain the significance of the process of photosynthesis.

NGSS Standard (PE): Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms!

Performance Expectations Consist of...

Disciplinary Core Ideas

- Life Science
- Earth Science
- Physical Sciences
- Engineering

Science and Engineering Practices

- Ask Questions and Define Problems
- Develop and Use Models
- Plan and Carry out Investigations
- Analyze and Interpret Data
- Construct Explanations and Design Solutions
- Engage in Argument from Evidence
- Obtain, Evaluation, and Communicate Information
- Use Mathematics and Computational Thinking

Crosscutting Concepts

- Patterns
- Structure and function
- Cause and Effect
- Cycling of Energy and Matter
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Stability and Change

Performance Expectations Consist of…

NGSS Standard (PE): Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms!

DCI – Disciplinary Core Ideas – Content –
role of photosynthesis in organisms

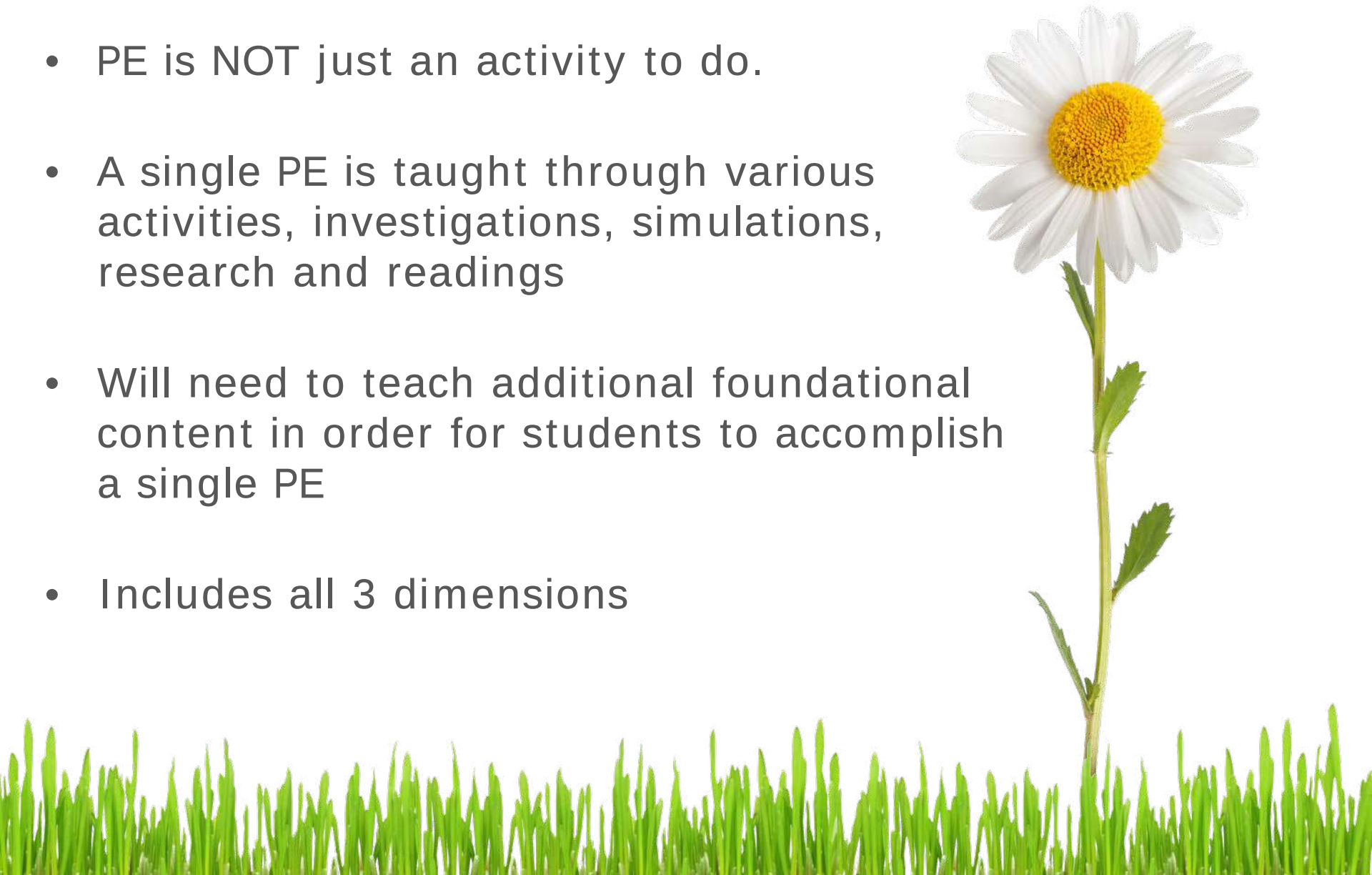
SEP – Science and Engineering Practices – Inquiry and Design Skills –
Construct a scientific explanation based on evidence for the role of photosynthesis in organisms.

