

Examples of How Practices are Used in Performance Expectations

The boxes below show examples from the May 2012 **DRAFT** of the NGSS showing how each practice could be used in a performance expectation.



1. Asking Questions (for Science) and Defining Problems (for Engineering)

[Example from Biology]

MS.LS-IRE Interdependent Relationships in Ecosystems		
c. Ask researchable questions about the ways organisms obtain matter and energy across multiple and varied ecosystems.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to formulating and refining empirically testable questions. <ul style="list-style-type: none"> Ask questions that arise from phenomena, models, or unexpected results. (c) 	LS2.A: Interdependent Relationships in Ecosystems Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (c)	Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system. (c)

2. Developing and Using Models

[Example from Chemistry]

MS.PS-SPM Structure and Properties of Matter		
a. Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models 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"> 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. (a) 	PS1.A: Structure and Properties of Matter <ul style="list-style-type: none"> All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (a) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (a) 	Patterns 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. (a)

3. Planning and Carrying Out Investigations

[Example from Physics]

MS.PS-FM Forces and Motion		
c. Collect data to generate evidence supporting Newton’s Third Law, which states that when two objects interact they exert equal and opposite forces on each other.		
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	Disciplinary Core Ideas	Crosscutting Concepts
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. <ul style="list-style-type: none"> Collect data and generate evidence to answer scientific questions or test design solutions under a range of conditions. (c) 	PS2.A: Forces and Motion <ul style="list-style-type: none"> For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law). (c) 	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, including the atomic scale. Small changes in one part of a system might cause large changes in another part. Stability might be disturbed either by sudden events or gradual changes that accumulate over time. Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms. (c)

4. Analyzing and Interpreting Data

[Example from Earth Science]

MS.ESS-WC Weather and Climate Systems		
h. Use maps and other visualizations to analyze large data sets that illustrate the frequency, magnitude, and resulting damage from severe weather events in order to assess the likelihood and severity of future events.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigation, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. <ul style="list-style-type: none"> Use graphical displays (e.g., maps) of large data sets to identify temporal and spatial relationships. (h) 	ESS3.B: Natural Hazards <ul style="list-style-type: none"> Severe weather events (e.g., hurricanes, floods, forest fires) are often preceded by observable phenomena that allow for reliable predictions. Constant monitoring of weather hazards in a region and the development of an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (h) 	Cause and Effect Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (h)

5. Using Mathematics and Computational Thinking

[Example from Physics]

MS.PS-FM Forces and Motion		
d. Use mathematical concepts and observations to describe the proportional relationship between the acceleration of an object and the force applied upon the object, and the inversely proportional relationship of acceleration to its mass.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Mathematical and Computational Thinking Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. <ul style="list-style-type: none"> Use mathematical concepts such as ratios, averages, basic probability, and simple functions, including linear relationships, to analyze data. (d) 	PS2.A: Forces and Motion <ul style="list-style-type: none"> 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. (d) 	Scale, Proportion, and Quantity Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. Scientific relationships can be represented through the use of algebraic expressions and equations. (b),(d)

6. Constructing Explanations (for Science) and Designing Solutions (for Engineering) [Example from Biology]

MS.LS-SFIP Structure, Function, and Information Processing		
c. Construct an explanation for the function of specific parts of cells including: nucleus, chloroplasts, and mitochondria and the structure of the cell membrane and cell wall for maintaining a stable internal environment.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions 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 consistent with scientific knowledge, principles, and theories. <ul style="list-style-type: none"> Apply scientific reasoning to show why the data are adequate for the explanation or conclusion. (c) Construct explanations from models or representations. (c) 	LS1.A: Structure and Function <ul style="list-style-type: none"> Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (c) 	Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (c)

7. Engaging in Argument from Evidence

[Example from Biology]

MS.LS-MEOE Matter and Energy in Organisms and Ecosystems		
f. Use evidence to support arguments that changing any physical or biological component of an ecosystem may result in shifts in the populations of species in the ecosystem.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. <ul style="list-style-type: none"> Use oral and written arguments supported by empirical evidence and reasoning to support or refute an argument for a phenomenon or a solution to a problem. (f) 	LS2.C: Ecosystem Dynamics, Functioning, and Resilience <ul style="list-style-type: none"> Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (f) 	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, including the atomic scale. Small changes in one part of a system might cause large changes in another part. Stability might be disturbed either by sudden events or gradual changes that accumulate over time. Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms. (f)

8. Obtaining, Evaluating, and Communicating Information

[Example from Astronomy]

MS.ESS-SS Space Systems		
b. Obtain, evaluate, and communicate information about the expansion and scale of the universe to support the Big Bang theory.		
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	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information 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"> Read critically using scientific knowledge and reasoning to evaluate data, hypotheses, conclusions, and competing information. (b) 	ESS1.A: The Universe and Its Stars <ul style="list-style-type: none"> 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. (b) 	Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. The observed function of natural and designed systems may change with scale. (b)