Phil Lafontaine, Director
Professional Learning Support Division
Why Science?

I Am a Scientist
California to Revise Science Standards

- SB 300
- SB 1200
- Revise CA Science Standards based on NGSS
- Submit to SBE July 2013
- SBE to act by November 2013
NATIONAL PROCESS FOR DEVELOPMENT
Building on the Past; Preparing for the Future

1990s

1990s-2009

Phase I

Phase II

1/2010 - 7/2011

NEXT GENERATION SCIENCE STANDARDS
For States, By States
7/2011 – April 2013
Lead Partners

- NAAAS
- NSTA
- NRC
- Next Generation Science Standards
- Council of State Science Supervisors
- Achieve
Development of the NGSS

- California State Review Team (SRT) of 80 science experts reviewed and commented on five (private and public) drafts of the NGSS
- Second and final public review January 2013
- Thousands of comments submitted to Achieve
- Final copy of NGSS released April 2013
Performance Expectations for NGSS

Developed in discipline core ideas
(Life Science, Earth and Space Science, Physical Science, and Engineering)

Arranged in
• K-5 grade specific
• 6-8 grade span
• 9-12 grade span
5-L52 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

5-L52-a. Construct and use models of food webs to describe the transfer of matter among plants, animals, decomposers, and the environment and discuss limitations of these models. [Clarification Statement: Examples of systems could be: organisms, ecosystems, and the Earth. Matter is transported among and within systems.]

5-L52-b. Formulate questions and predict outcomes about how organisms, such as fungi and bacteria, operate as decomposers to restore (recycle) some materials back to the soil for plants to use in local ecosystems. [Clarification Statement: Minerals and fertilizer are not food for plants.]

5-L52-c. Use models to test the functioning of a designed process that mitigates a factor upsetting the stability of a local ecosystem. [Clarification Statement: Factors that upset an ecosystem's stability include: invasive species, drought, human development, and removal or addition of predators. Models could include simulations, and representations, etc.]

5-L52-d. Ask questions about what organisms obtain from the environment and what they release as waste matter back into the environment. [Clarification Statement: Air, water, and minerals (fertilizer) are provided by plants but are not food for them; plants use energy from light to make food from non-food, primarily air and water.] [Assessment Boundary: Students should be assessed on the idea that plants make their own food from materials that are not food (air and water) out the process of photosynthesis.]

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

Asking Questions and Defining Problems
- Asking questions and defining problems in grades 3-5 builds from grades K-2 experiences and progresses to specifying qualitative relationships.
- Ask questions that relate one variable to another variable (5-L52-d)
- Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships (5-L52-b)

Developing and Using Models
- Modeling in 3-5 builds on K-2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution (3-L52-a)
- Use simple models to describe phenomena concerning the functioning of a natural system (5-L52-a)
- Identify limitations of models (5-L52-a)
- Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool, or process (5-L52-c)

Connections to Nature of Science

Scientific Knowledge Is Based on Empirical Evidence
- Science findings are based on recognizing patterns (5-L52-a)

Disciplinary Core Ideas

- Animals and plants alike generally need to take in air and water (secondary to 5-L52-a)
- Plants acquire their material for growth chiefly from air and water and process matter (secondary to 5-L52-d)

LS3.A: Interdependent Relationships in Ecosystems
- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants (5-L52-a)
- Either way, they are “consumers.” Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants and animals) and help return matter (secondary to 5-L52-d)

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LS3.B: Cycles of Matter and Energy Transfer in Ecosystems
- Matter cycles between the air and soil and among plants, animals, and decomposers as these organisms live and die (5-L52-a)
- Organisms obtain gases, water, and minerals from the environment, and release waste matter (gas, liquid, or solid) back into the environment (5-L52-d)

IT3.B: Describing Possible Solutions
- There are many different types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs. (secondary to 5-L52-c)

January 2013
Confidential: DO NOT DISTRIBUTE
Performance Expectations = Standard

a) Stem: Each standard is written in the form of one sentence, that identifies the disciplinary core idea, the scientific practice and the crosscutting concept the student is expected to demonstrate at the end of instruction.

b) The clarification statements provide a short description of a nuance of the standard

c) The assessment boundary provides the depth of understanding all students are expected to demonstrate.
Example of a Performance Expectation

Students who demonstrate understanding can:

• 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]
Foundation boxes provide information that expands and explains the standard statements in relation to the three dimensions:
Example of a performance expectation cited to a foundation box

Students who demonstrate understanding can:
- **K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive.

Disciplinary Core Ideas

**LS1.C: Organization for Matter and Energy Flow in Organisms**
- All animals need food in order to live and grow. They obtain their food from plants or from other animals.
- Plants need water and light to live and grow. (K-LS1-1)
Connection boxes provide:

a) connections to other topics in a particular grade level.

b) articulation across grade levels.

c) connections to Common Core State Standards (CCSS).
Example of CCSS Connection

K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* Connections to other DCIs in kindergarten: K.ETS1.A (K-ESS3-2), (K-ESS3-3)

Articulation of DCIs across grade-levels: 1.LS1.A (K-ESS3-1); 2.ESS1.C (K-ESS3-2); 2.ETS1.B (K-ESS3-3); 3.ESS3.B (K-ESS3-2); 4.ESS3.A (K-ESS3-3); 4.ESS3.B (K-ESS3-2); 5.LS2.A (K-ESS3-1); 5.ESS2.A (K-ESS3-1); 5.ESS3.C (K-ESS3-3)

Common Core State Standards Connections:
ELA/Literacy - RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2) W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-2) SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2) SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)

Mathematics - MP.2 Reason abstractly and quantitatively. (K-ESS3-1) MP.4 Model with mathematics. (K-ESS3-1), (K-ESS3-2) K.CC Counting and Cardinality (K-ESS3-1), (K-ESS3-2)
NGSS 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
NGSS Endorsements

• National Research Council (NRC)
  – Fidelity to K-12 Framework
• National Science Teachers Association (NSTA)
California Headquartered Business Support

- Autodesk, Inc.
- Baybio Association
- Baybio Institute
- Broadcom
- Causecast
- Chevron
- Cisco Systems
- Intel
- Optum RX
- Parsons
- Pasco
- Sally Ride Science
- SSL
- Steller Solutions INC.
- Symantec
Businesses with Significant California Presence

- Bayer
- Corning
- DuPont
- Eaton
- Eli Lilly
- EMC
- Hitachi
- IBM
- McKinstry
- Merck
- Microsoft
- Raytheon
- Dell
- Prudential
- Travelers
- State Farm
# Moving from Current CA Standards to NGSS-CA

<table>
<thead>
<tr>
<th>Less emphasis on</th>
<th>More emphasis on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discrete facts</td>
<td>Conceptual understanding with a focus on depth over breadth</td>
</tr>
<tr>
<td>Isolated investigation and experimentation process skills</td>
<td>Integration of science and engineering practices with content</td>
</tr>
<tr>
<td>Student acquisition of information</td>
<td>Student understanding and use of scientific knowledge within and across science disciplines, and science engineering practices</td>
</tr>
<tr>
<td>Numerous standards</td>
<td>Limited number of Disciplinary Core Ideas and Cross Cutting Concepts that unify the study of science and engineering</td>
</tr>
<tr>
<td>Uneven articulation throughout grade levels</td>
<td>Learning progressions that develop K-12</td>
</tr>
<tr>
<td>No engineering</td>
<td>Engineering standards and practices that all students should encounter</td>
</tr>
<tr>
<td>Assessing science knowledge</td>
<td>Assessing scientific understanding and reasoning specified by the performance expectations</td>
</tr>
<tr>
<td>Limited correlation with other subjects</td>
<td>Correlation with CCSS ELA and Mathematics</td>
</tr>
<tr>
<td>Limited integration of science disciplines in middle school</td>
<td>Integration of science disciplines in middle school</td>
</tr>
</tbody>
</table>

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Note: NGSS-CA stands for Next Generation Science Standards in California.
Grade 7 – Life Science

California 7th Grade Life Science

- *Students know the* function of the Umbilicus and placenta during pregnancy.

- **NGSS Life Science - Middle School**
  
  Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
Grade 5 – Physical Science

• California 5th Grade Physical Science

• Students know the common properties of salts, such as sodium chloride (NaCl).

• NGSS Physical Science- Grade 5

• Make observations and measurements to identify materials based on their properties.
High School – Earth and Space Sciences

California High School - Earth Science 1.b

• Students know the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.

California Investigation and Experimentation High School

• 1.i. Analyze the locations, sequencing, or time intervals that are characteristic of natural phenomena (e.g. relative ages of rocks, location of planets over time, and succession of species in an ecosystem)

Or/And

• 1.k. Recognize the cumulative nature of scientific evidence.

• NGSS Earth and Space Science High school

Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth’s formation and early history.
Engineering Design Standards Grades K-2

Students who demonstrate understanding can:

• **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

• **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

• **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
California’s Process to Adoption
Next Generation Science Standards Development Process

2011
- September 2011: California Selected as Lead State in the Development of NGSS, Based on NRC Framework

2012
- February 2012: Second Meeting of SRT
- October 2012: Third Meeting of SRT

2013
- April 2013: Final Draft of NGSS Release
- April – June 2013: SEP Meetings

2014
- By November 2013: California SBE Adopts, Rejects, or Modifies Recommended Science Standards

* Pending SBE's action
California Science Expert Panel (SEP)

- 27 Science Experts who are representative of the SRT
  - K-12 Teachers, COE Science Leaders, IHE Faculty, Business, Industry, and Informal Science Centers
  - Noted Scientist Advisors
    - Dr. Bruce Alberts
    - Dr. Helen Quinn
    - Dr. Art Sussman
SEP Role

- Review National NGSS to make preliminary recommendations for field comment
- Review feedback from public forums and SRT surveys
- Recommend new California Science Standards based on the NGSS to the Superintendent of Public Instruction
- The SEP met for three times during April, May, and June
SEP April Meeting Recommendations to the Field

• Accept NGSS for California
• Build on current California middle grades semi-integrated standards to integrated standards for grades 6-8.
Regional Public Meetings

- Sacramento County Office of Education (COE) – April 29
- Santa Clara COE – April 30
  - Also broadcast via live Webinar
- Riverside COE – May 2
Responses

• Majority supported the recommendation of the SEP to adopt the NGSS for California
• Confirmed the notion of integrated standards at middle grades
• Some questions about the implementation of NGSS and clarification of the content
SEP Response

• Modified clarification statements when appropriate.
• Wrote implementation recommendations for the Framework.
Clarification

- Grade 6 NGSS
- MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one or many different numbers and types of cells. [Clarification Statement; Emphasis is on developing evidence that living things (Including Bacteria, Archaea, and Eukarya) are made of cells, distinguished between living and non-living cells, and understanding living things may be made of one cell or many varied cells. Viruses, while not cells, have features that are both common with, and distinct from, cellular life].
Performance Expectations

NGSS:
• K-5 grade specific
• 6-8 grade span
• 9-12 grade span

For CA:
• K-8 grade specific instructional materials adoption
• 6-8 must be grade specific
Middle School Process – May

Common Criteria

Compare and Contrast

Refine Models → SRT
Criteria for Design

PEs must:

- Be arranged to provide a transition from elementary to high school
- Align with CCSS ELA and Math
- Build within and across grade levels
- Be balanced in complexity and quantity at each grade
- Integrate engineering appropriately
Middle School Process – June

Presentation

Straw Vote

Grp #1
Grp #2
Grp #3

Grp #1
Grp #2

MS Learning Progression

100% Consensus
Middle School Storyline

- Dr. Bruce Alberts
  Professor Emeritus
  UC San Francisco

- Dr. Helen Quinn
  Professor Emeritus
  Stanford Linear Accelerator
# Middle Grade Learning Progression

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cross cutting concepts</th>
<th>Life</th>
<th>Earth and Space</th>
<th>Physical</th>
<th>Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th</td>
<td>Stability and change; scale, proportion and quantity</td>
<td>Natural Selection</td>
<td>History of the Earth</td>
<td>Waves and Electromagnetic radiation</td>
<td>Human Impact</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Space systems</td>
<td>Energy</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>Forces and Interactions</td>
<td></td>
</tr>
<tr>
<td>7th</td>
<td>Energy and Matter: flows, cycles, and conservation; cause and effect</td>
<td>Ecosystems</td>
<td>Natural resources</td>
<td>Structure and property of matter</td>
<td>Human Impact</td>
</tr>
<tr>
<td>6th</td>
<td>Patterns; structure and function; systems and system models</td>
<td>Cells and Organisms</td>
<td>Weather and climate</td>
<td>Energy</td>
<td>Human Impact</td>
</tr>
<tr>
<td>5th</td>
<td>Energy and matter: flows, cycles and conservation; Scale, proportion and quantity</td>
<td>Matter cycles through living and non living things</td>
<td>Earth in space, interactions of earth systems</td>
<td>Properties and structure of matter</td>
<td>Human Impact</td>
</tr>
</tbody>
</table>
Endorsement

• Achieve Inc. has reviewed and endorsed the learning progressions as defined by California.
Lots of work completed, underway, and left to do

CA Framework
Assessment
Instruction
Teacher Development
Support NGSS for Adoption in California

- California Science Expert Panel (SEP)
- California Science Project (CSP)
- California Science Teachers Association (CSTA)
- California STEM Learning Network (CSLNet)
- Children Now
- The Education Trust-West
- K-12 Alliance/WestEd
- Resource Area for Teaching (RAFT)
- Silicon Valley Education Foundation (SVEF)
State Superintendent of Public Instruction, Tom Torlakson, recommends that the California State Board of Education adopt the Next Generation Science Standards for California Public Schools, Kindergarten Through Grade Twelve.
NGSS for California Public Schools; Kindergarten Thought Grade Twelve

Includes:

K-5 grade specific performance expectations as defined by the national NGSS.

6-8 modified grade specific performance expectations based on integrated topics defined by NGSS

9-12 grade span performance expectations as defined by the national NGSS.
Thank you!

To all who worked on the project.