CCC – Crosscutting Concepts - Themes – Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

Old Standards/Objectives vs NGSS PE

- PE is NOT just an activity to do.
- A single PE is taught through various activities, investigations, simulations, research and readings
- Will need to teach additional foundational content in order for students to accomplish a single PE
- Includes all 3 dimensions



Three Dimensions of NGSS

- Core Disciplinary Ideas
  BRICKS

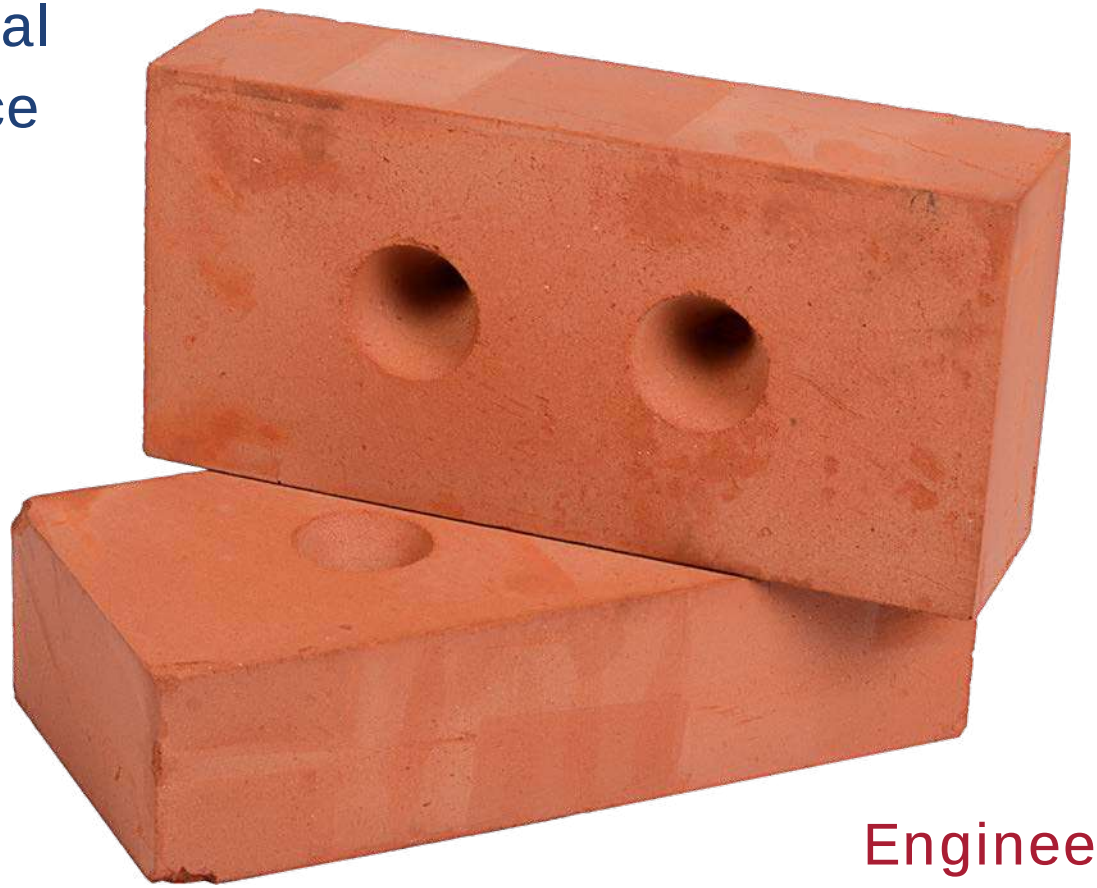
- Science and Engineering Practices
  TOOLS

