

## How to Read the Next Generation Science Standards (NGSS)

The Next Generation Science Standards (NGSS) are distinct from prior science standards in that they integrate three dimensions within each standard and have intentional connections across standards. To provide guidance and clarification to all users of the standards, the writers have created a System Architecture that highlights the NGSS as well as each of the three integral dimensions and connections to other grade bands and subjects. The standards are organized in a table with three main sections:

- 1) Performance expectation(s)
- 2) The foundation boxes, and
- 3) The connection boxes

### Reading the Elements of the System Architecture

In the figure below, from top to bottom are seen the title, the topic label row, the performance expectation(s) (the assessable component), the foundation boxes (containing Practices, Disciplinary Core Ideas and Crosscutting Concepts), and the connection boxes.

Code for Topic Name

System Architecture

Assessable Component	<b>MS.ESS-SS Space Systems</b> Students who demonstrate understanding can: <b>a. Construct explanations for the occurrences of day/night cycles, seasons, tides, eclipses, and lunar phases based on patterns of the observed motions of celestial bodies.</b> [Assessment Boundary: Kepler's Laws of orbital motion are not used as the basis for evidence at this level.] <b>b. Obtain, evaluate, and communicate support for the Big Bang theory.</b> [Clarification Statement: Qualitative discussions of the cosmic background radiation, the motions of galaxies away from each other, and the expansion and scale of the universe to support the Big Bang theory.] <b>c. Construct and use models to describe the solar system, Milky Way Galaxy, and universe.</b> [Assessment Boundary: Mathematical models are not expected; use AU for Solar System scale; use light years for universal scale.] <b>d. Use models to support explanations of the composition, structure, and formation of the solar system from a disk of dust and gas drawn together by gravity.</b>		
Foundation Boxes	<b>Science and Engineering Practices</b> <b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs.</li> </ul> <b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence, scientific knowledge, principles, and models. <ul style="list-style-type: none"> <li>Base scientific explanations on the scientific knowledge and theories that have been tested and refined through the scientific process.</li> <li>Use models to represent relationships between variables.</li> </ul> <b>Obtaining Information</b> Obtaining, evaluating, and communicating information in 6–8 builds on 3–5 and progresses to evaluate the merit and validity of ideas and methods. <ul style="list-style-type: none"> <li>Read critically using scientific knowledge and reasoning to evaluate data, hypotheses, conclusions, and competing information. (b)</li> </ul>	<b>Disciplinary Core Ideas</b> <b>ESS1.A: The Universe and Its Stars</b> <ul style="list-style-type: none"> <li>Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (a)</li> <li>The universe began with a period of extreme and rapid expansion known as the Big Bang. Nearly all observable matter in the universe is hydrogen or helium, which formed in the first minutes after the Big Bang.</li> <li>Earth and the other planets in the solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (c)</li> </ul> <b>ESS1.B: Earth and the Solar System</b> <ul style="list-style-type: none"> <li>The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are in orbit around the sun by its gravity. Objects in orbit are held in place by the gravitational attraction of the sun.</li> <li>This model of the solar system includes the sun, planets, moons, and asteroids. (b)</li> <li>This model of the solar system includes the sun, planets, moons, and asteroids. (b)</li> <li>Earth's spin on its axis causes day and night (short-term) but tilted relative to its orbit around the sun; the differential intensity of sunlight on different areas of Earth over the year is a result of that tilt, as are the seasons that result. (a)</li> </ul> <b>PS2.C: Stability and Instability in Physical Systems</b> <ul style="list-style-type: none"> <li>A system can be changing but have a stable repeating cycle of changes; such observed regular patterns allow predictions about the system's future (e.g., Earth orbiting the sun). (a)</li> </ul>	<b>Crosscutting Concepts</b> <b>Patterns</b> Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data. <b>Scale, Proportion, and Quantity</b> Time, space, and energy phenomena can be observed at various scales using models to study systems that are not directly observable. Lowercase letters designate which of the performance expectations incorporate this crosscutting concept. (a),(d)
Connections Boxes	Connections to other DCIs in this grade-level: <b>MS.LS-GDRO, MS.PS-FM, MS.PS-IF, MS.PS-E</b> Articulation to DCIs across grade-levels: <b>1.PCS, 5.SSS, HS.ESS-SS</b> Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases] <b>ELA</b> <b>W.6.1</b> Write arguments to support claims with clear reasons and relevant evidence. <b>W.6.4</b> Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. <b>W.7.1</b> Write arguments to support claims with clear reasons and relevant evidence. <b>W.7.4</b> Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. <b>SL.7.4</b> Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details and examples; use appropriate eye contact, adequate volume, and clear pronunciation. <b>W.8.1</b> Write arguments to support claims with clear reasons and relevant evidence. <b>W.8.4</b> Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. <b>SL.8.4</b> Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. <b>Mathematics</b> <b>MP.4</b> Model with mathematics <b>8.F</b> Use functions to model relationships between quantities		

A detailed explanation of the elements of the System Architecture follows:

1. Performance Expectations

The standards are written as student performance expectations. These statements each incorporate a practice, a disciplinary core idea, and a crosscutting concept. The performance expectations are the assessable components of the NGSS architecture identified with lowercase letters, and each combines Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The performance expectations were initially written in topical groupings, but can also be viewed independently. Topical groupings of performance expectations do not imply a preferred ordering for instruction—nor should all performance expectations under one topic necessarily be taught in one course. There are two additional statements associated with the performance expectations that are meant to render additional support and clarity:

- a. *Assessment Boundary Statements* are included with individual performance expectations where appropriate, to provide further guidance or to specify the scope of the expectation at a particular grade level.
- b. *Clarification Statements* are designed to supply examples or additional clarification to the performance expectations.

2. Foundation Boxes

Foundation boxes provide additional information, expanding and explaining the performance expectations in relation to the three dimensions: Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. Each statement in any one of the three foundation boxes is coded to the performance expectation(s) that embody it by a lowercase letter in parentheses.

- a. *Science and Engineering Practice Statements*: These statements are derived from and grouped by the eight categories detailed in the *Framework* to further explain the science and engineering practices important to emphasize in each grade band. Most topical groupings of performance expectations emphasize only a few of the practice categories; however, all practices are emphasized within a grade band. Teachers should be encouraged to utilize several practices in any instruction. The purpose is to demonstrate the specific practice for which students will be held accountable.
- b. *Disciplinary Core Ideas (DCIs)*: These statements are taken verbatim from the *Framework*, and detail the sub supporting ideas necessary for student mastery of the core idea.
- c. *Crosscutting Concept Statements*: These statements were derived from the *Framework* to further explain the crosscutting concepts important to emphasize in each grade band. The crosscutting concepts are grouped by the categories detailed in the *Framework*. Most topical groupings of performance expectations emphasize only a few of the crosscutting concept categories, however all are emphasized within a grade band. Again, the list is not exhaustive nor is it intended to limit instruction.

3. Connection Boxes

- a. *Connections to other DCIs in this grade level*: This box will contain the names of science topics in other disciplines that have corresponding disciplinary core ideas at the same grade level. For example, both Physical Science and Life Science standards contain core ideas related to Photosynthesis, and could be taught in relation to one

another. As the standards move toward completion, this box will provide links to specific performance expectations.

- b. *Articulation of DCIs across grade levels:* This box will contain the names of other science topics that either 1) provide a foundation for student understanding of the core ideas in this standard (usually standards at prior grade levels) or 2) build on the foundation provided by the core ideas in this standard (usually standards at subsequent grade levels). As the standards move toward completion, this box will provide links to specific performance expectations.
- c. *Connections to the Common Core State Standards:* This box will contain the coding and names of Common Core State Standards in English Language Arts & Literacy and Mathematics that align to the performance expectations. For example, performance expectations that require student use of exponential notation will align to the corresponding CCSS mathematics standards.

### Color Coding

Online versions of the standards display color coding of the words within each standard statement. The colors represent the three dimensions: blue for Science and Engineering Practices, orange for Disciplinary Core Ideas, and green for Crosscutting Concepts. Clarification Statements and Assessment Boundaries are red. Printed versions of the standards do not have color coding of the three dimensions; in these cases the coding for the three dimensions will be accomplished through the lowercase letters found after each foundation box statement.