Board Study Session:

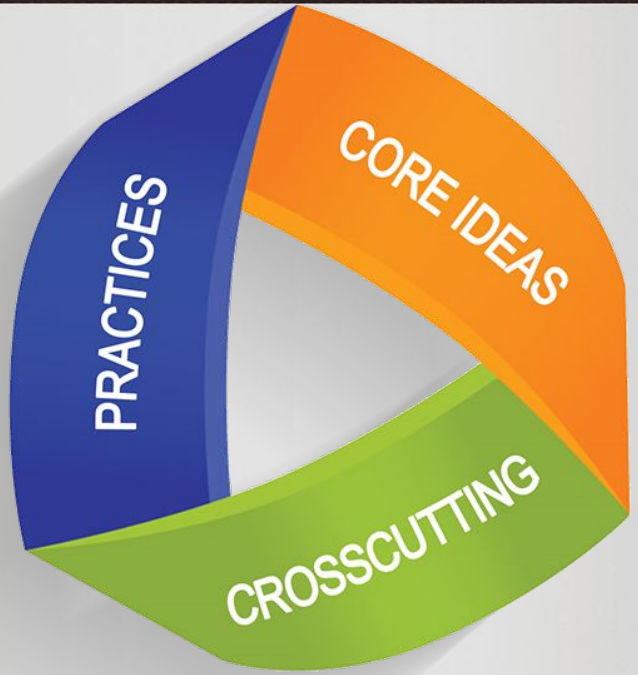
Next Generation Science Standards

October 11, 2016

Presentation Outcomes

- Experience NGSS Activity
- View an NGSS Standard
- Review NGSS Timeline
- Learn about Instructional Shifts
- Consider Implications for Laguna Beach Unified

NGSS: Three Dimensional Learning



DIVE IN!

Setting the Stage for Learning

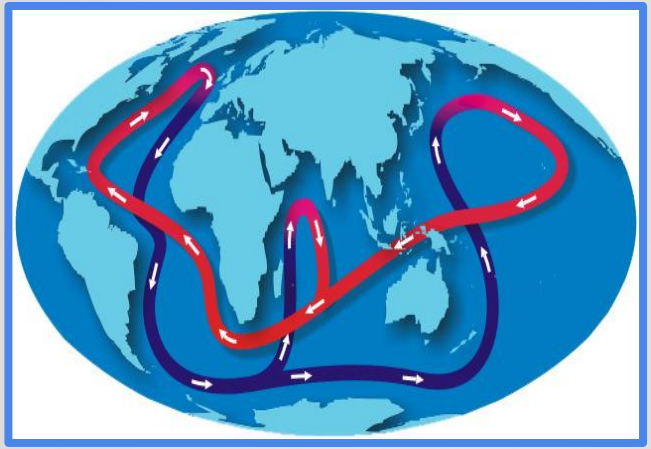
Let’s begin with ice.

Essential Question

Why don’t oceans freeze?

Performance Expectation

(Unit Level):

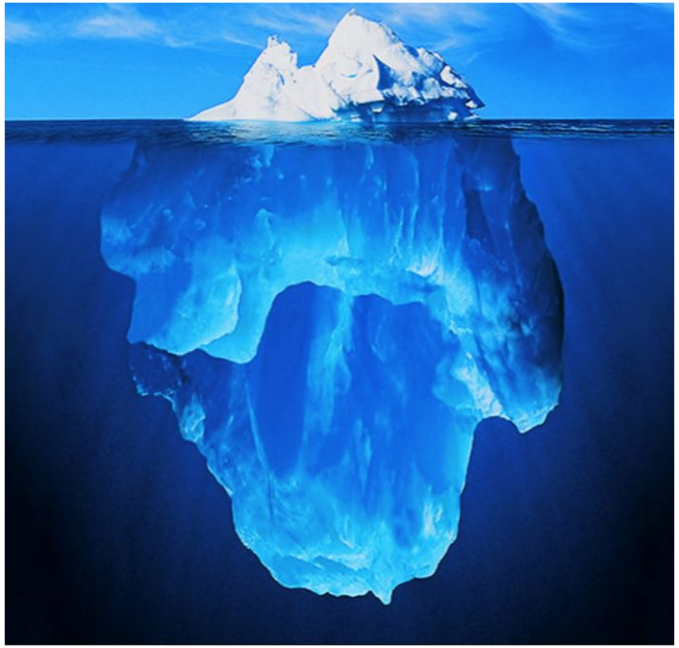


How do the properties and movements of water shape Earth's surface and affect its systems?

MS- ESS2-6

Guiding Question:

Will ice melt faster in fresh water or saltwater?



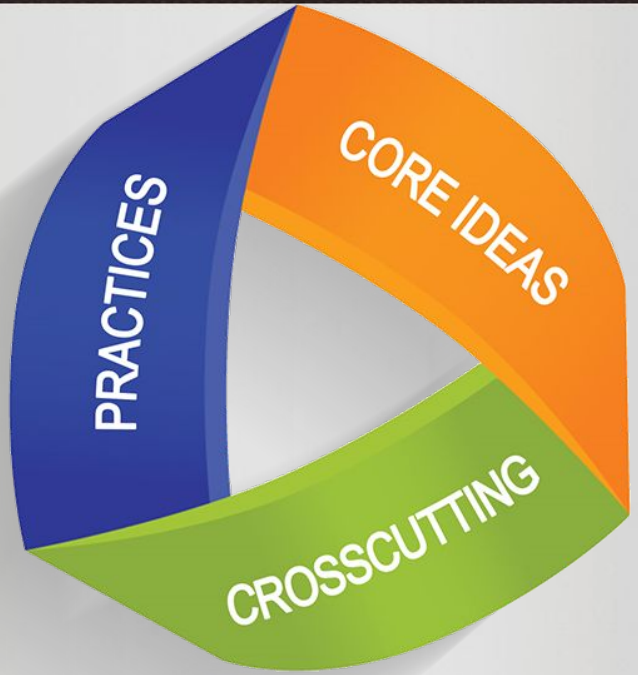
Laguna Beach Unified Board Study Session

Guiding Question	Will an ice cube melt faster in fresh water or in salt water?
Draw a model. This is what I think will happen.	
Revise this model. This is what actually happened. *Note your observations.*	
Construct an explanation.	
Line of Learning	

Partner talk:

- *What did you observe?*
- *Was it expected?*
- *Can you construct an explanation?*
- *Revise your initial model*

NGSS: Three Dimensional Learning



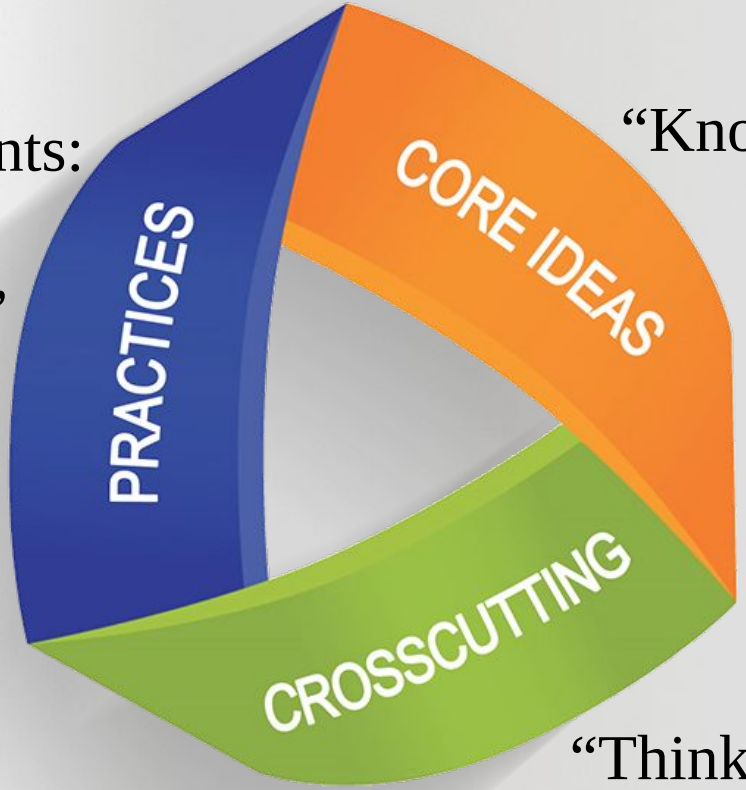
NGSS by State

Rhode Island
Kentucky
Kansas
Maryland
Vermont
California
Delaware
Washington
District of Columbia
Nevada
Oregon
Illinois
New Jersey

What students:

“Know”

“Do”



“Think”

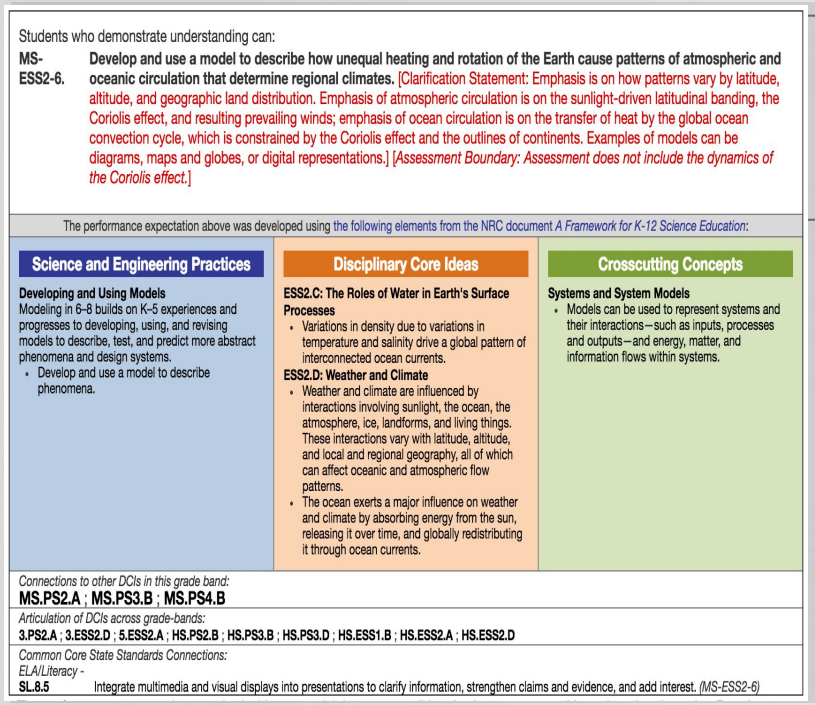
NGSS Standards are written as Performance Expectations.

Disciplinary Core Ideas

Crosscutting Concepts

Science and Engineering Practices

Anatomy of a NGSS Standard



Students who demonstrate understanding can:

MS-ESS2-6. **Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [*Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena.

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

ESS2.D: Weather and Climate
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

Crosscutting Concepts

Systems and System Models
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Connections to other DCIs in this grade band:
MS.PS2.A ; **MS.PS3.B** ; **MS.PS4.B**

Articulation of DCIs across grade-bands:
3.PS2.A ; **3.ESS2.D** ; **5.ESS2.A** ; **HS.PS2.B** ; **HS.PS3.B** ; **HS.PS3.D** ; **HS.ESS1.B** ; **HS.ESS2.A** ; **HS.ESS2.D**

Common Core State Standards Connections:
ELA/Literacy -
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-ESS2-6)*

Performance Expectations

3 Dimensions

- **Science & Engineering Practices**
- **Disciplinary Core Ideas**
- **Crosscutting Concepts**

Common Core & DCI Connections

Anatomy and Architecture of a NGSS Performance Expectation

Scientific and Engineering Practices
The 8 scientific and engineering practices are the major practices that scientists employ as they investigate and build models and theories about the world, and that engineers use as they design and build systems

Crosscutting Concepts
The 7 crosscutting concepts are concepts that bridge disciplinary boundaries, thus have explanatory value throughout much of science and engineering

Disciplinary Core Ideas
The disciplinary core ideas have broad importance across multiple sciences or engineering disciplines or are a key organizing concept of a single discipline. There are 44 of these core ideas across the areas of Life Sciences, Physical Science, Earth and Space Sciences, and Engineering, Technology, and Applications of Science

MS-PS2-2. **Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [*Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.*]

Title and Code

Performance Expectations
Performance expectations specify what students should know, understand, and be able to do. They also illustrate how students engage in scientific practices to develop a better understanding of the essential knowledge. These expectations support targeted instruction and assessment by providing tasks that are measurable and observable.

Dimensions of Learning
Scientific and Engineering Practices
Disciplinary Core Ideas
Crosscutting Concepts

Connections Boxes
Connections to Other DCIs in grade-band
Articulation of DCIs across grade-level
Common Core State Standard Connections

MS-PS2-2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

MS-PS2-2. **Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [*Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

PS2.A: Forces and Motion
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Stability and Change
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

Connections to other DCIs in this grade-band:
MS.PS3.A ; MS.PS3.B ; MS.ESS2.C

Articulation of DCIs across grade-bands:
3.PS2.A ; HS.PS2.A ; HS.PS3.B ; HS.ESS1.B

Common Core State Standards Connections:

ELA/Literacy -
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS2-2)*
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS2-2)

Mathematics -
MP.2 Reason abstractly and quantitatively. (MS-PS2-2)
6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. *(MS-PS2-2)*
7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *(MS-PS2-2)*
7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-PS2-2)*

SAN DIEGO COUNTY OFFICE OF EDUCATION
NEXT GENERATION SCIENCE STANDARDS

LBUSD's Identified Decisions

Creating Our Team

- Leads: Alysia, Dustin and Steve
- Site Administrators
- Teacher Leaders from each site, grade span, including special education

Establishing Our Priorities

- Instructional Shifts
- All Standards
- Team collaboratively makes recommendations
- Take time needed to make informed decisions

NGSS Implementation Team: Important Considerations

What does our data tell us about our students in science?

Where do we want to begin?

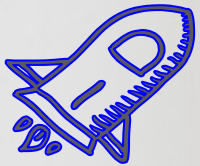
- All performance expectations spiral

89.9% students take 3+ years of science already

11 of 12 (92 %) of our teachers credentialed to teach integrated

3rd and 4th Year Enrollment Numbers for this Year:

ACR - 26	*AP Biology - 20*
AP Physics - 35	*Physics - 129*
Anatomy & Phys - 63	*Marine Ecology -58*



NGSS Implementation Team: Important Considerations

Middle School

Middle School Course Model

- Interdisciplinary
- Discipline Specific

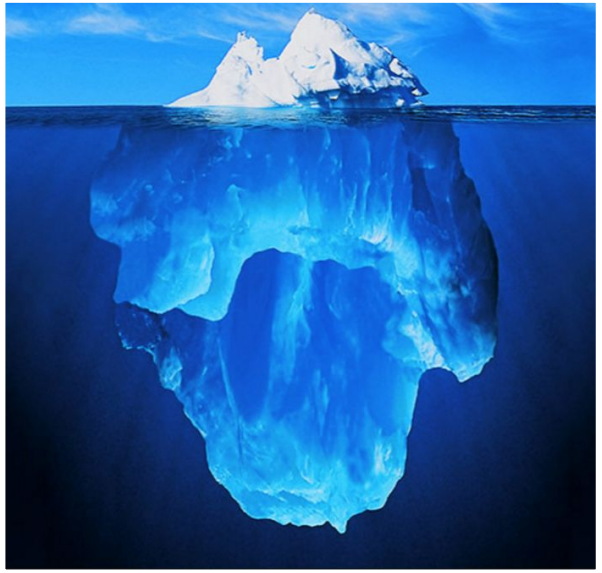
High School

High School Course Model

- 3 Years of Science Literacy
- 2 Years for Graduation Requirement

Essential Question: Why Don’t the Oceans Freeze?

Guiding Question: Will an ice cube melt faster in fresh water or in salt water?



Laguna Beach Unified Board Study Session

Guiding Question	Will an ice cube melt faster in fresh water or in salt water?
Draw a model. This is what I think will happen.	
Revise this model. This is what actually happened. *Note your observations.*	
Construct an explanation.	
Line of Learning	

Take a few moments to revise your model.

What actually happened?

Instructional Shifts

1. K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.
2. The NGSS are student performance expectations, NOT curriculum
3. The science concepts build coherently from K-12
4. The NGSS focus on deeper understanding of content as well as application of content
5. Science and engineering are integrated in the NGSS from K-12
6. The NGSS are designed to prepare students for college, career and citizenship
7. The NGSS and Common Core State Standards (Math & ELA) are aligned

Disciplinary Core Ideas

Physical Science

- 4 Core Ideas
  - 12 subtopics

Earth & Space Science

- 3 Core Ideas
  - 12 subtopics

Life Science

- 4 Core Ideas
  - 14 subtopics

Engineering, Technology & Application of Science

- 1 Core Idea
  - 3 subtopics

Science and Engineering Practices

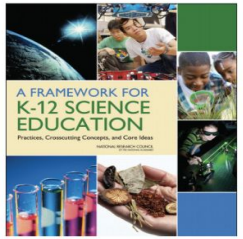
1. Asking Questions and Defining Problems
2. Developing and Using Models
3. Planning and Carrying Out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematical and Computational Thinking
6. Constructing Explanations and Designing Solutions
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, Communicating Information

Crosscutting Concepts

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

NGSS Timeline

2011 → **2011-13** → **2013-15** → **2015-16** → **2016+**



Step 1: Vision for Science

NEXT GENERATION SCIENCE STANDARDS

Step 2: Develop NGSS

Awareness

CA Adopts NGSS September 2014

CA Implementation Plan Nov 2014

NGSS Releases Classroom Assessments Nov 2014

Transition

NGSS Releases Evidence Statements Jan 2015

NRC Releases NGSS Implementation Plan Jan 2015

CA Science Framework Rough Draft May/Aug 2015

Implementation

Assessments
2016-2017
Pilot
2017-2018
Field Test
2018-2019
Operational

Curricula

Stay Tuned…

Laguna Beach NGSS Implementation Team

Hopes

- Not overwhelming for teachers
- Clear understanding
- Focus on instruction
- Hands-on, yet practical
- Integrate multiple content areas (science, literacy, math)

Dreams

- Equal access (SpEd)
- Students will love science
- All students will have deep understanding
- Critical consumers of science
- Relevant opportunities

Non-Negotiables

- Teacher driven
- K-12 learning progressions articulated
- Every student- every standard (rigorous)
- Not assessment driven
- Remain open minded

THANK YOU!

Any questions?

Resources

1. Today's NGSS Standard (MS-ESS2-6)
2. Disciplinary Core Ideas by Topic (NSTA)
3. Middle School and High School Model Course Maps (Appendix K, NGSS)