

Using Phenomena to Drive NGSS Lessons

SDNI-NNCI Annual Educational Symposium 2020

bit.ly/SDCOE-NNCI

Scientific Phenomena Defined

Scientific phenomena are occurrences in the natural and human-made world that can be observed and which cause one to wonder and ask questions.

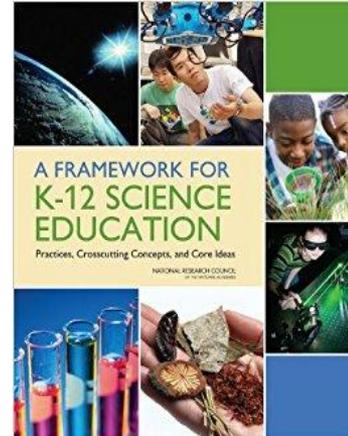


Why is NGSS Important?



ALL students...

- have some appreciation of the beauty and wonder of science
- possess sufficient knowledge of science and engineering to engage in public discussion on related issues
- are careful consumers of scientific and technological information related to their everyday lives
- are able to continue to learn about science outside school
- have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology.”

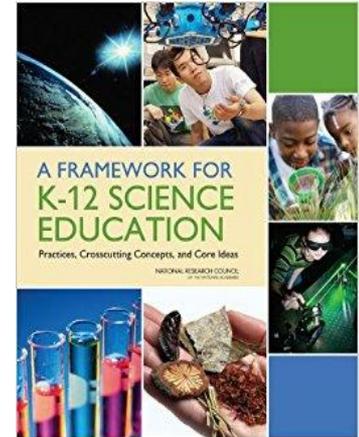


Why is NGSS Important?



“...a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in **scientific and engineering practices** and apply **crosscutting concepts** to deepen their understanding of the **core ideas** in these fields.”

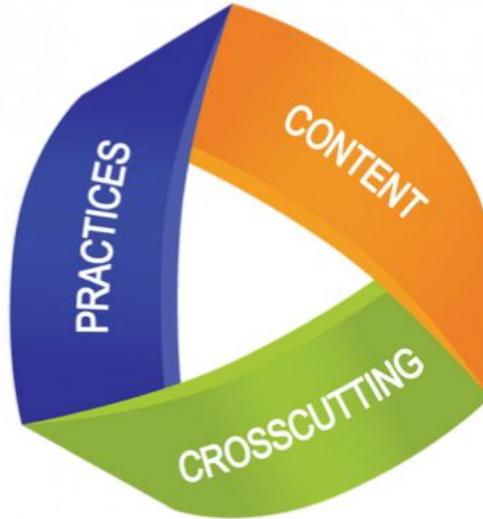
NRC Framework, 2012, p. 8



Three dimensions of the NGSS

Science and Engineering Practices

- 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



Crosscutting Concepts

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

Disciplinary Core Ideas

Physical Sciences

- 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 Sciences

- 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 Applications of Science

- ETS1: Engineering design
- ETS2: Links among engineering, technology, science, and society

Next Generation Science Standards

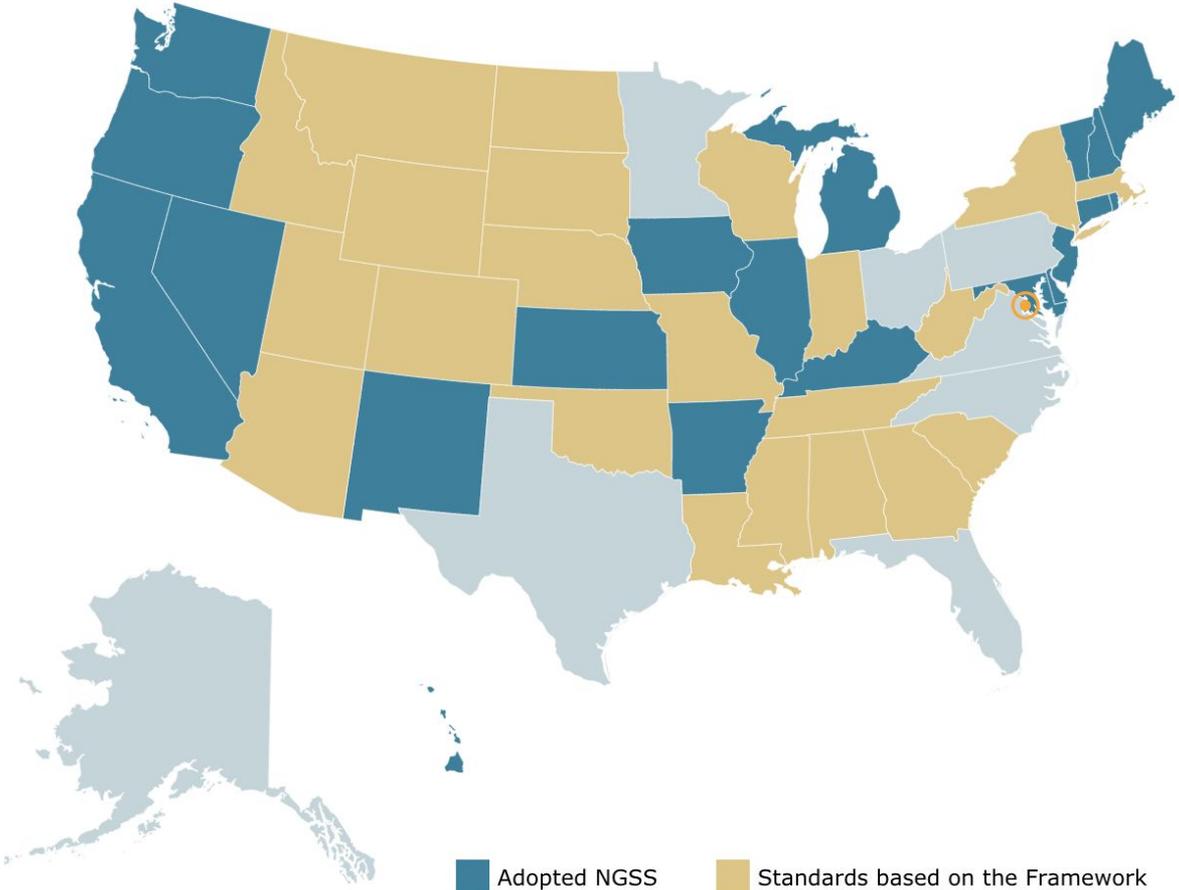


Image Source:
<https://ngss.nsta.org/About.aspx>

Design Team Approach

Design Team Organization

- Scientists and Experts
- Classroom Teachers
- SDCOE Facilitator



Research
Sharing and
Science Learning

Classroom
Content
Connections

Identify
Possible
Phenomena

Driving
Questions

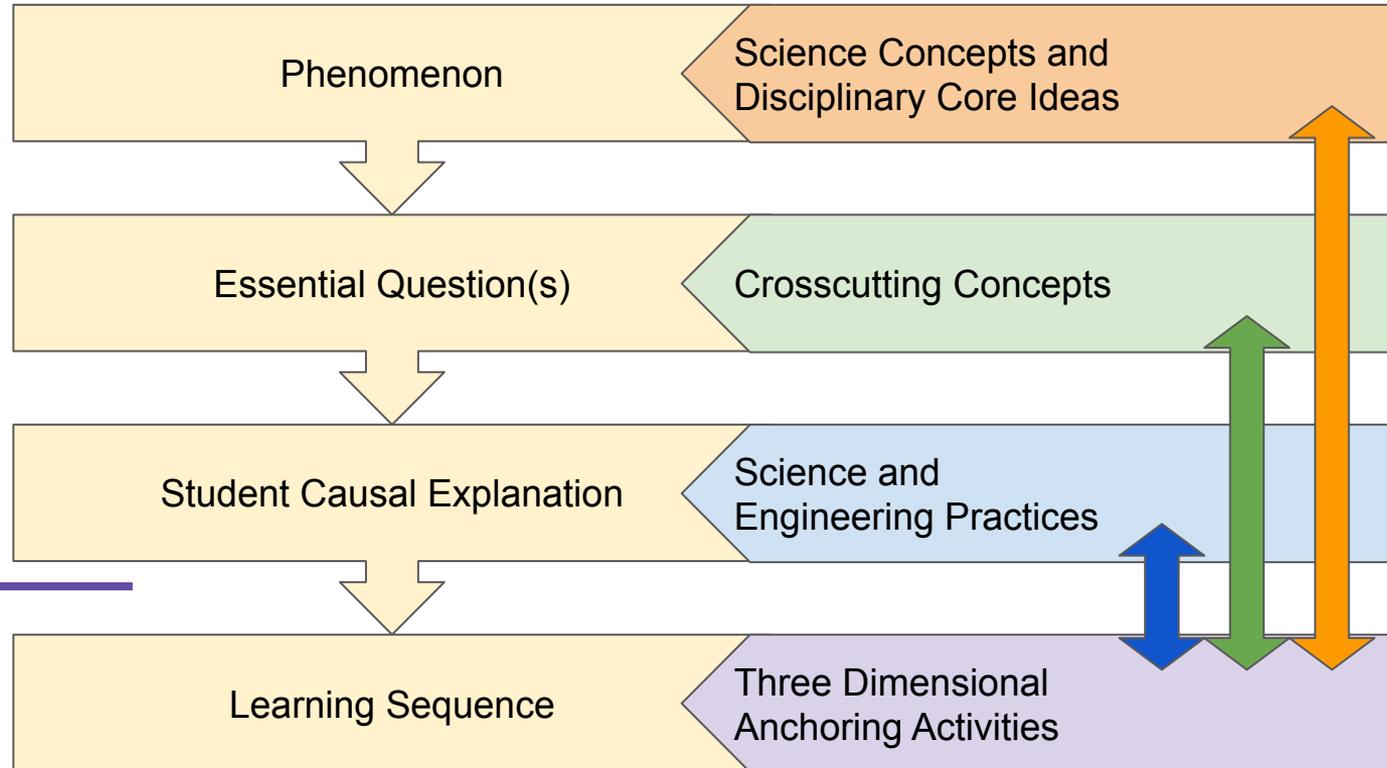
Student
Causal
Explanation

Learning
Sequence and
Lessons



Planning with Phenomena

#ProjectPhenomena



Phenomena resources



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Outdoor activities get cancelled because of air quality concerns.
High School

Image source: CBS Sacramento News CBS 15 Twitter

Driving Question(s)	Crosscutting Concept(s)
Why do we have concerns about air quality when it rains?	Cause & Effect

Vernal Pools stay wetter longer than the surrounding areas.
7th Grade Integrated

Image source: Nathan Marley

Driving Question(s)	Crosscutting Concept(s)
Why do vernal pools stay wetter longer than the surrounding areas?	Scale, Proportion, & Quantity

The Force of Water Affects the Environment.
Grade 8.

Image Source: Kelly M. Grow / California Department of Education

Driving Question(s)	Crosscutting Concept(s)
Why do we have concerns about air quality when it rains?	Scale, Proportion, & Quantity

It rains more in the mountains than at the beach.
Grade 3.

Image source: Wikimedia Commons

Driving Question(s)	Crosscutting Concept(s)
How does the height of the land affect the amount of rain on an area?	Patterns

California Wildfire
5th Grade

Image by abazusa from Pixabay

Driving Question(s)	Crosscutting Concept(s)
How have people affected the size and strength of wildfires in California?	Systems and System Models

Plastic Ducksies are found floating in the ocean around the world.
Grade 6 Integrated.

Image source: <https://www.youtube.com/watch?v=AvwW9B80>

Driving Question(s)	Crosscutting Concept(s)
How do plastic ducksies from the same source end up floating in different places around the world?	Systems and System Models

The size of most plastic in the Great Pacific Garbage Patch is smaller than 1 cm².
High School: Chemistry in the Earth System level

Image Sources: Scripps Institution of Oceanography (right) and Image Comics (left)

Driving Question(s)	Crosscutting Concept(s)
What constraints need to be made when designing a solution to reduce and remove plastics from the ocean and why do they need to be considered?	Scale, Proportion, & Quantity

Water moves through our world in many forms and different ways. Heat from the sun causes water to become water vapor. Wind is one way that water vapor is moved from place to place in our world. Mountains act as barriers for water movement. When water vapor is pushed up a mountain, it cools down and falls as rain (liquid water). This does not happen in areas such as the desert and the ocean.

Driving Question(s)	Crosscutting Concept(s)
How does the height of the land affect the amount of rain on an area?	Patterns

Plastic ends up in the ocean from eating plastic.
Grade 3.

Image source: Wikimedia

Driving Question(s)	Crosscutting Concept(s)
How do plastic ducksies from the same source end up floating in different places around the world?	Systems and System Models

Driving Question(s)	Crosscutting Concept(s)
How have people affected the size and strength of wildfires in California?	Systems and System Models
Stability and Change	<ul style="list-style-type: none"> Some systems appear stable, but over long periods of time will eventually change.

Driving Question(s)	Crosscutting Concept(s)
How do plastic ducksies from the same source end up floating in different places around the world?	Systems and System Models
Ideal Student Explanation	<p>When the Plastic Ducksies spilled off of a boat into the Pacific Ocean and popped free of their containers and packaging they set off on a journey. This journey was controlled by the same forces that drive the surface currents of the ocean systems.</p> <p>There are three major contributing forces that move ocean waters around the world in these patterns. They are global winds, the rotation of the Earth, and large land masses.</p>

Driving Question(s)	Crosscutting Concept(s)
What constraints need to be made when designing a solution to reduce and remove plastics from the ocean and why do they need to be considered?	Scale, Proportion, & Quantity
Ideal Student Explanation	<p>Most plastic is single use and not easily recycled. As a result, plastic has been disposed of in landfills or littered on beaches, streets, and waterways. During runoff events, an abundance of plastics makes its way into waterways, rivers and streams that empty into the ocean. As seen below, areas of high human population density are correlated with high concentrations of plastic being deposited into the ocean and sediment.</p>

Driving Question(s)	Crosscutting Concept(s)
How does the height of the land affect the amount of rain on an area?	Patterns
Ideal Student Explanation	<p>Water moves through our world in many forms and different ways. Heat from the sun causes water to become water vapor. Wind is one way that water vapor is moved from place to place in our world. Mountains act as barriers for water movement. When water vapor is pushed up a mountain, it cools down and falls as rain (liquid water). This does not happen in areas such as the desert and the ocean.</p>

Driving Question(s)	Crosscutting Concept(s)
How do plastic ducksies from the same source end up floating in different places around the world?	Systems and System Models
Ideal Student Explanation	<p>Plastic ends up in the ocean from eating plastic.</p>

ngss.sdcoe.net (Environmental Literacy tab)

From Phenomenon to Lessons: Examples

Grade 8 - Sound

Anchoring Phenomenon:

Cochlear implants allow people to hear.

Driving Question:

How do the sound patterns in music get transferred to a cochlear implant?

Grade 8 - Forces and Energy

Anchoring Phenomenon:

A mantis shrimp uses a raptorial appendage to strike and break a shell.

Driving Question:

How is a mantis shrimp able to use its raptorial appendage to break a shell?

Grade 7: Ecosystems

Anchoring Phenomenon:

The population of wolverines, who used to live throughout the Sierra Nevada Mountains, has declined and are now exceedingly rare.

Driving Question:

How do the interactions of different populations of organisms in an ecosystem cause organisms like the wolverine to decline in population?

Biology: Genetics

Anchoring Phenomenon:

Genetically, 0.5% (a half of a percent!) of your DNA makes *you* uniquely *you*.

Driving Questions:

What does it mean to be human? How does our DNA make us human? How does DNA make each human unique?

Physics: Galaxies Collide

Anchoring Phenomenon:

Galaxies in the universe interact with each other and sometimes collide.

Driving Questions:

How do galaxies interact with each other when they collide? What evidence do scientists use to understand the interactions of objects in the universe?

Physics: Energy and Electricity

Anchoring Phenomenon:

The electric grid is the means through which power is generated, transmitted, and distributed to consumers.

Driving Questions:

How do power plants convert energy to generate electricity? In what ways does pollution contribute to public health and environmental issues?

Other lesson modules can be found at: bit.ly/SDCOE-Learn

Questions?

John Spiegel

john.spiegel@sdcoe.net

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