- Cross-cutting Concepts
  MORTAR

Core Disciplinary Ideas

Physical Science

Life Science

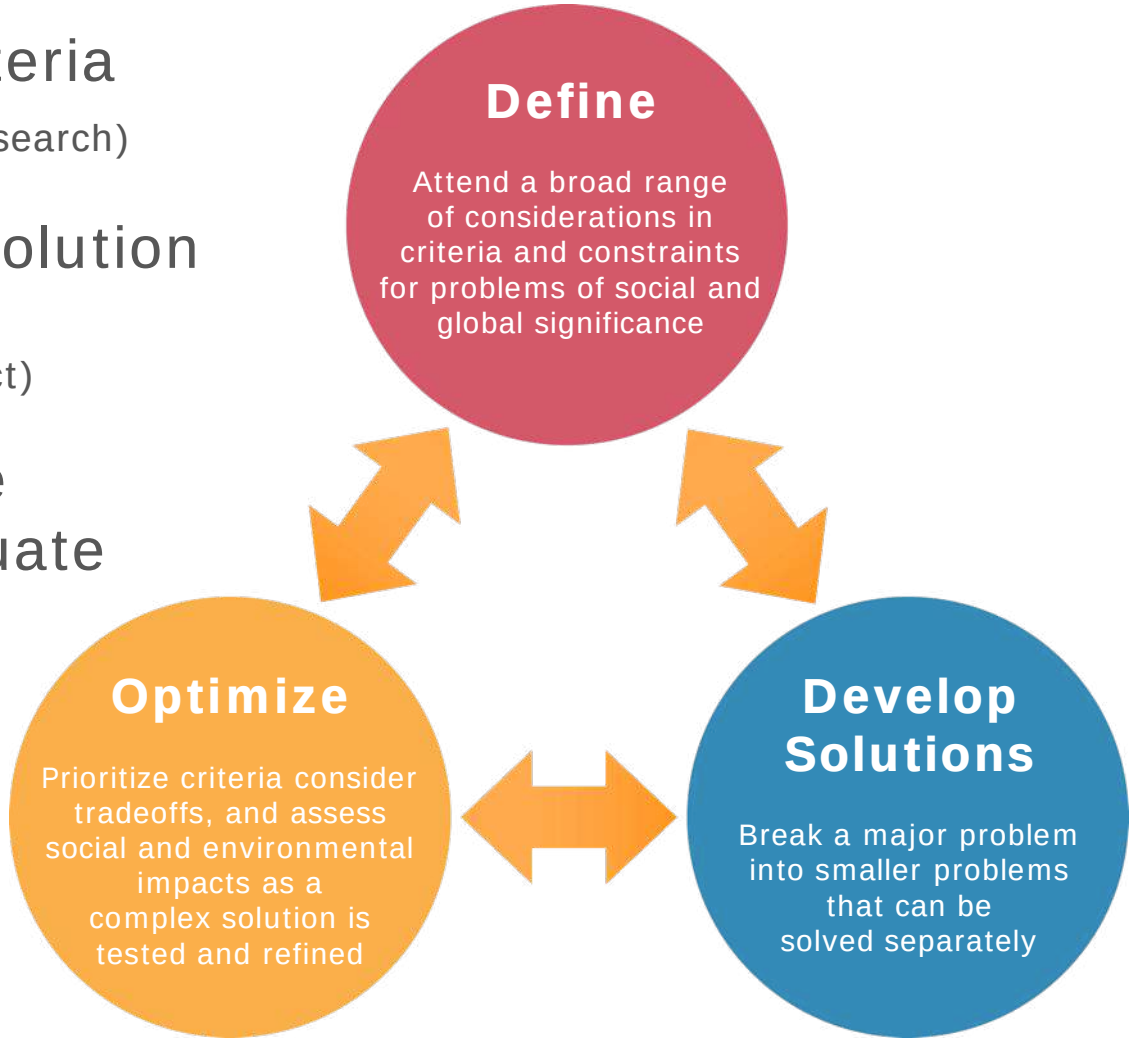


Earth & Space Science

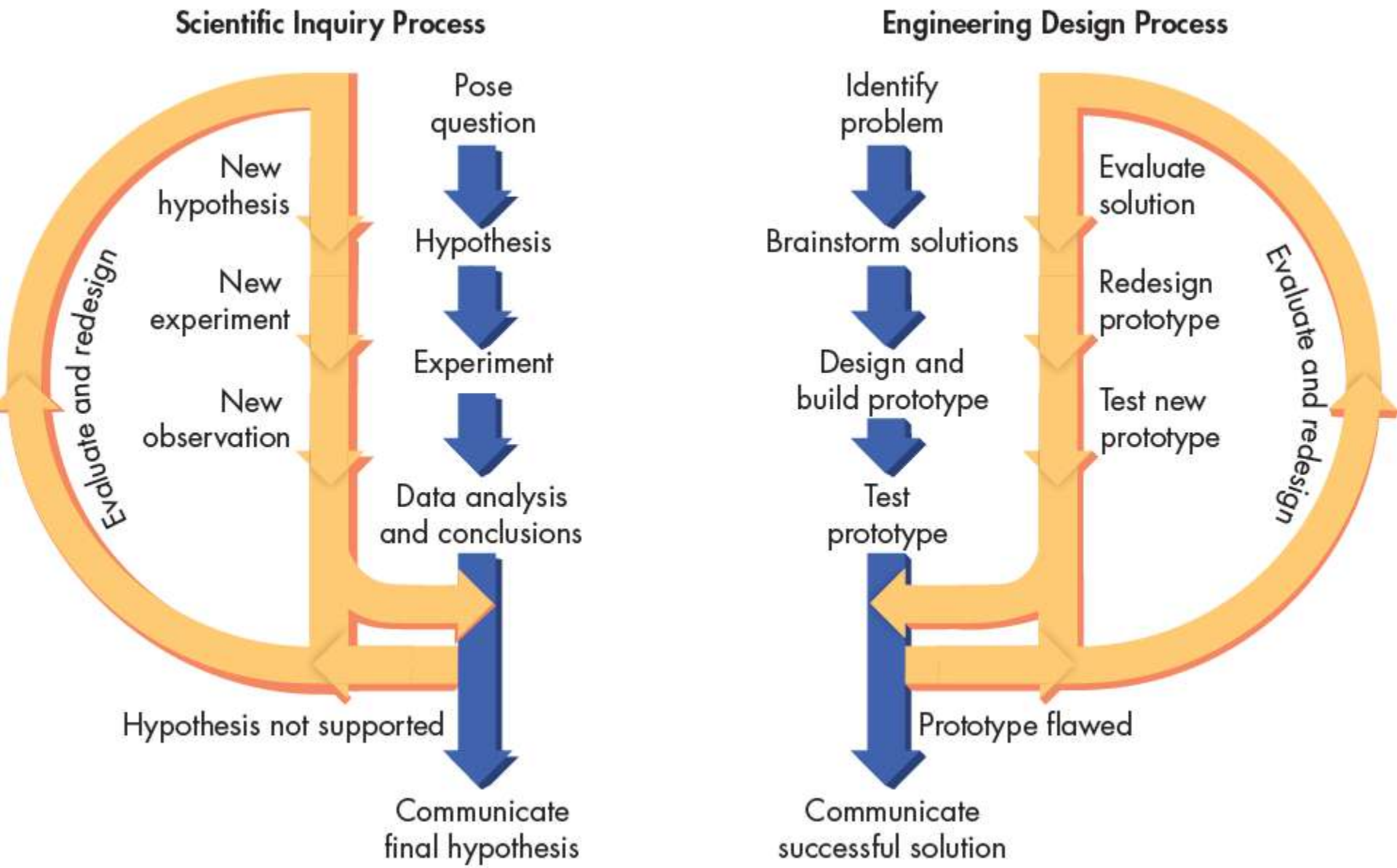
Engineering & Applied Science

Engineering – What Is It?

- **Define** – Identify criteria & constraints (Identify research)
- **Develop** – Possible solution via visual or physical (choose solution, design/construct)
- **Optimize** – Compare solutions, TEST, evaluate (test, communicate, evaluate, redesign)



Engineering – What Is It?



