## Performance Expectations at a Glance

In this unit, students will discover and practice the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts needed to perform the following Performance Expectations.

| Performance Expectations | Module: **Forces and Motion** | Module: **Mechanical Energy** | Module: **Electromagnetic Forces** |
|---|---|---|---|
| MS-PS2-1 | ● | | |
| MS-PS2-2 | ● | | |
| MS-PS2-3 | | | ● |
| MS-PS2-4 | ● | | |
| MS-PS2-5 | | | ● |
| MS-PS3-1 | | ● | |
| MS-PS3-2 | | ● | ● |
| MS-PS3-5 | | ● | |
| MS-ETS1-1 | ● | | ● |
| MS-ETS1-2 | ● | | ● |
| MS-ETS1-3 | ● | | ● |
| MS-ETS1-4 | ● | | ● |

## Correlations by Module to the NGSS

MODULE: Forces and Motion

| MS-PS2 | Motion and Stability: Forces and Interactions | |
|---|---|---|
| **MS-PS2-1.** | **Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [*Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.*] | 70, 95–102 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| **SEP Science and Engineering Practices** | |
| **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 ideas, principles, and theories.<br>• Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | *15–17*, *65–66*, 95–102 |
| **DCI Disciplinary Core Ideas** | |
| **PS2.A: Forces and Motion**<br>• 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). (MS-PS2-1) | *62–63*, 64, *65–66*, 66–67, *68–69*, 70–74, 83–84, 84, 89, 95–102, 103 |
| **CCC Crosscutting Concepts** | |
| **Systems and System Models***<br>• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1)<br>* Other aspects of this CCC are integrated throughout this module and are listed in the *Also Integrates* section. | 19, *27–28*, 29–30, 44, *48–49*, *50–51*, 55, *62–63*, *65–66*, 67, *68–69*, *72–73*, *83–84*, 85, 89, 93, 95–102, Lab *Calculate Average Speed from a Graph* (online) |
| ***Connections to Engineering, Technology, and Applications of Science***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1) | 24, 71, 91, 95–102 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 36–37, 60–61, 78–79, 85, 95–102, Literacy Skill Handbook (online) |
| ELA RST.6–8.3 | *20–21*, *38–40*, *41–42*, *45–46*, *48–49*, *50–51*, *62–63*, *68–69*, *80–81*, *87–88* Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 24, 53, 71, 91, 95–102, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 23, *27–28*, *38–40*, 44, *81–82*, 83–84, 85, 89, Math Skill Handbook (online) |
| Math 6.NS.C.5 | *11–12*, 12 Math Skill Handbook (online) |

*Labs and investigations are in italics.*

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| | |
|---|---|
| Math 6.EE.A.2 | 22–23, 44, 89 Math Skill Handbook (online) |
| Math 7.EE.B.3–4 | 32, 38–41, 44, 89 Math Skill Handbook (online) |

| MS-PS2 | Motion and Stability: Forces and Interactions | |
|---|---|---|
| **MS-PS2-2.** | **Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's PDF Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [*Assessment Boundary: Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.*] | 40, *40–42* |
| **SEP Science and Engineering Practices** | | |
| **Planning and Carrying Out Investigations**<br>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.<br>• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2) | *15–17,* 40, *41–42,* 95–102, 103 |
| ***Connections to Nature of Science***<br>**Scientific Knowledge is Based on Empirical Evidenc**<br>• Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2) | 23, 40, 47, *81–82,* 85 |
| **DCI Disciplinary Core Ideas** | | |
| **PS2.A: Forces and Motion**<br>• The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. 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. (MS-PS2-2) | *41–42,* 43–44, 47, *48–49, 50–51,* 51–52, 54–56, 66, 84, 95–102, 103 |
| • All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) | *10–11,* 11, *11–12,* 12, *13–14,* 14, *15–17,* 18, *20–21,* 25, 26, 40 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| | |
|---|---|
| **ETS1.C: Optimizing the Design Solution**<br>• Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) | 95–102, Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 36–37, 60–61, 78–79, 85, 95–102, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | *81–82,* 95–102, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 46, 95–102, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| MP.2 | 23, *27–28, 38–40,* 44, *81–82, 83–84,* 85, 89, Math Skill Handbook (online) |
| Math 7.EE.B.3 | 32, *38–41,* 44, 89, Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | 95–102 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models***<br>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.<br>• Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 95–102 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions**<br>• A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | | 95–102, Science and Engineering Practices Handbook (online) |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | | 95–102, Science and Engineering Practices Handbook (online) |

