

## Middle School CCCs (Discipline Specific Model)<sup>1</sup>

**PATTERNS** In grades 6-8, students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.

- **Macroscopic patterns are related to the nature of microscopic and atomic-level structure.**

MS-PS1-2

- **Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.**

MS-ESS2-3

- **Patterns can be used to identify cause and effect relationships.**

MS-LS2-2; MS-LS4-2

MS-ESS1-1

- **Graphs, charts, and images can be used to identify patterns in data.**

MS-LS4-1; MS-LS4-3

MS-ESS3-2

MS-PS4-1

**CAUSE AND EFFECT: MECHANISM AND PREDICTION** In grades 6-8, students classify relationships as causal or correlational and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

- **Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.**

MS-ESS3-3

- **Cause and effect relationships may be used to predict phenomena in natural or designed systems.**

MS-LS1-8; MS-LS2-1; MS-LS3-2

MS-ESS2-5; MS-ESS3-1; MS-ESS3-4

MS-PS1-4; MS-PS2-3; MS-PS2-5

- **Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.**

MS-LS1-4; MS-LS1-5; MS-LS4-4; MS-LS4-5; MS-LS4-6

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<sup>1</sup> Items in grey are not cited in Grades 6-8 Performance Expectations.

**SCALE, PROPORTION, AND QUANTITY** In grades 6-8, students observe time, space and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale and that the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude or properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.

- **Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.**

MS-ESS1-3; MS-ESS1-4; MS-ESS2-2

MS-PS1-1

- The observed function of natural and designed systems may change with scale.

- **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.**

MS-PS3-1; MS-PS3-4

- Scientific relationships can be represented through the use of algebraic expressions and equations.

- **Phenomena that can be observed at one scale may not be observable at another scale.**

MS-LS1-1

**SYSTEMS AND SYSTEM MODELS** In grades 6-8, students understand that systems may interact with other systems; they may have sub-systems, and be part of larger complex systems. They can use models to represent systems and their interactions – such as inputs, processes, and outputs – and energy, matter and information flows within systems. They also learn that models are limited in that they only represent certain aspects of the system under study.

- **Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.**

MS-LS1-3

- **Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.**

MS-ESS1-2; MS-ESS2-6

MS-PS2-1; MS-PS2-4; MS-PS3-2

- Models are limited in that they only represent certain aspects of the system under study.

**ENERGY AND MATTER** In grades 6-8, students learn that matter is conserved because atoms are conserved in physical and chemical processes. They also learn 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.

- **Matter is conserved because atoms are conserved in physical and chemical processes.**

MS-LS1-7

MS-PS1-5

- **Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.**

MS-LS1-6

MS-ESS2-4

- **Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).**

MS-PS3-5

- **The transfer of energy can be tracked as energy flows through a designed or natural system.**

MS-LS2-3

MS-PS1-6; MS-PS3-3

**STRUCTURE AND FUNCTION** In grades 6-8, students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.

- **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.**

MS-LS1-2; MS-LS3-1

- **Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.**

MS-PS1-3; MS-PS4-2; MS-PS4-3

**STABILITY AND CHANGE** In grades 6-8, students explain stability and change in natural or designed systems by examining changes over time and considering forces at different scales, including the atomic scale. Students learn that changes in one part of a system might cause large changes in another part. Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

- **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.**

MS-ESS2-1

MS-PS2-2

- **Small changes in one part of a system might cause large changes in another part.**

MS-LS2-4; MS-LS2-5

- **Stability might be disturbed either by sudden events or gradual changes that accumulate over time.**

MS-ESS3-5

- Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms