Grades 6, 7, 8

Adopted 2013

Appendix G: Crosscutting Concepts

Patterns

1. Observe patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. AG.1

1. Macroscopic patterns are related to the nature of microscopic and atomic-level structure. 6-8.AG.1.1
2. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. 6-8.AG.1.2
3. Patterns can be used to identify cause and effect relationships. 6-8.AG.1.3
4. Graphs, charts, and images can be used to identify patterns in data. 6-8.AG.1.4

Cause and Effect: Mechanism and Prediction

2. Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. AG.2

1. Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. 6-8.AG.2.1
2. Cause and effect relationships may be used to predict phenomena in natural or designed systems. 6-8.AG.2.2
3. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. 6-8.AG.2.3

Scale, Proportion, and Quantity

3. In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. AG.3

1. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 6-8.AG.3.1
2. The observed function of natural and designed systems may change with scale. 6-8.AG.3.2
3. 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. 6-8.AG.3.3

   Scientific relationships can be represented through the use of algebraic expressions and equations. 6-8.AG.3.4

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5. Phenomena that can be observed at one scale may not be observable at another scale. 6-8.AG.3.5

Systems and System Models

4. A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. AG.4

1. Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. 6-8.AG.4.1
2. Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. 6-8.AG.4.2
3. Models are limited in that they only represent certain aspects of the system under study. 6-8.AG.4.3

Energy and Matter: Flows, Cycles, and Conservation

5. Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior. AG.5

1. Matter is conserved because atoms are conserved in physical and chemical processes. 6-8.AG.5.1
2. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 6-8.AG.5.2
3. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). 6-8.AG.5.3
4. The transfer of energy can be tracked as energy flows through a designed or natural system. 6-8.AG.5.4

Structure and Function

6. The way an object is shaped or structured determines many of its properties and functions. AG.6

1. 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. 6-8.AG.6.1
2. Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. 6-8.AG.6.2

Stability and Change

7. For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand. AG.7

- 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. 6-8.AG.7.1

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2. Small changes in one part of a system might cause large changes in another part. 6-8.AG.7.2
3. Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 6-8.AG.7.3
4. Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms. 6-8.AG.7.4