*Labs and investigations are in italics.*

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| CCC Crosscutting Concepts | |
|---|---|
| **Stability and Change**<br>• Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2) | *7, 20–21,* 22–23, *25, 27–28,* 29, 30–32, 40, *41–42,* 52, *83–84,* 90, 95–102, Lab *Calculate Average Speed from a Graph* (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.3 | *20–21, 38–40, 45–46, 50–51, 62–63, 68–69, 80–81, 87–88,* Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 24, 53, 71, 91, 95–102, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 23, *27–28, 38–41,* 44, *81–82, 83–84,* 85, 89, Math Skill Handbook (online) |
| Math 6.EE.A.2 | 22–23, 44, 89, Math Skill Handbook (online) |
| Math 7.EE.B.3–4 | 32, *38–41,* 44, 89, Math Skill Handbook (online) |

| MS-PS2 | Motion and Stability: Forces and Interactions | |
|---|---|---|
| **MS-PS2-4.** | **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**<br>[Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [*Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.*] | 85, 90, 92 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence**<br>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.<br>• Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4) | | 30, 43, 67, 90, 92, 95–102 |
| ***Connections to Nature of Science***<br>**Scientific Knowledge is Based on Empirical Evidenc**<br>• Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-4) | | 23, 40, 47, *81–82,* 85 |

*Labs and investigations are in italics.*

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| DCI Disciplinary Core Ideas | |
|---|---|
| **PS2.B: Types of Interactions**<br>• Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) | *81–82,* 82, *83–84,* 84–86, *90,* 90, 92–94, 95–102 |
| **CCC Crosscutting Concepts** | |
| **Systems and System Models***<br>• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-4)<br>* Other aspects of this CCC are integrated throughout this module and are listed in the *Also Integrates* section. | 19, *27–28,* 29–30, 44, *48–49, 50–51,* 55, *62–63, 65–66,* 67, *68–69,* 72–73, *83–84,* 85, 89, 93, 95–102, PhET Interactive Simulation *The Moving Man* (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| MS-ETS1-1. | **Define the criteria and constraints of a design problem wit sufficient precision to ensure a successful solution, taking in account relevant scientific principles and potential impacts o people and the natural environment that may limit possible solutions.** | 95–102 |
| **SEP Science and Engineering Practices** | | |
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarifying arguments and models.<br>• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 95–102 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.A: Defining and Delimiting Engineering Problem**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | 95–102 Science and Engineering Practices Handbook (online) |
| **CCC Crosscutting Concepts** | | |
| ***Connections to Science, Technology, Society and the Environment***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) | | 95–102 |

*Labs and investigations are in italics.*

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|---|---|
| • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1) | 95–102 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 36–37, 60–61, 78–79, 85, 95–102, Literacy Skill Handbook (online) |
| ELA WHST.6–8.8 | 95–102, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| MP.2 | 23, *27–28, 38–41,* 44, *81–82, 83–84,* 85, 89, Math Skill Handbook (online) |
| Math 7.EE.B.3 | 32, *38–41,* 44, 89, Math Skill Handbook (online) |

| **MS-ETS1** | **Engineering Design** | |
|---|---|---|
| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | 95–102 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence**<br>Engaging in argument from evidence in 6–8 builds on 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.<br>• Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) | | 95–102 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions**<br>• There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | | *65–66,* 95–102, Science and Engineering Practices Handbook (online) |

*Labs and investigations are in italics.*

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| **CCSS ELA/Literacy Connections** | |
|---|---|
| ELA RST.6–8.1 | 8–9, 36–37, 60–61, 78–79, 85, 95–102, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 46, 95–102, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 24, 53, 71, 91, 95–102, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | 90, 92, 95–102, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| MP.2 | 23, *27–28, 38–41,* 44, *81–82, 83–84,* 85, 89, Math Skill Handbook (online) |
| Math 7.EE.3 | 32, *38–41,* 44, 89, Math Skill Handbook (online) |

| **MS-ETS1** | **Engineering Design** | |
|---|---|---|
| **MS-ETS1-3.** | **Analyze data from tests to determine similarities and differences among several design solutions to identify the bes characteristics of each that can be combined into a new solution to better meet the criteria for success.** | 95–102, Science and Engineering Practices Handbook (online) |
| **SEP Science and Engineering Practices** | | |
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *10–11, 80–81,* 95–102 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3) | | 95–102, Science and Engineering Practices Handbook (online) |
| • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) | | Science and Engineering Practices Handbook (online) |

*Labs and investigations are in italics.*

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| **ETS1.C: Optimizing the Design Solution**<br>• The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | Science and Engineering Practices Handbook (online) |
|---|---|
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 53, 71, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 23, *27–28, 38–40,* 44, *81–82, 83–84,* 85, 89, Math Skill Handbook (online) |
| Math 7.SP.C.7 | Math Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 3, 24, *65–66,* 95–102, 103 |
| SEP Developing and Using Models | 19, *45–46, 48–49, 50, 51,* 55, *62–63, 65–66,* 67, *68–69, 72–73,* 85, 93, 95–102 |
| SEP Analyzing and Interpreting Data | 5, *11–12, 20–21, 27–28,* 29, 30–32, *38–40,* 95–102 |
| SEP Using Mathematics and Computational Thinking | *11–12,* 23, *25, 27–28,* 29, *31–32, 44, 87–88, 89* |
| SEP Constructing Explanations and Designing Solutions | 8–9, 30, 36–37, *41–42,* 47, *48–49, 50–51,* 55–56, 60–61, *68–69,* 74, 78–79, *83–84,* 94, 103 |
| SEP Obtaining, Evaluating, and Communicating Information | *10–11, 13–14,* 24, 85, 95–102 |
| Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena | 44, 47, 51, 64, *83–84,* 85 |
| DCI ESS1.A: The Universe and its Stars | 86 |
| DCI ESS1.B: Earth and the Solar System | 86 |
| DCI ESS1.C: The History of Planet Earth | 43 |
| DCI ESS2.C: The Role of Water in Earth's Surface Processes | 86 |
| DCI PS3.C: Relationship Between Energy and Forces | 71 |

*Labs and investigations are in italics.*

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|---|---|
| CCC Patterns | *62–63,* 64, Lab *Calculate Average Speed from a Graph* (online) |
| CCC Cause and Effect | 43, 47, 70, *83–84,* 91 |
| CCC Scale Proportion, and Quantity | *10–11, 11–12, 13–14,* 22, *25,* 26, *27–28,* 30–32, 44, *87–88,* 89 |
| CCC Systems and System Models | 52, 64, 95–102 |
| Connections to Nature of Science Science is a Way of Knowing | 85 |
| Connections to Nature of Science Science is a Human Endeavor | 71 |
| Connections to Nature of Science Science Addresses Questions About the Natural and Material World | 91 |
| CCSS ELA RST.6–8.10 | 85 |
| CCSS ELA WHST.6–8.4 | 92 |
| CCSS ELA WHST.6–8.6 | 91, 95–102 |
| CCSS ELA SL.8.1 | 85 |
| CCSS ELA SL.8.4 | 24, 53, 71, 95–102 |
| CCSS MATH MP.4 | 44, 51, 89 |
| CCSS MATH 6.RP.A.1 | *87–88* |
| CCSS MATH 6.RP.A.3 | *87–88* |
| CCSS MATH 6.SP.B.5 | *38–41* |
| CCSS MATH 7.RP.A.2 | *62–63, 87–88* |

## MODULE: Mechanical Energy

| MS-PS3 | Energy | |
|---|---|---|
| **MS-PS3-1.** | **Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.] | *113–115, 117–119* |

