Teaching with Science Phenomena, Part 1

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http://bit.ly/EngagePhenomena

Session Goals

- Define “phenomenon” and “design challenge”
- Develop a criteria for determining what is and is not a phenomenon

Alignment to Learning Forward Standards

- The federal education law, Every Student Succeeds Act (ESSA), redefines professional development with a purposeful influence from Learning Forward.
- Learning Forward, a national association recognized as leaders in professional learning, has established standards for professional learning that set a high bar for quality learning experiences.
- This session aligns to the following standard(s):
  - ✓ Resources ***Professional learning that increases educator effectiveness and results for all students*** *requires prioritizing, monitoring, and coordinating resources for educator learning.*
  - ✓ Learning Designs ***Professional learning that increases educator effectiveness and results for all students*** *integrates theories, research, and models of human learning to achieve its intended outcomes.*
  - ✓ Implementation ***Professional learning that increases educator effectiveness and results for all students*** *applies research on change and sustains support for implementation of professional learning for long-term change.*
  - ✓ Outcomes ***Professional learning that increases educator effectiveness and results for all students*** *aligns its outcomes with educator performance and student curriculum standards.*

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STEP 1: Understanding what phenomenon are & are not.

- How have you heard **"phenomena" described**, especially in relation to science teaching?

- **What questions do you have** about phenom**e**n**a** we should answer together?

STEP 1: Understanding what phenomenon are & are not.

Work in small groups to sort cards into three piles, and determine which of these is:

- A phenomenon
- A design challenge
- A science idea/concept/disciplinary core idea

STEP 1: Understanding what phenomenon are & are not.

- ❑ Share one card and where you placed it.
- ❑ Share why you placed it in that category.

STEP 1: Understanding what phenomenon are & are not.

What are some **criteria** we can use to decide if something's a **phenomenon**?

STEP 1: Understanding what phenomenon are & are not.

Phenomena are ***observable events*** that occur in the universe and that ***we can use our science knowledge to explain or predict***. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena.

Definition from [Achieve, Next Generation Science Storylines & STEM Teaching Tools]

STEP 1: Understanding what phenomenon are & are not.

What are some **criteria** we can use to decide if something's a **design challenge**?

STEP 1: Understanding what phenomenon are & are not.

Engineering involves **designing solutions to problems** that **arise from phenomena**, and **using explanations of phenomena** to design solutions.

Definition from Achieve, Next Generation Science Storylines & STEM Teaching Tools

STEP 1: Understanding what phenomenon are & are not.

What are some **criteria** we can use to decide if something's a disciplinary core idea (DCI).

5TH GRADE

5-ESS2-1 Earth's Systems

Science & Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. **Developing and using models**
   Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
   - **Develop a model using an example to describe phenomena.**
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Earth Materials and System:

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes.
- The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate.
- Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

Performance Expectations

5-ESS2-1

Students who demonstrate understanding can:

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Clarification Statement:
Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.

Assessment Boundary:
Assessment is limited to the interactions of two systems at a time.

Crosscutting Concepts: System and System Models

- A system can be described in terms of its components and their interactions.

Teaching with Science Phenomena, Part 2

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Session Goals

- Understand the different types of phenomena and how they are used in the classroom
- Understand how phenomena support equity in the classroom

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

- A phenomenon can be **"a case"** of something...What happened to the aspens when wolves were introduced into the Yellowstone?

- A phenomenon can be a "**puzzling observation**" of the everyday... Rainwater isn't salty, even when it is coming from the salt water in the ocean.

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

Phenomena are rich in context with a **specific event** under **specific conditions and time** rather than general provide robust opportunities to drive equitable instruction.

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

How are volcanoes formed?

→ **Why** do Mt. Rainier and Hawaiian volcanoes erupt differently?

How do plant reproduce?

→ **How** did an apple tree start growing in the meadow, a mile from other apple trees?

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

Some phenomena can be used to **anchor** a long sequence of instruction, because they are likely to take many class periods to explore. Other phenomena, though, become the **focus of a single period of instruction**—or a small number of periods.

These might be phenomena that help students gain understanding of some aspect of a bigger phenomenon students are investigating.

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

Anchoring Phenomenon: How can a singer break a glass with their voice?

Day 2: At recess, we observed... “that we could hear the ball bouncing from across the playground.

Day 3: From the humming near the glass activity, we learned… “when we humm hear the glass the salt on top shakes and we think it is because of sound waves.

Day 4: In the hall… “the closer you are to things the louder you hear them.”

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

Analogous phenomenon are phenomenon that **utilize the same** science ideas/concepts/disciplinary core ideas **to explain**.

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

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- Choosing the right phenomena for our students **helps empower** those who don't normally identify as successful science students.
- When a phenomenon sparks enough student curiosity to carry a unit, it's because the phenomenon is **relevant to them.** It taps into their **interest and their identity**.
- Read NGSS for All Students to learn **strategies** to reach all your diverse learners.
- Check out https://www.rubicon.com/ngss-using-phenomena-engage-students

STEP 2: Understanding different types of phenomena & how they can be used to drive equitable instruction.

Before we introduce any phenomenon to our students, we have to take the time to explore it ourselves.

- What **questions** does it make us ask (CCCs)?
- What **science ideas** are required to explain it (DCIs)?
- What ways do I **collect more information** to explain the phenomenon (SEPs)?

Crosscutting Concepts: How Scientists Think

Dimension 2: Crosscutting Concepts

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

Disciplinary Core Ideas: Ideas Scientists Use & Discover

Dimension 3: Disciplinary Core Ideas

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

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 Unity and Diversity

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

Science & Engineering Practices: What Scientists Do

Dimension 1: Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
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 (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
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