Science and Engineering Practices

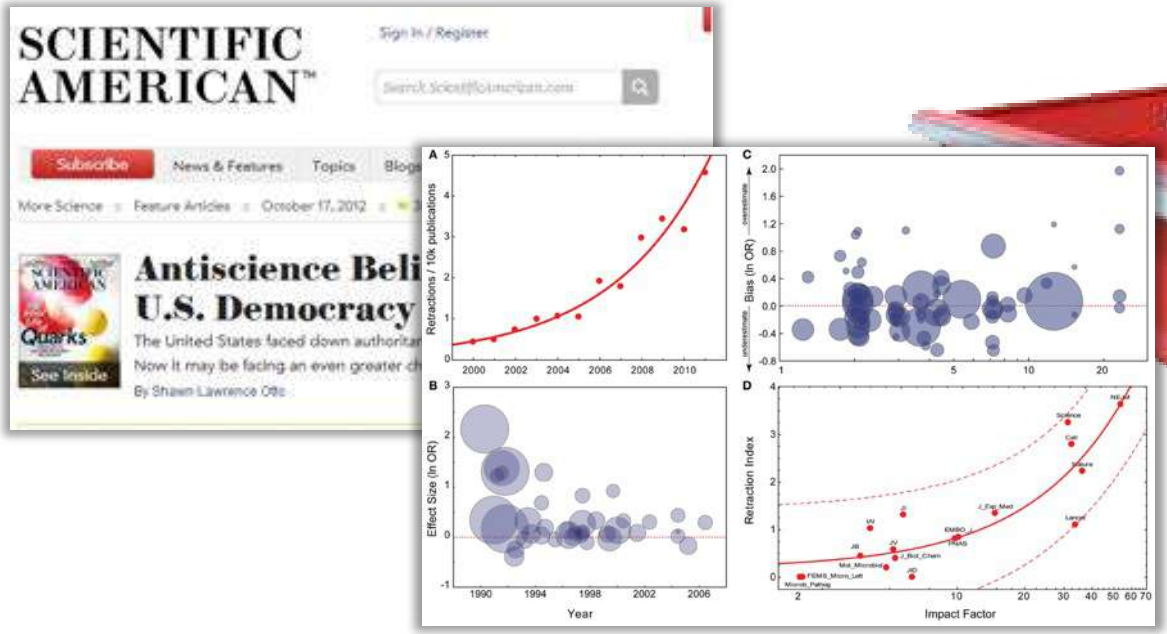
Asking Questions and Defining Problems

Developing and Using Models

Planning and Carrying Out Investigations

Science and Engineering Practices

Engaging in Argument from Evidence



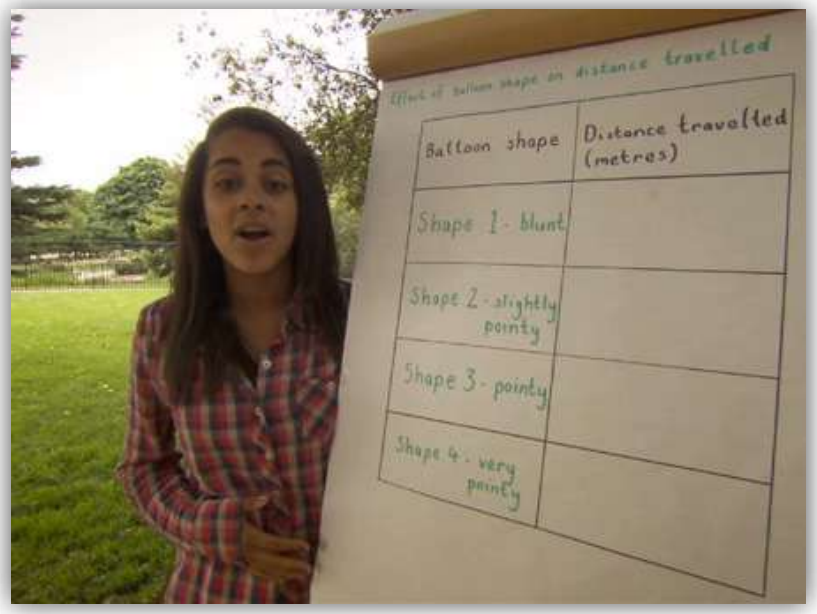
Analyzing and Interpreting Data

Science and Engineering Practices

Using Mathematics and Computational Thinking

Constructing Explanations and Designing Solutions

Science and Engineering Practices



Obtaining, Evaluating, and Communicating Information

Cross Cutting Concepts

MORTAR

1. **Patterns**
2. **Cause and Effect: Mechanism and Prediction**
3. **Scale, Proportion, and Quantity**
4. **Systems and System Models**
5. **Energy and Matter: Flows, Cycles, and Conservation**
6. **Structure and Function**

Three Dimensions

- Science and Engineering Practices

  TOOLS

- Cross-cutting Concepts

  MORTAR

- Core Disciplinary Ideas

  BRICKS

Integrating the Three Dimensions

> “Students actively engage in **Scientific and Engineering Practices** in order to deepen their understanding of **Cross-Cutting Concepts** and **Disciplinary Core Ideas**”

—A Framework for K-12 Science Education

And???

- Concerns for implementation of new standards?

- Any ideas for meeting the new standards in your classroom?

How to Read the NGSS

Performance Expectation represents the following: **HS-ESS 3-4**

HIGH SCHOOL

DOMAIN: EARTH/SPACE SCIENCE

TOPIC/DCI: ENERGY

STANDARD: 4

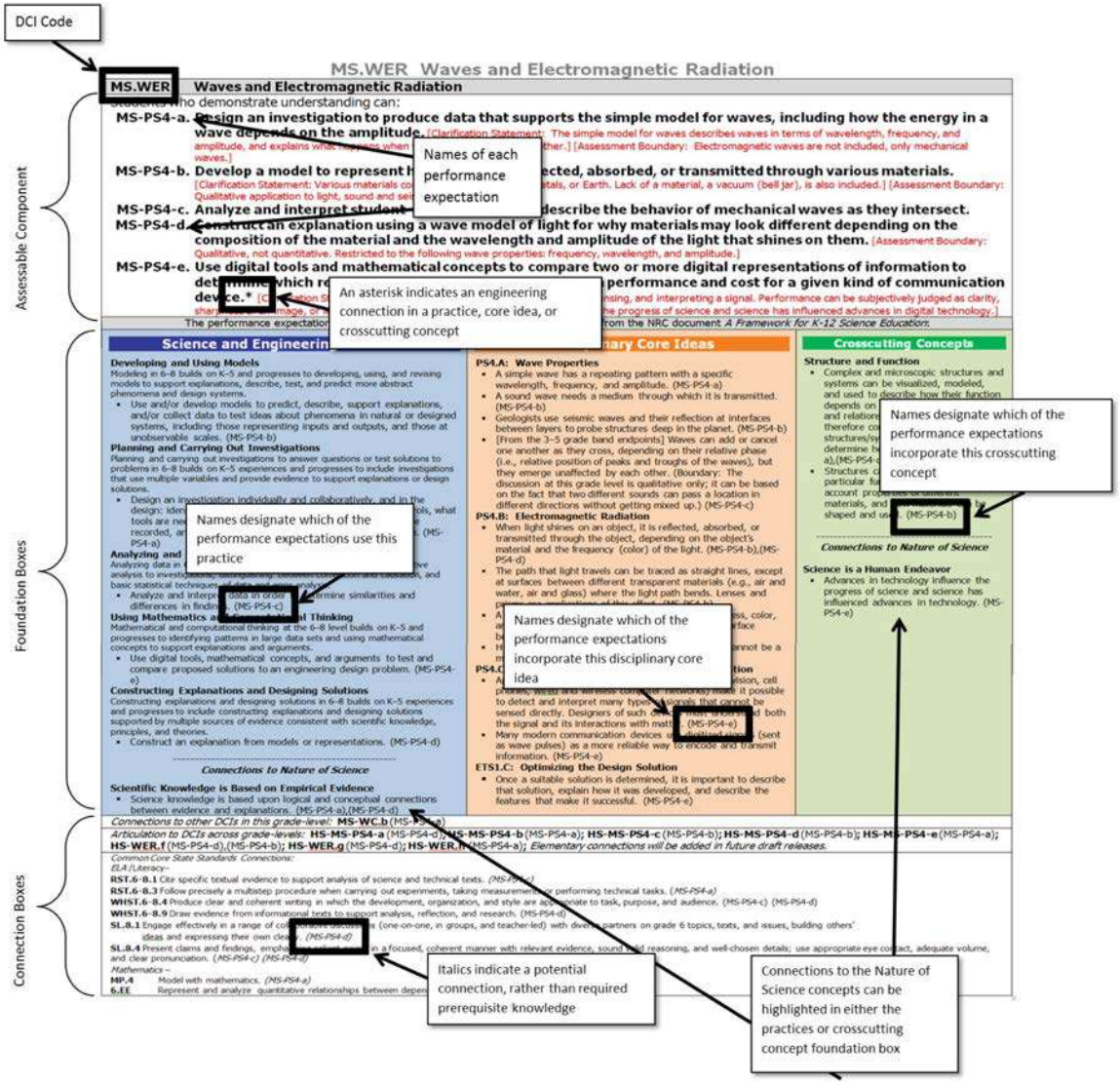
NOTE: Each grade level contains Performance Expectations from each Domain.

How to Read the NGSS

Assessable Component
(Performance Expectation)

Foundation Boxes
(Three Dimensions)

Connection Boxes
(Common Core, Articulation)



Example of an **Earth-Space Science Performance Expectation**

and its linking

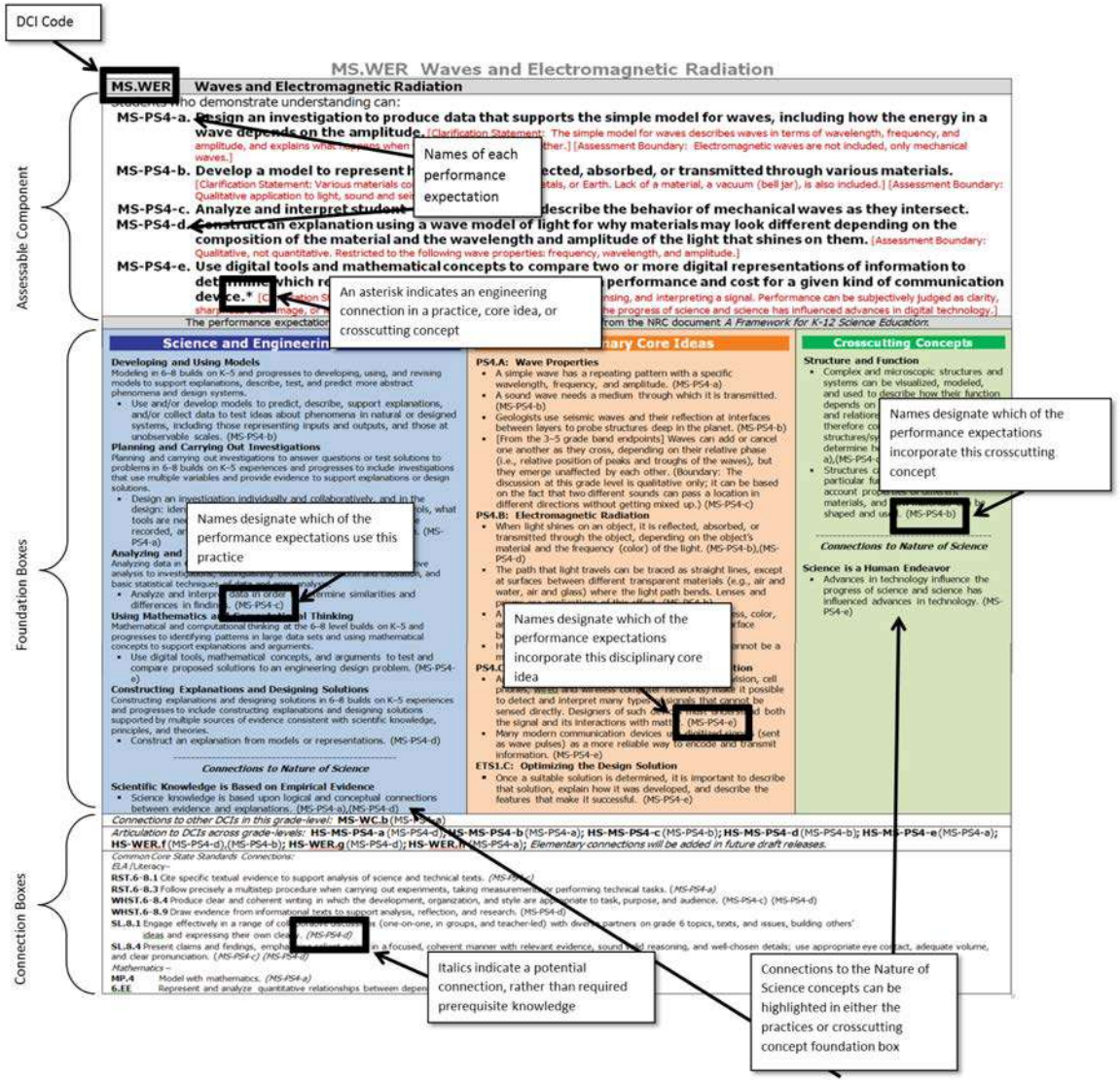
Science and Engineering Practice

to

Connecting Concepts

and

Clarification and Assessment



MS.ESS-EIP Earth's Interior Processes

Students who demonstrate understanding can:

a) Use models to explain how the flow of energy drives a cycling of matter between the Earth's surface and deep interior.

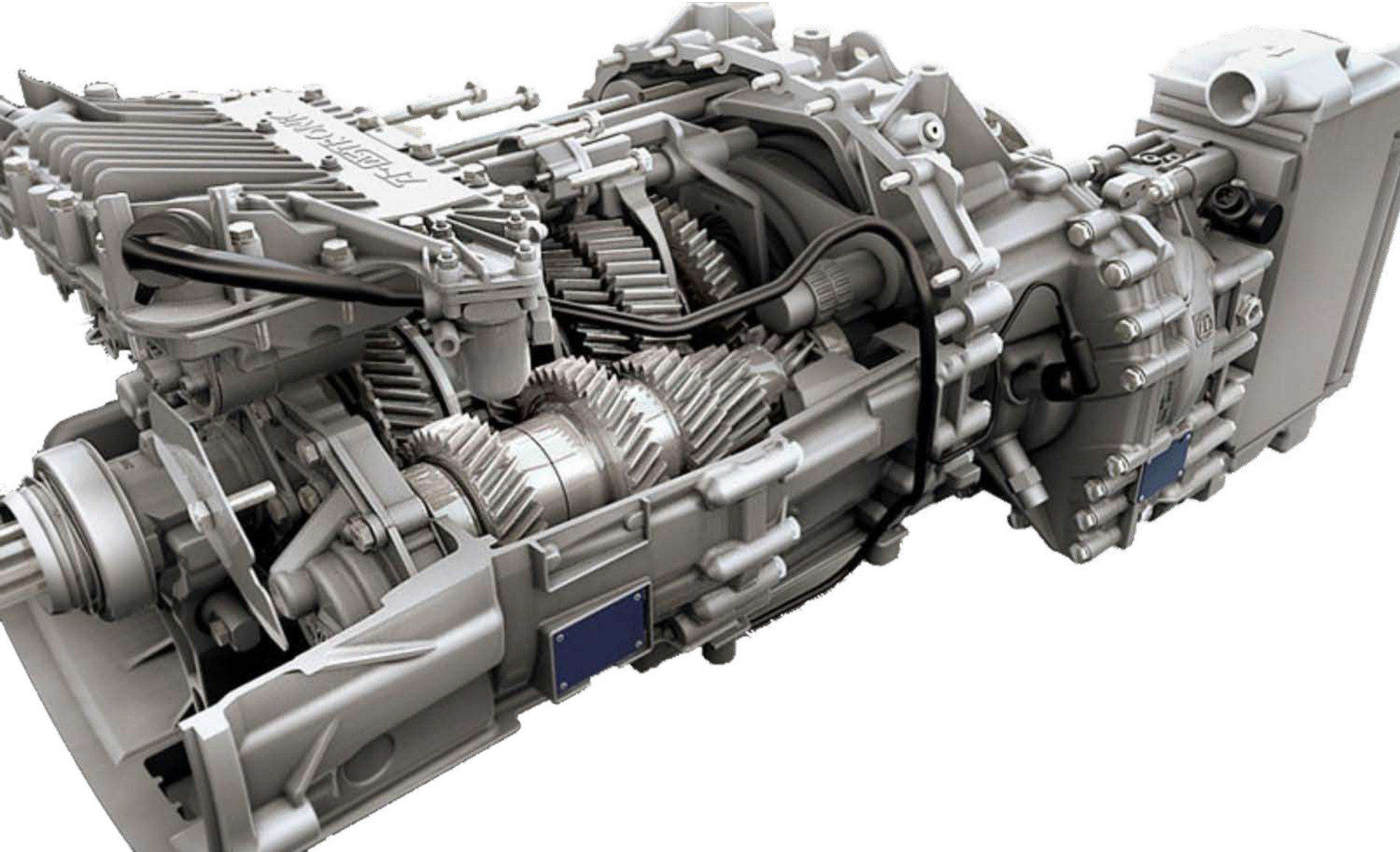
[Assessment Boundary: The thermodynamic processes that drive convection are not required, only a description of those motions. Explanations should include mid-ocean ridges.

Assessment Boundaries and Clarifying Statements

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Develo **Models** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and constructing models to predict and explain relationships between systems and their components in the natural and designed world.	**Systems** ▪ Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of	matter in closed systems is conserved. 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. Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or

Connections to other DCIs
Articulation to DCIs Across Grade Levels
Common Core and State Standards Connections

Let’s Put Theory into Practice!



High School Example STEM Activity - Handout

STEM ACTIVITY

Earth and Human Activity

Science and Engineering Practices

Designing Solutions

Design to Reduce Waste

As the world's human population soars, so does the problem of solid waste management. By 2025, some warn that people will be producing more than 6 billion kilograms of solid waste every day as compared to the more than 3.5 billion kilograms they produced each day in 2010. Managing all this waste costs hundreds of billions of dollars a year. However, without effective management, solid waste will pollute the environment, sicken people, and contribute greenhouse gases to the atmosphere.

Developed countries, especially the United States, contribute the major share of the daily solid waste produced globally. According to the Environmental Protection Agency (EPA), Americans generated about 707 million kilograms of solid waste every day in 2013. You might be surprised to learn that containers and packaging made up almost 30%, or about 211 million kilograms of that solid waste every day in 2013.

To reduce the amount of packaging heading to landfills, companies must find new ways to package their products. By redesigning their packaging, businesses can reduce the amount of solid waste entering landfills. However, different products need different types of packaging. Therefore, many new packaging options need to be developed.

Which Science & Engineering Practices did you engage in this activity?

How do I encourage students to:

NGSS Science & Engineering Practices	
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	❑

What Cross-Cutting Concepts were in this activity?

NGSS - Cross-Cutting Concepts	
1. Patterns	❑
2. Cause and Effect: Mechanisms and explanations	❑
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	❑

What to Look for in a Program

- Problem based learning
- No longer have Chapter 1 as Nature of Science (should be integrated)
- Integrated Engineering/STEM
- Doing science isn't enough – must be thinking critically, researching and reading.
- Student engagement (both mental engagement and physical engagement).
- Students should be: making claims – using evidence – supported by reasoning

An NGSS Program Should Include: