

# Next Generation Science Standards

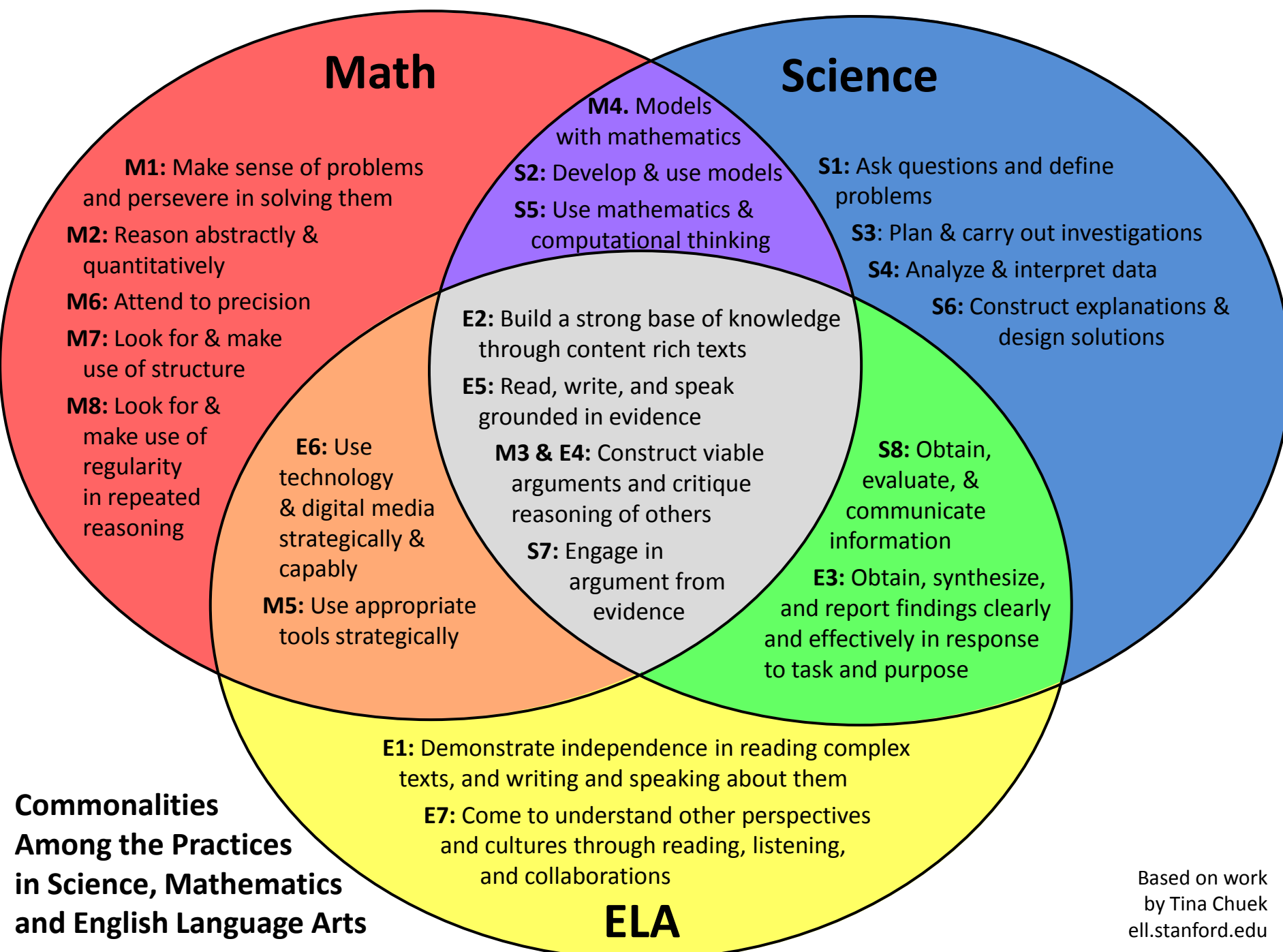
NGSS Overview

# Conceptual Shifts in NGSS

1. K-12 Science Education Should Reflect the Interconnected Nature of Science as it is Practiced and Experienced in the Real World.
2. The Next Generation Science Standards are student performance expectations – NOT curriculum.
3. The science concepts in the NGSS 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 (Mathematics and English Language Arts) are Aligned.

# Science & 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



# Disciplinary Core Ideas

Life Science	Physical Science
LS1: From Molecules to Organisms: Structures & Processes LS2: Ecosystems: Interactions, Energy, & Dynamics LS3: Heredity: Inheritance & Variation of Traits LS4: Biological Evolution: Unity & Diversity of Life	PS1: Matter & Its Interactions PS2: Motion & Stability: Forces & Interactions PS3: Energy PS4: Waves & Their Applications in Technologies for Information Transfer
Earth & Space Science	Engineering & Technology
ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth & Human Activity	ETS1: Engineering Design ETS2: Links Among Engineering, Technology & Society

# Core and Component Ideas

Life Science	Earth & Space Science	Physical Science	Engineering & Technology
<b>LS1: From Molecules to Organisms: Structures and Processes</b> LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing  <b>LS2: Ecosystems: Interactions, Energy, and Dynamics</b> LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior  <b>LS3: Heredity: Inheritance and Variation of Traits</b> LS3.A: Inheritance of Traits LS3.B: Variation of Traits  <b>LS4: Biological Evolution: Unity and Diversity</b> LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	<b>ESS1: Earth's Place in the Universe</b> ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth  <b>ESS2: Earth's Systems</b> ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology  <b>ESS3: Earth and Human Activity</b> ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	<b>PS1: Matter and Its Interactions</b> PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes  <b>PS2: Motion and Stability: Forces and Interactions</b> PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems  <b>PS3: Energy</b> PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life  <b>PS4: Waves and Their Applications in Technologies for Information Transfer</b> PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	<b>ETS1: Engineering Design</b> ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution  <b>ETS2: Links Among Engineering, Technology, Science, and Society</b> ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World  <i><b>Note:</b> In NGSS, the core ideas for Engineering, Technology, and the Application of Science are integrated with the Life Science, Earth &amp; Space Science, and Physical Science core ideas</i>

# 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

# Foundation Boxes

## MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

**MS-PS1-d. Develop molecular models of reactants and products to support the explanation that atoms, and therefore mass, are conserved in a chemical reaction.** [Clarification Statement: Models can include physical models and drawings that represent atoms rather than symbols. The focus is on law of conservation of matter.] [Assessment Boundary: The use of atomic masses is not required. Balancing symbolic equations (e.g.  $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$ ) is not required.]

The performance expectations above were 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 and progresses to developing, using and revising models to support explanations, describe, test, and predict more abstract phenomena and design systems.

- Use and/or develop models to predict, describe, support explanation, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. (MS-PS1-a), (MS-PS1-c), (MS-PS1-d)

### Disciplinary Core Ideas

#### PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-d), (MS-PS1-e), (MS-PS1-f)
- The total number of each type of atom is conserved, and thus the mass does

### Crosscutting Concepts

#### Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-d)





# NGSS Timeline

## Pacifica School District



	Earlier Yrs.	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Science	CSS	<u>Next Generation Science Standards Adopted</u>	Grade 6 -8 Awareness Phase	Grade 6-8 Transition Phase ----- Grade K-5 Awareness Phase	Grade 6-8 Implement ----- Grade K-5 Transition Phase	Grade K-8 Implement  *Curriculum available for adoption *Anticipated Field Testing for NGSS	*Anticipated Administration of NGSS Assessment

# Integrated Middle School

Grade	Cross cutting concepts	Life	Earth and Space	Physical	Human Impact	Engineering
<b>Eighth</b>	Stability and change; scale, proportion and quantity	Natural Selection	History of the Earth Space systems	Waves and Electro-magnetic radiation Energy Forces and Interactions	Human Impact	ETS
Seventh	Energy and Matter: flows, cycles, and conservation; cause and effect	Ecosystems	Natural resources	Structure and property of matter	Human Impact	ETS
Sixth	Patterns; crosscutting concepts	Cells and Organisms	Weather and climate	Energy	Human Impact	ETS

# MODIFYING LABS FOR INQUIRY AND SCIENCE PRACTICES

## WHY LABS?

In teaching him botany, he must handle the plants and dissect the flowers for himself: in teaching him physics and chemistry, you must not be solicitous to fill him with information, but you must be careful that what he learns he knows of his own knowledge. Don't be satisfied with telling him that a magnet attracts iron. Let him see that it does; let him feel the pull of the one upon the other for himself (Huxley, 1899).

# PBL School Visits

- Bulldog Tech Charter School, Evergreen SD
- Roosevelt K-8 School, Redwood City

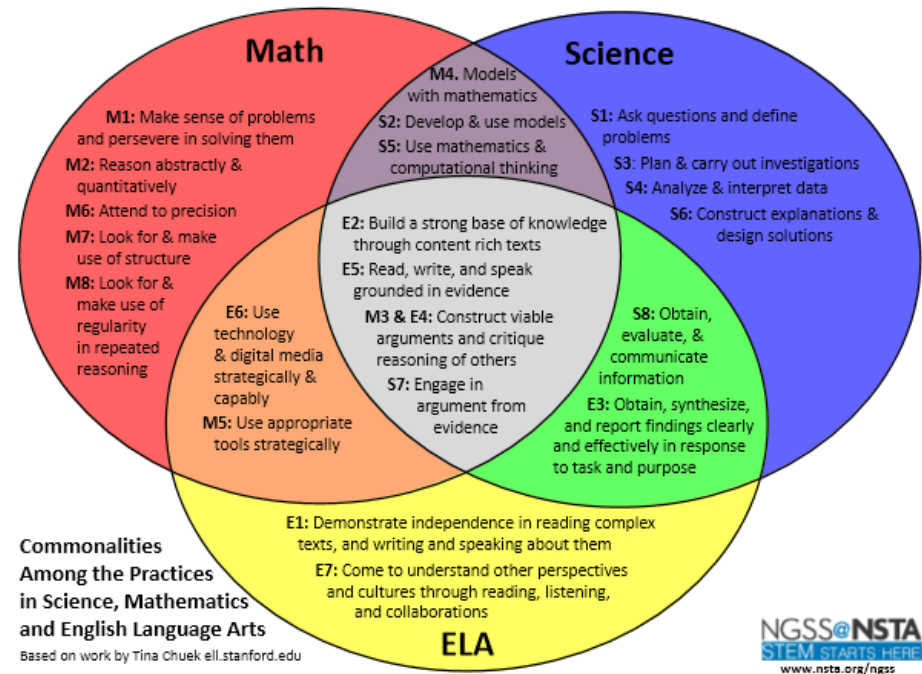
# Students will be able to...

PBL allows for authentic connections among subject areas.

What are the important practice connections you see in these subjects?

What other connections would you add?

What does this suggest for your teaching?



# Engineering in the NGSS

## Problem/Context:

- ▶ Context: Three Gorges Dam
- ▶ Lesson: [building a dam and considering impact](#)
- ▶ MS-LS2, MS-ESS3, and MS-ETS1



# Engineering in the NGSS

## Challenge:

- ▶ Design a dam
- ▶ Draw (model) your design
- ▶ What materials would you use?
- ▶ What else would you need to know?
- ▶ How would you test your design?
- ▶ Brief gallery walk





# Goals for 2014-2015

- Write a K-8 NGSS aligned Science Plan
- Support Middle School Teachers Transition to NGSS
  - Re-design current lessons and labs to incorporate Science and Engineering Practice Standards
  - Create new units and projects for new grade level content
  - Offer Professional Development, site visits, and collaboration opportunities



# Supporting Materials



- Appendices have been added to support the NGSS and in response to feedback
  - Appendix A – Conceptual Shifts
  - Appendix B – Responses to Public Feedback
  - Appendix C – College and Career Readiness
  - Appendix D – All Standards, All Students
  - Appendix E – Disciplinary Core Idea Progressions in the NGSS
  - Appendix F – Science and Engineering Practices in the NGSS
  - Appendix G – Crosscutting Concepts in the NGSS
  - Appendix H – Nature of Science
  - Appendix I – Engineering Design in the NGSS
  - Appendix J – Science, Technology, Society, and the Environment
  - Appendix K – Model Course Mapping in Middle and High School
  - Appendix L – Connections to Common Core State Standards in Mathematics
  - Appendix M – Connections to Common Core State Standards in ELA

# **PSD: Teacher's Transition to NGSS**

- Focus on content areas that will continue with the NGSS
- Modify labs for Inquiry and Science Practices
- Use project based learning for new content

# Modifying Labs for Inquiry and Science Practices

- **Revise the Question Section**
  - Allow students to come up with their own question or problem to make the investigation more meaningful
    - Ex: Bacteria at School Lab: Students designed an experiment testing bacteria at school.
      - Compared teacher hand
      - Compared classrooms
      - Compared school surfaces

# Modifying Labs for Inquiry and Science Practices

- **Revise the Materials Section**
  - Allow students to determine which materials or supplies they will need.
    - Ex: Squirt Gun Lab: Students chose materials based on their designed experiment.
      - Different Squirt Guns
      - Different Liquids
      - Accuracy Targets
      - Marble Launcher for Angle

# **The Marine Mammal Center Ocean Ambassadors**

- Inspiring the next generation of marine scientists
- Expand knowledge about marine mammals, their health and ocean environment
- Call to action for global conservation

# **The Marine Mammal Center Ocean Ambassadors**

- Map a patient's path based on GPS data after being released from TMMC.
- Study patient charts to diagnose (human related injury) and determine treatment plan

# ConservationCon at TMMC

- Present Call to Action at TMMC
  - How they are doing something about what happened to their patient
  - Call to conserve
  - Create awareness
  - Improve ocean health
  - Protect Marine Mammals
  - Human Impact

# Resources

- <http://ngss.nsta.org/>
- <http://www.nextgenscience.org/>
- [www.bie.org/PBL](http://www.bie.org/PBL)
- [www.marinemammalcenter.org](http://www.marinemammalcenter.org)



Thank You