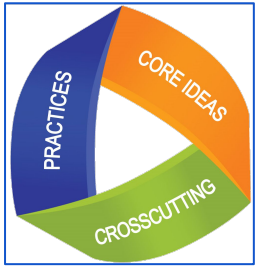
Tamalpais Union High School District

Next Generation Science Standards

An Overview

What is NGSS?



The Next Generation Science Standards outline a conceptual shift in science education:

- Reflect the interconnected nature of science as it is practiced and experienced in the real world
- Sets clear student performance expectations describing what students should know and be able to do (but it is not curriculum)
- Science concepts and practices build coherently from K–12
- Deeper understanding and application of content

Currently adopted in 18 states and the District of Columbia
California adopted NGSS in 2013

What We Do Now

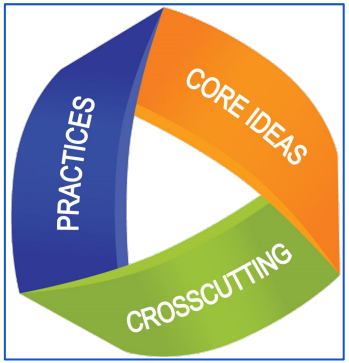
- Required Courses
  - 2-year Integrated Science (Bio/Earth/Intro Chem & Physics) -
    - Meets old California standards in Biology and Earth Science,
    - Meets TUHSD Grad Requirement,
    - Counts for:
      - one year of UC laboratory science (“D”) requirement and
      - one year of UC elective (“G”) requirement
- Elective Courses
  - Chem, Physics, Ecology, Environmental Science, Marine Biology, Physiology, AP Env Science, AP Biology, AP Chemistry, Honors Physics, Honors Physiology, Honors Biomedical Science
    - Count for UC laboratory science (“D”) requirement
  - Astronomy, Sustainable Agriculture -
    - Count for UC elective (“G”) requirement

Presently 97% of district students take 3 or more years of science.

NGSS and 3 Dimensional Learning

Science and Engineering Practices

- Ask Questions and Define Problems
- Plan and Carry out Investigations
- Develop and Use Models
- Analyze and Interpret Data
- Use Mathematical Thinking
- Construct Explanations and Design Solutions
- Argue from Evidence
- Obtain, Evaluate and Communicate Information



Disciplinary Core Ideas

- Physical Science (11)
- Earth Science (12)
- Life Science (12)
- Engineering and Technology (3)

Crosscutting Concepts

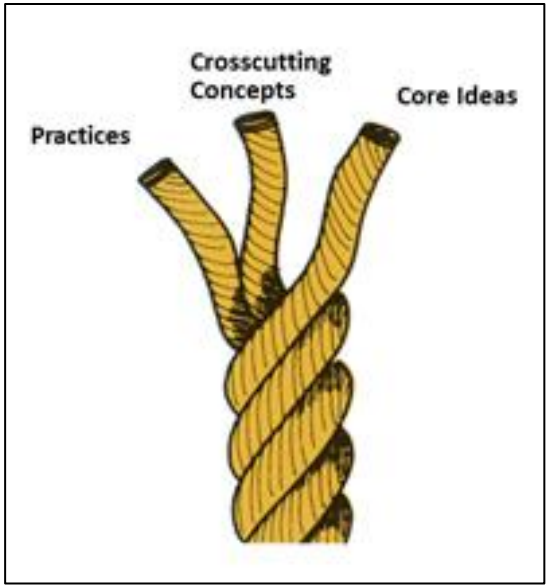
- Energy and Matter
- Structure and Function
- Patterns
- Structure and Function
- Stability and Change
- Systems and System Models
- Scale, Proportion and Quantity

