NGSS:
JOURNEY TO THE NEXT GENERATION

JUNE 18, 2019

#2019OCEP

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OUR AGENDA:

- WHAT IS NGSS AND WHY SHOULD I CARE?
- “20TH CENTURY” VS. “21ST CENTURY” SCIENCE
- EFFECTIVE PRACTICES FOR DEEP LEARNING
  - NORMING
  - OBSERVING
  - QUESTIONING
  - MODELING
  - REFLECTING
- EXAMPLES OF STUDENT LEARNING
BUT FIRST, A CONNECTOR...

The 6-Word Story!
Disciplinary core ideas are meant to focus K–12 science curriculum, instruction, and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have broad importance across multiple sciences or engineering disciplines;
- Provide a key tool for understanding complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or concerns that require scientific knowledge;
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.
### DCI Video

#### LS: 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

#### ESS: Earth and Space Science
- ESS1: Earth’s Place in the Universe
- ESS2: Earth’s Systems
- ESS3: Earth and Human Activity

#### PS: Physical Science
- PS1: Matter and Its Interactions
- PS2: Motion and Stability: Forces and Interactions
- PS3: Energy
- PS4: Waves and Their Applications in Technologies for Information Transfer

#### ETS: Engineering, Technology and the Application of Science
- ETS1: Engineering Design
Cross Cutting Concepts

Crosscutting concepts are the ideas have application across all domains of science. They are a way of linking the different Disciplinary Core Ideas. The NGSS Framework emphasizes that these concepts need to be made clear and direct for students because they provide an organizational foundation for interrelating various science fields into a scientifically-based view of the world.

Cross Cutting Concepts Video
1. Patterns
Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

2. Cause and Effect
Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

3. Scale, Proportion, and Quantity
In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

4. Systems and System Models
A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

5. Energy and Matter
Tracking energy and matter flows, into, out of, and within systems helps one understand their system’s behavior.

6. Structure and Function
The way an object is shaped or structured determines many of its properties and functions.

7. Stability and Change
For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Science and Engineering Practices

There are certain behaviors that ALL scientists engage in as they investigate and build models and theories about the natural world. There are also a key set of engineering practices that engineers use as they design and build models and systems.

NGSS uses the term *practices* instead of a term like “skills” to emphasize that participating in scientific investigation requires not knowledge, but action. The Science and Engineering practices are meant to tap into the cognitive, social, and physical aspects of being a scientist/engineer.

Interested in the distinction between scientific inquiry and engineering design? There are differences: *scientific inquiry involves the formulation of a question that can be answered through investigation*, while *engineering design involves the formulation of a problem that can be solved through design*.

Simply put, the SAEP are “designed” (pardon the pun) to increase the relevance of science, technology, engineering and mathematics (STEM) in our nation’s schools.
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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<tbody>
<tr>
<td>Asking Questions and Defining Problems</td>
<td>A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.</td>
</tr>
<tr>
<td>Developing and Using Models</td>
<td>A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.</td>
</tr>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.</td>
</tr>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.</td>
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## Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

## Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

## Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

## Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.
“LESS & MORE"

<table>
<thead>
<tr>
<th>SCIENCE EDUCATION WILL INVOLVE LESS:</th>
<th>SCIENCE EDUCATION WILL INVOLVE MORE:</th>
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<tbody>
<tr>
<td>Rote memorization of facts and terminology</td>
<td>Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.</td>
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<tr>
<td>Learning of Ideas disconnected from questions about phenomena</td>
<td>Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned</td>
</tr>
<tr>
<td>Teachers providing information to the whole class</td>
<td>Students conducting investigations, solving problems, and engaging in discussions with teachers’ guidance</td>
</tr>
<tr>
<td>Teachers posing questions with only one right answer</td>
<td>Students discussing open-ended questions that focus on the strength of the evidence used to generate claims</td>
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<tr>
<td>Students reading textbooks and answering questions at the end of the chapter</td>
<td>Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.</td>
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<tr>
<td>Pre-planned outcome for “cookbook” laboratories or hands-on activities</td>
<td>Multiple investigations driven by students’ questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas</td>
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<tr>
<td>Worksheets</td>
<td>Student writing of journals, reports, posters, and media presentations that explain and argue</td>
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<tr>
<td>Oversimplification of activities for students who are perceived to be less able to do science and engineering</td>
<td>Provision of supports so that all students can engage in sophisticated science and engineering practices</td>
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Prior to beginning your NGSS science year, it is important to establish classroom/lab norms that will help foster an environment of deep science learning.

However you choose to develop your norms, some key NGSS concepts to cover could be:

- Shared voice
- Lean into struggle
- Critical thinking
- Control and focus
- Hog vs. Log vs. Cog
SOMETHING LIKE A PHENOMENON
BURNING QUESTIONS

- Generate
- Sort
- Connect
- Extend

https://padlet.com/graymck1984/fjhpswmjq8q4
YOU’RE A SUPERMODEL(ER)

1. Individual
2. Group
3. Gallery Walk / Science Talk
4. Consensus Model
Individual Modeling
Group Models

My groups model!
Gallery Walk and Science Talk

My groups model!
Consensus Model

https://padlet.com/graymck1984/pes7uiw53uhz
Taking it to the Next Level
SAVE ROOM FOR P.I.E.

At the culmination of most activities, a great way to assess student-learning and implement technology is the use of a P.I.E Activity, or, “Post Investigation Explanation.” Using Seesaw, OneNote, FlipGrid, or paper/pencil, utilize this resource in the Schoology folder in each unit as a way to have students demonstrate understanding using both written expression, art, and VOICE. A great differentiation tool for learners of all needs.

**Earth and Space Systems**

**Investigation 5A/5B**

**P.I.E Activity (Post Investigation Explanation)**

**Directions:** Using the drawing tool, respond to the following questions by referencing pages 41-42 of your ESS Student Journal.

1. Could the biosphere exist without the hydrosphere, atmosphere, and geosphere? Why or why not?
2. Draw a model that demonstrates the interaction amongst all of earth's "spheres."

**Due:** Thursday, February 28th, by 9 p.m.
Sample Question

Earth and Space Systems

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Pictorial Model Response

Verbal Model Response (link) https://tinyurl.com/yxo7x5ev
Have you ever wished that absent students had a way to experience your daily science investigations? Are you looking for a fun, easy, app for students to master the art of presenting scientific findings? Is iMovie or Adobe Spark too cumbersome? Powerpoint or KeyNote too time-consuming? Try Apple Clips, or simply “Clips”! This free program is very simple for students to learn, and contains endless possibilities for summative and formative assessment.


Apple Clips Science Example (Landforms Projects): [https://tinyurl.com/yxo7x5ev](https://tinyurl.com/yxo7x5ev)
AND FINALLY, A REFLECTION...

padlet.com/graymck1984/20190CEP

The 6-Word Story Returns!
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