*Labs and investigations are in italics.*

*Continued from previous page.*

| | |
|---|---|
| **SEP Science and Engineering Practices** | |
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.<br>• Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | *113–115, 117–119* |
| **DCI Disciplinary Core Ideas** | |
| **PS3.A: Definitions of Energ**<br>• Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) | 113, *113–115,* 116, *117–119,* 120, 122–124, 161–166, 167 |
| **CCC Crosscutting Concepts** | |
| **Scale, Proportion, and Quantity**<br>• 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) | *13–115,* 116, *117–119,* 120, 122–124, 161–166 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 110–111, 128–129, 144–145, 161–166, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | 153, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *113–115, 117–119,* Math Skill Handbook (online) |
| Math 6.RP.A.1 | 116, Math Skill Handbook (online) |
| Math 6.RP.A.2 | 117, Math Skill Handbook (online) |
| Math 7.RP.A.2 | *113–115,* 116, *117–119,* 120, Math Skill Handbook (online) |
| Math 8.EE.A.1 | 122–124, Math Skill Handbook (online) |
| Math 8.EE.A.2 | Math Skill Handbook (online) |
| Math 8.F.A.3 | *113–115, 117–119,* Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS3 | Energy | |
|---|---|---|
| MS-PS3-2. | **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts o potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [*Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions*.] | 132, 136, 138, 160, 161–166 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS3-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 127, 132, 136, 138, *146–148, 151–152,* 53, 160, 161–166 |
| **DCI Disciplinary Core Ideas** | | |
| **PS3.A: Definitions of Energ** • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) | | *130–131,* 131–132, *133–135,* 135–136, 138–140, 161–166, 167 |
| **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) | | 135–136, *151–152,* 152–153, *154–155,* 155, 157, 160, 161–166, 167 |
| **CCC Crosscutting Concepts** | | |
| **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems. (MS-PS3-2) | | 132, 136, 138, *146–148,* 149–150, *151–152,* 153, 155, 157–158, 160, 161–166, PhET Interactive Simulation *Energy Skate Park: Basics* (online) |
| **CCSS ELA/Literacy Connections** | | |
| ELA SL.8.5 | | 121, 137, 157, 161–166, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS3 | Energy | |
|---|---|---|
| MS-PS3-5. | **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [*Assessment Boundary: Assessment does not include calculations of energy.*] | 160, 161–166 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence**<br>Engaging in argument from evidence in 6–8 builds on 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 worlds.<br>• Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) | | *117–119,* 150, 160, 161–166 |
| ***Connections to Nature of Science***<br>**Scientific Knowledge is Based on Empirical Evidenc**<br>• Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-5) | | *113–115, 117–119,* 120, *130–131, 133–135, 146–148,* 150, *151–152, 154–155,* 161–166 |
| **DCI Disciplinary Core Ideas** | | |
| **PS3.B: Conservation of Energy and Energy Transfer**<br>• When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) | | *151–152,* 152–153, *154–155,* 155–157, 160, 161–166, 167 |
| **CCC Crosscutting Concepts** | | |
| **Energy and Matter***<br>• Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). (MS-PS3-5)<br>* Other aspects of this CCC are integrated throughout this module and are listed in the *Also Integrates* section. | | 113, 121–124, 131–132, 136, 138–140, *146–148,* 148, 153, 155, 157–160, 161–166, 167 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 110–111, 128–129, 144–145, 161–166, Literacy Skill Handbook (online) |
| ELA WHST.6–8.1 | | *117–119,* 150, 160, 161–166, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | *113–115, 117–119,* Math Skill Handbook (online) |
| Math 6.RP.A.1 | | 116, Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-1.** | **Define the criteria and constraints of a design problem wit sufficient precision to ensure a successful solution, taking in account relevant scientific principles and potential impacts o people and the natural environment that may limit possible solutions.** | 261–266 |
| **SEP Science and Engineering Practices** | | |
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarifying arguments and models.<br>• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 261–266 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.A: Defining and Delimiting Engineering Problem**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | 261–266, Science and Engineering Practices Handbook (online) |
| **CCC Crosscutting Concepts** | | |
| ***Connections to Science, Technology, Society and the Environment***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) | | Science and Engineering Practices Handbook (online) |
| • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1) | | 261–266 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 174–175, 185, 200–201, 220–221, 236–237, Literacy Skill Handbook (online) |
| ELA WHST.6–8.8 | | 193, 229, 257, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | *208–209*, *225–226*, *240–241*, *243–245,* Math Skill Handbook (online) |

*Labs and investigations are in italics.*

*Continued from previous page.*

| | |
|---|---|
| Math 7.RP.A.2 | *113–115,* 116, *117–119,* 120, Math Skill Handbook (online) |
| Math 8.F.A.3 | *113–115, 117–119,* Math Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 167 |
| SEP Planning and Carrying Out Investigations | 109, *112,* 127, *133–135,* 167 |
| SEP Analyzing and Interpreting Data | 109, *133–135* |
| SEP Using Mathematics and Computational Thinking | 110–111, *113–115*, *117–119*, 120, 123, 128–129, 144–145, 161–166 |
| SEP Constructing Explanations and Designing Solutions | 110–111, 120, 123–124, 128–129, *130–131,* 136–137, 140, 144–145, *146–148,* 153, 167 |
| SEP Obtaining, Evaluating, and Communicating Information | 121, 137, 156 |
| DCI PS2.A: Forces and Motion | 109, 112, 136, *151–152,* 153, *154–155,* 155 |
| CCC Patterns | *113–115, 117–119, 133–135,* 150 |
| CCC Cause and Effect | *133–135* |
| CCC Energy and Matter | 120, 150, *151–152* |
| Connections to Nature of Science Scientific is a Human Endeavor | 137 |
| CCSS ELA SL.8.4 | 161–166 |
| CCSS ELA SL.8.5 | 121, 137, 157, 161–166 |
| CCSS ELA RST.6–8.10 | 156 |
| CCSS ELA WHST.6–8.4 | 161–166 |
| CCSS ELA WHST.6–8.10 | 161–166 |
| CCSS Math MP.4 | *113–115, 117–119,* 120 |
| CCSS Math 6.SP.B.5 | *113–115, 117–119* |