NGSS and 3 Dimensional Learning

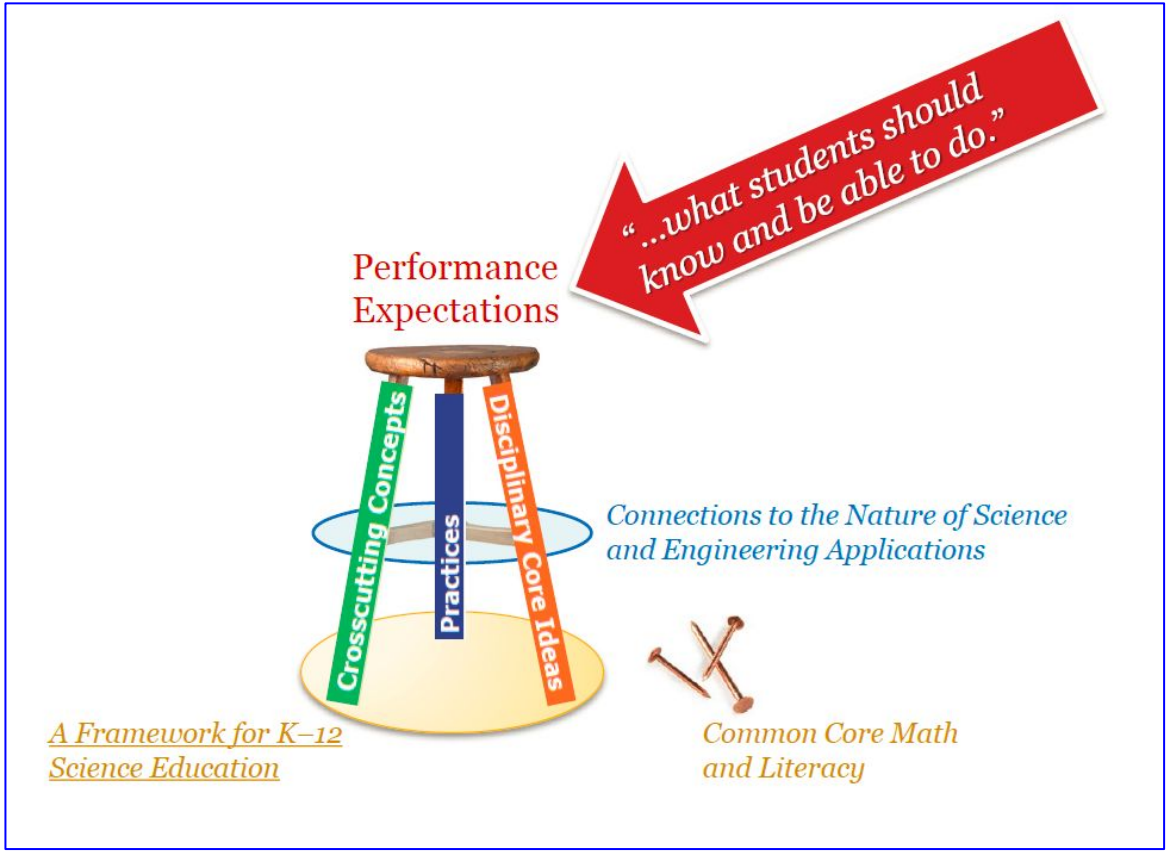
"All three dimensions serve as tools to build understanding. When the dimensions are blended and work together, like strands of a rope, learning is stronger. "

Joe Krajcik, NGSS author

Performance Expectations



NGSS + Performance Expectations

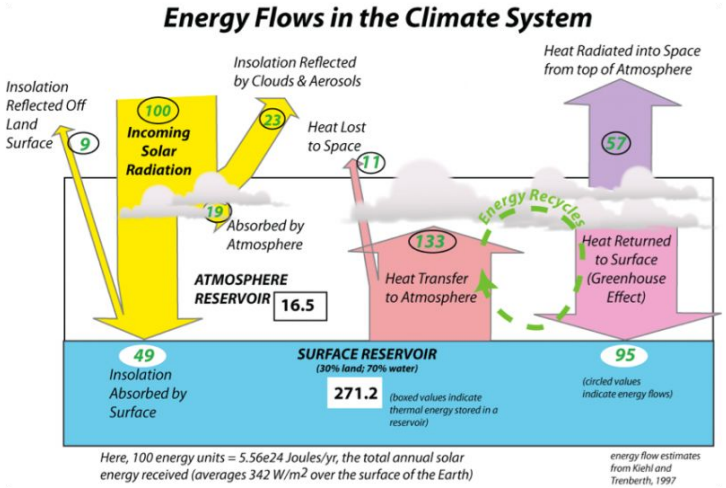


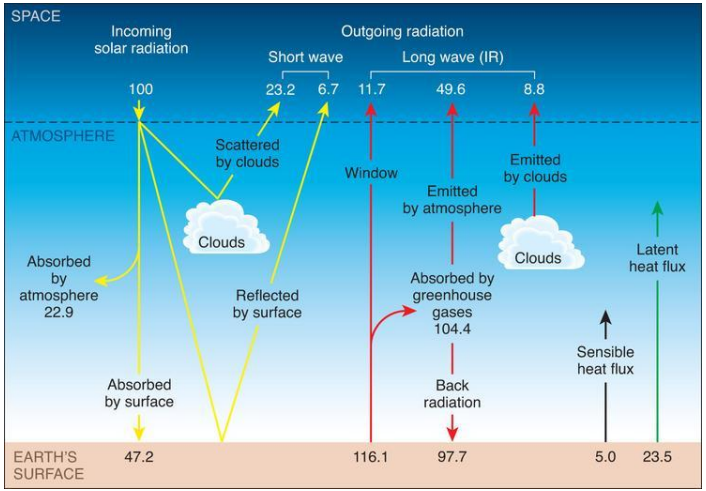
- ★ 3 dimensional learning supports performance expectations as the ultimate goal of NGSS.
- ★ Each Performance Expectation embeds all three dimensions.
- ★ Instruction is designed to explicitly incorporate all three dimensions.

Performance Expectations - An Example

Students who demonstrate understanding can:

HS-ESS2-4. **Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.** [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [*Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.*]





Three Dimensions for HS-ESS 2-4

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Use a model to provide mechanistic accounts of phenomena.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. *(secondary)*

ESS2.A: Earth Materials and Systems

- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

ESS2.D: Weather and Climate

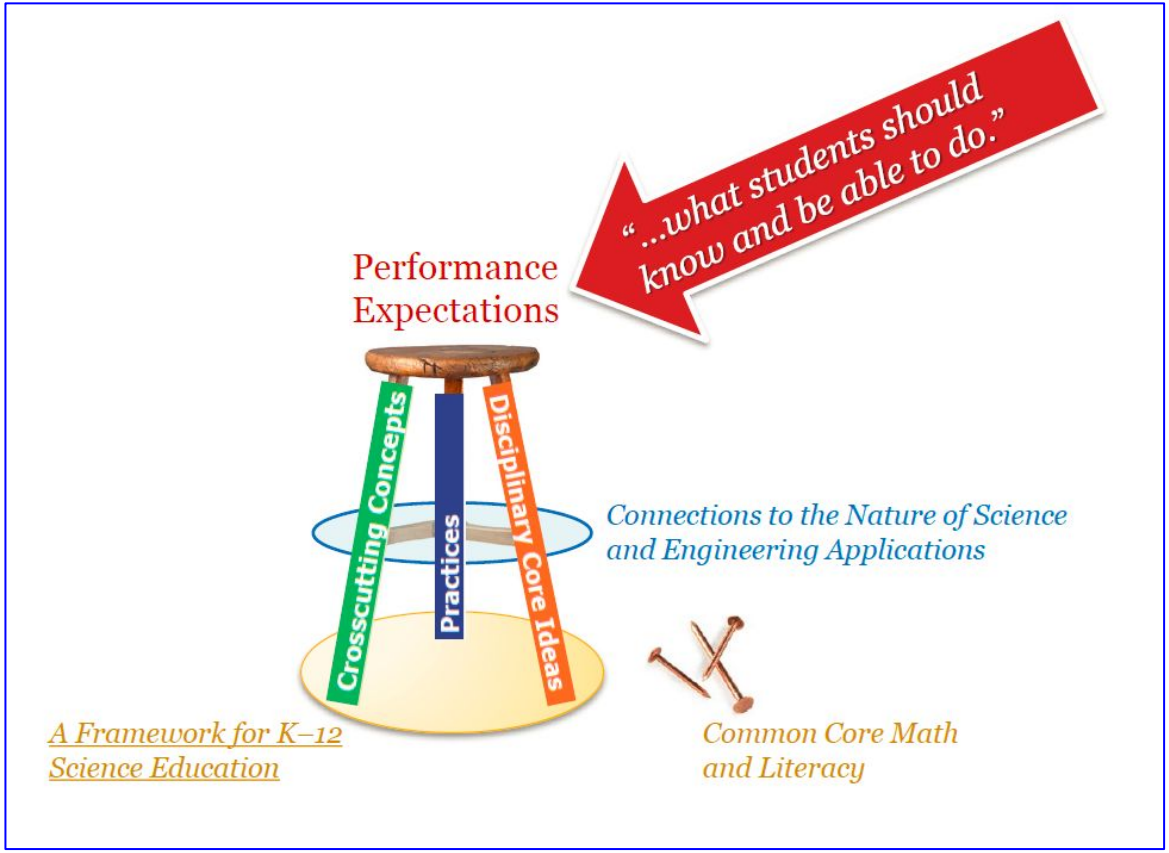
- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

NGSS + Performance Expectations



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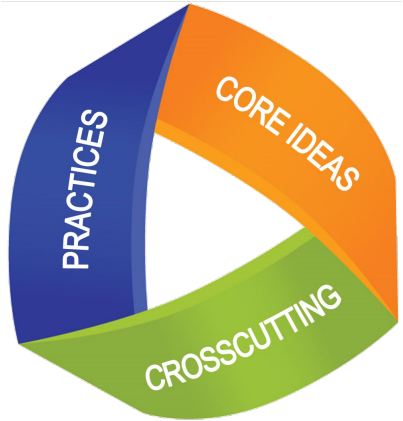
What is required upon implementation?

"All Students, All Standards"

All aspects of courses include all 3 dimensions.

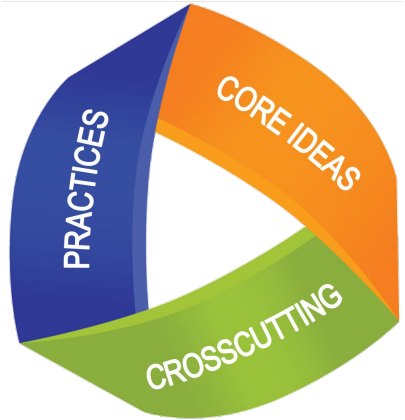


Engineering for all.

"Model Course Maps are starting points, not finished products".
Source: NGSS Appendix K

How will this impact students?

- 3 dimensional learning experiences
  - More focus on conceptual understanding and application of content
  - Units, projects and lessons centered around scientific phenomena
- 3 year graduation requirement (*to be proposed*)
  - Starting in the Fall of 2018
  - UC/CSU Lab D requirement satisfied by end of 10th grade
- NGSS standardized testing in grades 10, 11, OR 12



How is this different from what we have been doing?

Now:

All students only meet state standards in two scientific disciplines – Biology and Earth Science.

2-course sequence

Old standards emphasize discrete knowledge

Laboratory work is largely based on experimentation

Future:

“All students, all standards”, in all scientific disciplines

3-year course sequence recommended

Standards based on performance expectations- less “know”, more “do”

Emphasize deeper learning and application of knowledge

Scientific practices go beyond experimentation and include engineering practices

How is this different from what we have been doing?

Less of this:

- Worksheets with no student input or higher level thinking skills
- Memorization of facts and terminology, vocabulary front-loaded without context
- Teachers provide information to the whole class and teacher-led discussions
- Teachers pose questions with one right answer and little student discussion regarding questions

More of this:

- Students produce reports, posters and media presentations that explain and argue
- Facts and terminology learned as needed, supported by evidence-based arguments and reasoning
- Students discuss open-ended questions based on evidence used to generate claims
- Students pose questions, conduct investigations to solve problems, engage in discussions about the results

How is this different from what we have been doing?

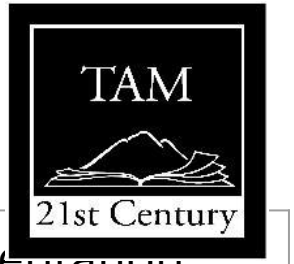
Less of this:

- Learning ideas disconnected from questions about phenomena, with no continuity of context
- Oversimplification for students who are perceived to be less able to do science and engineering
- Students read textbooks and answering questions at the end of the chapter or completing chapter reviews
- Pre-planned outcome for ‘cookbook’ laboratories or hands-on activities

More of this:

- Systems thinking and modeling to explain phenomena, giving context for ideas to be learned
- Supports provided so that all students can engage in sophisticated science and engineering practices
- Students read multiple science sources, including web-based resources to develop summaries of information
- Multiple investigations driven by students’ questions with range of outcomes, that lead to deep understanding of established core scientific ideas

NGSS - TUHSD Timeline



Awareness (2016 - Spring 17)	Transition (2017-2018)	Implementation (2018-2020)
➔ NGSS/3-D learning Curriculum Framework ➔ Provide education and information to Parents, Students, etc. ➔ Decide on course sequence ➔ Proposed change to grad requirement	➔ Finalize system recommendations ➔ Courses of Study and Instructional Materials ➔ Professional Development ➔ Curriculum Development ➔ Collaborative Time	➔ First New course implemented in 2018 for Freshmen ➔ The two other courses are rolled out in Fall 2019 and Fall 2020 ➔ Operational State Assessments

NGSS – California Timeline

NGSS Adopted — **2013**

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Curriculum Framework — **2015 (approved Jan 2016)**

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Assessments - Pilot Testing — **2016-17**

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Assessments - Field Testing — **2017-18**

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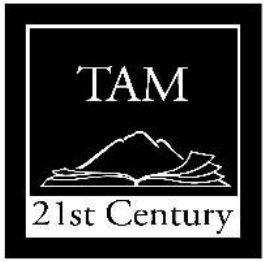
Assessments - Operational Testing — **2018-19**

What do teachers think?



Teachers like:

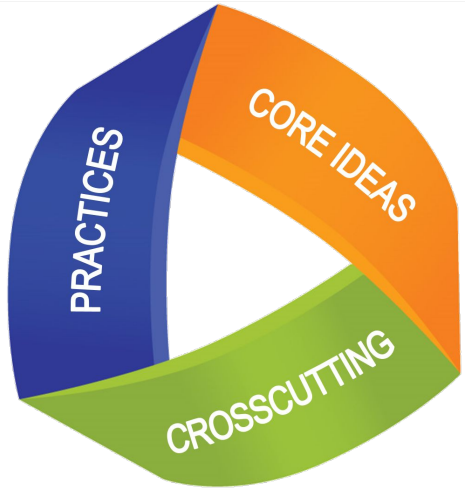
- All students learn Life, Physical, and Earth Science
- Standards are more reflective of how Science is carried out in the “real world”
- Explicit integration of scientific content and skills
- Connection to engineering and technology
- Standards are more detailed and clear
- All NGSS - aligned courses will have UC “d” approval

Next Steps

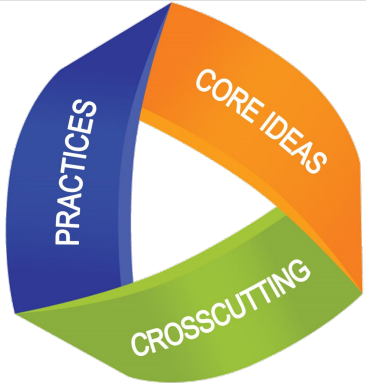
Science Task Force:

- Review/Revision of Course Sequences
- Implementation Plan Details
  - What are other schools/districts doing?
  - What does the UC system say/want?
- Parent, Student, Board, and Teacher Input
- Professional Development

Resource Implications (Fiscal and Human)



Next Steps...



For Teachers...

- Implementation of NGSS in current classes
- Continued professional development
- Exploration and decision regarding new course sequences

For Stakeholders...

- Parent, Student, and Board input on new course sequences

For Schools and District...

- New testing practices, potential changes to graduation requirements

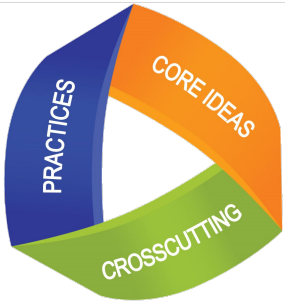
Some Potential Course Models

Conceptual Progression Model:
Performance Expectations are integrated and build upon one another. Disciplines are not separated.

Course 1

Course 2

Course 3



Science Domains Model:

Performance Expectations are organized around disciplines.

Engineering is integrated throughout.

Course 1

Course 2

Course 3

Course 4

Modified Science Domains Model:

Performance Expectations are organized around disciplines.

Engineering and other DCIs are integrated throughout.

Course 1

Course 2

Course 3

"All Students, All Standards"

Questions?