

Using Phenomena to Drive NGSS Lessons

SDNI-NNCI Annual Educational Symposium 2020

bit.ly/SDCOE-NNCI

Scientific Phenomena Defined

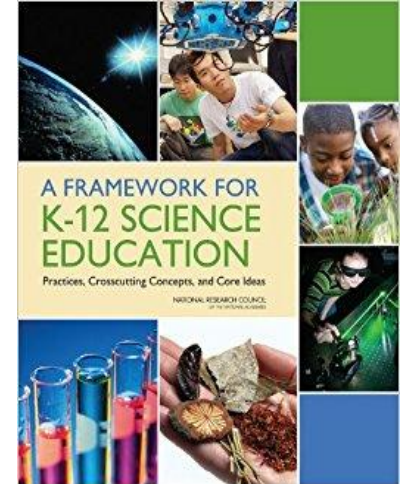
Scientific phenomena are occurrences in the natural and human-made world that can be observed and which cause one to wonder and ask questions.



National Research Council

“The actual **doing of science** or engineering can pique students’ curiosity, capture their interest, and motivate their continued study.”

“Any education that focuses predominantly on the detailed products of scientific labor – the facts of science – without **developing an understanding of how those facts were established** or that ignores the many important applications of science in the world misrepresents science and marginalizes the importance of engineering.”

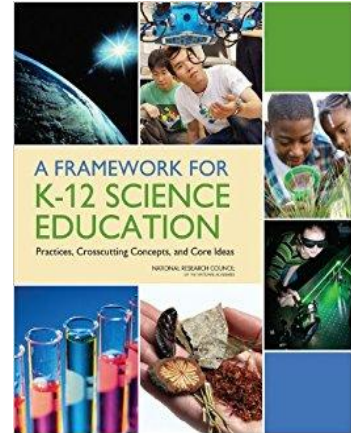


Why is NGSS Important?



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."

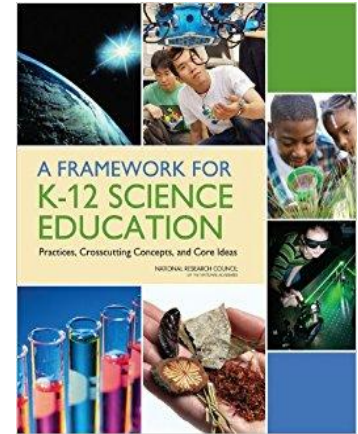


Why is NGSS Important?



“...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.”

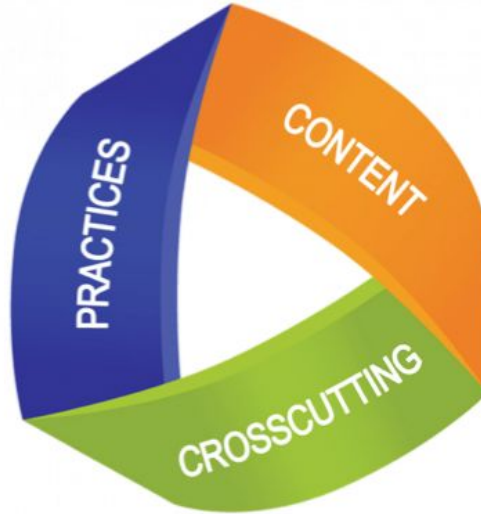
NRC Framework, 2012, p. 8



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

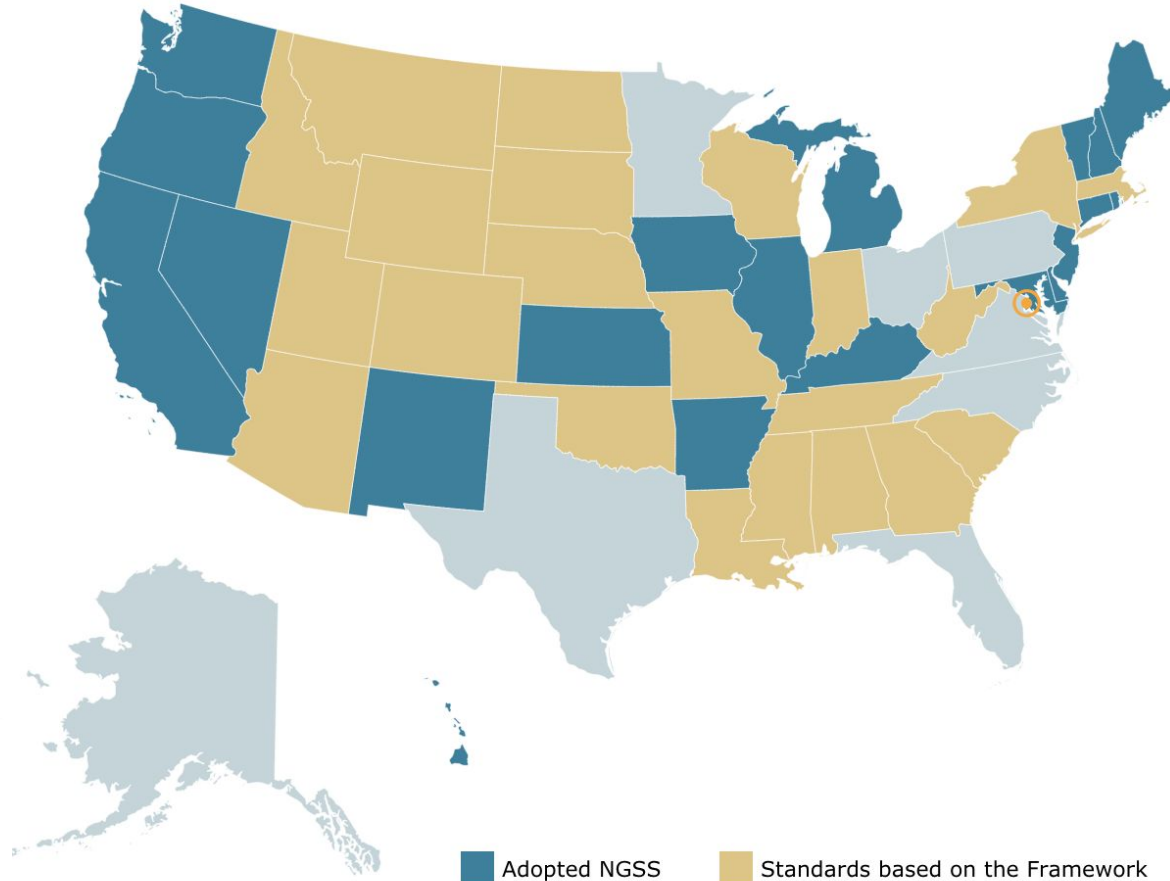
Earth and Space Science

- 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

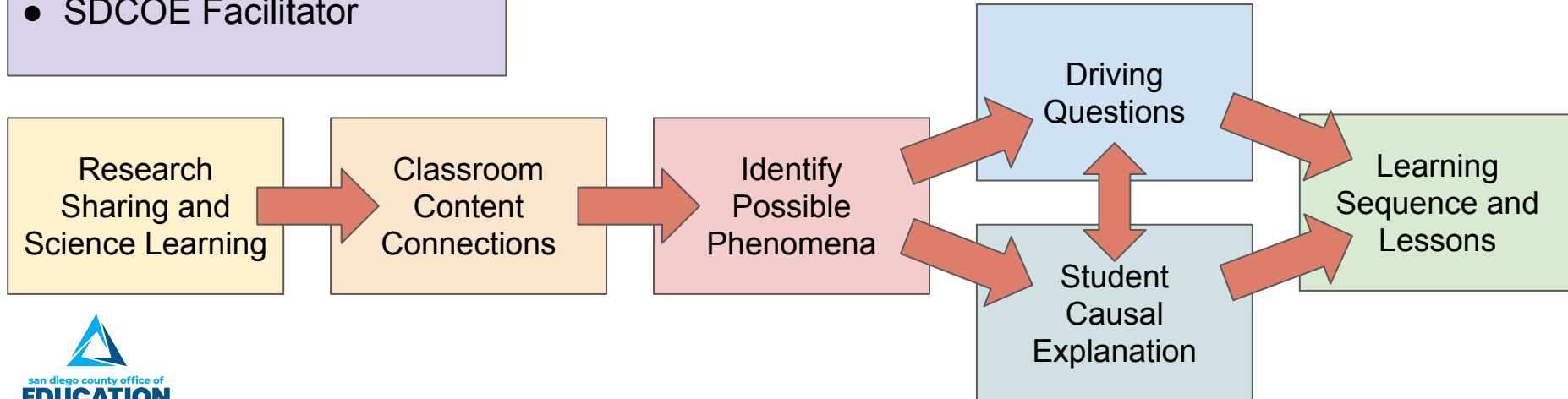
Next Generation Science Standards



Design Team Approach

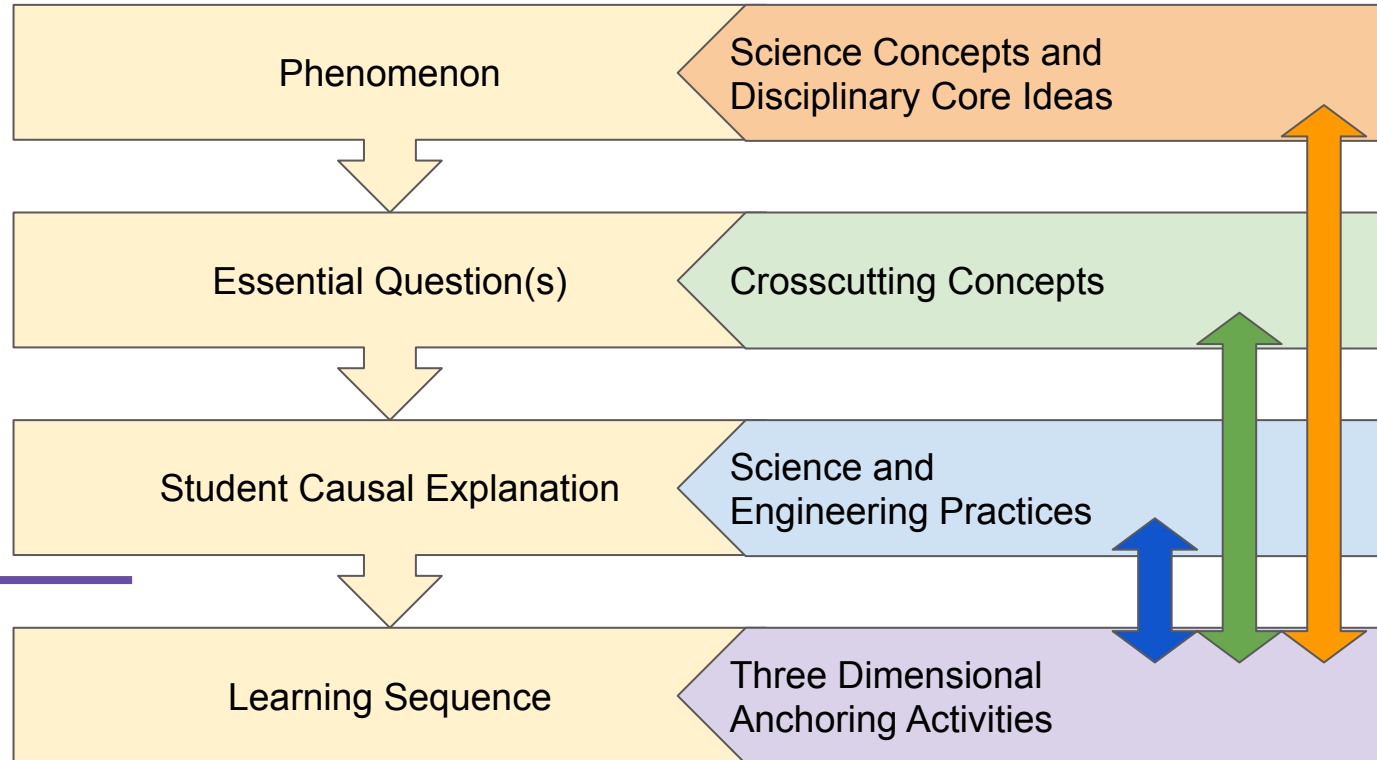
Design Team Organization

- Scientists and Experts
- Classroom Teachers
- SDCOE Facilitator



Planning with Phenomena

#ProjectPhenomena



Phenomena resources



san diego county office of
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California Wildfire
5th Grade



Image by alissa/ from iStockphoto

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

Contributors: J. Galloway, K. Cooke, K. Galloway, C. Hernandez, A. Hernandez, H. Pappas, D. Targui, J. Webb
Funding through the California Department of Education, Budget Act of 2017, Item 610-488-0001, Proposition 6.

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



Image source: CBS Sacramento News CBS13 Twitter

Driving Question(s)	Crosscutting Concept(s)
Why do we have concerns about air quality when outdoor activities are cancelled?	Cause & Effect <ul style="list-style-type: none"> Environmental conditions are caused by human actions.

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



Image source: <https://www.youtube.com/watch?v=AvwWV880>

Driving Question(s)	Crosscutting Concept(s)
How do plastic ducks from the same source end up floating in different places around the world?	Systems and System Models <ul style="list-style-type: none"> Models can be used to represent systems and their interactions such as inputs and outputs and energy, matter and information.
Patterns <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. 	

ESB2.C The Roles of Water in Earth's Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Variation in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents (MS-ESS2-6).

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.

Contributors: B. Brinkley, K. Koch, A. Babin, G. Ryan, D. Sandoval
Funding through the California Department of Education, Budget Act of 2017, Item 610-488-0001, Proposition 6.

The Force of Water Affects the Environment.
Grade 8.



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

Driving Question(s)	Crosscutting Concept(s)
Using the amount of water behind a dam, how does the force of water affect the environment of the river?	Scale, Proportion, & Quantity <ul style="list-style-type: none"> Models can be used to represent systems and their interactions such as inputs and outputs and energy, matter and information.

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 <ul style="list-style-type: none"> Models can be used to represent systems and their interactions such as inputs and outputs and energy, matter and information.

ESB3.C Human Impacts on Earth Systems

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)
- ETS1.B: Developing Possible Solutions**
 - When evaluating solutions, it is important to take into account a range of constraints.

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



Image source: Nathan Marley

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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 it can get?	Patterns <ul style="list-style-type: none"> Similarities and differences in patterns can be used to sort, classify, communicate and analyze single rates of change for natural phenomena and designed products. Patterns of change can be used to make predictions.

ESB2.D Weather and Climate

- Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.

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Animals die from eating plastic.
Grade 3.



Image source: Wikimedia

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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?

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