*Labs and investigations are in italics.*

## MODULE: Electromagnetic Forces

| MS-PS2 | Motion and Stability: Forces and Interactions | |
|---|---|---|
| MS-PS2-3. | **Ask questions about data to determine the factors that affect th strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [*Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.*] | 177, 209, 235 |
| **SEP Science and Engineering Practices** | | |
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.<br>• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the Also Integrates section. | | 177, 209, 235, 267 |
| **DCI Disciplinary Core Ideas** | | |
| **PS2.B: Types of Interactions**<br>• Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) | | *176–177*, 177, *178–179*, *180–181*, 181, *182–183*, 186, *187–188*, 188, 195, *202–203*, 204, *205–207*, 207, *208–209*, 209, 215–216, *238–239*, *240–241*, 240–241, 261–266 |
| **CCC Crosscutting Concepts** | | |
| **Cause and Effec**<br>• Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3) | | 177–178, *178–179*, *187–188*, 204, *240–241*, 242, 246, 252, *254–255* |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 174–175, 185, 200–201, 220–221, 236–237, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | *208–209*, *225–226*, *240–241*, *243–245*, Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS3 | Energy | |
|---|---|---|
| **MS-PS2-5.** | **Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects e erting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically charged strips of tape, and electrically charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [*Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.*] | *182–183*, *202–203*, *205–207*, 261–266 |
| **SEP Science and Engineering Practices** | | |
| **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. • Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *178–179*, *202–203, 205–207*, *225–226*, 261–266 |
| **DCI Disciplinary Core Ideas** | | |
| **PS2.B: Types of Interactions** • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5) | | *182–183*, 184–185, 194–195, 204–205, 207, *208–209*, *238–239*, 240, *240–241*, 241–242, 261–266, Lab *Experiment with Magnets* (online), PhET Interactive Simulation *Magnet and Compass* (online) |
| **CCC Crosscutting Concepts** | | |
| **Cause and Effec** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-5) | | 177–178, *178–179*, *187–188*, 204, *240–241*, 242, 246, 252, *254–255* |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.3 | | *176–177*, *178–179*, *180–181*, *182–183*, *187–188*, *190–191*, *202–203*, *205–207*, *222–223*, *225–226*, *238–239*, *243–245*, *247–248*, *250–251*, *254–255,* Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | | 193, 213, 229, 257, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS3 | Energy | |
|---|---|---|
| MS-PS3-2. | **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts o potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [*Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions*.] | 189, 214, 261–266 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS3-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *182–183*, 184, 189, 192, *205–207*, *222–223*, 230, 242, 258, 261–266, PhET Interactive Simulation *Magnet and Compass* (online) |
| **DCI Disciplinary Core Ideas** | | |
| **PS3.A: Definitions of Energ** • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) | | *187–188*, 188–189, 194–195, 210, 227–228, 231–232, 261–266 |
| **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) | | *187–188*, 188–189, 194–195, 210, 261–266 |
| **CCC Crosscutting Concepts** | | |
| **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems. (MS-PS3-2) | | 189, 195, *205–207*, 214, *222–223*, 230, 258, 261–266 |
| **CCSS ELA/Literacy Connections** | | |
| ELA SL.8.5 | | 213, 229, 257, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-ETS1 | Engineering Design | |
|---|---|---|
| MS-ETS1-2. | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | 261–266 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence*** Engaging in argument from evidence in 6–8 builds on 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. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 261–266 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | | 261–266, Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 174–175, 185, 200–201, 220–221, 236–237, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | | 193, 229, 257, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | | 193, 213, 229, 257, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | | Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | *208–209*, *225–226*, *240–241*, *243–245,* Math Skill Handbook (online) |
| Math 7.EE.B.3 | | Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| MS-ETS1-3. | **Analyze data from tests to determine similarities and differences among several design solutions to identify the bes characteristics of each that can be combined into a new solution to better meet the criteria for success.** | 261–266 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| SEP Science and Engineering Practices | |
|---|---|
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.<br>• Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 261–266 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.B: Developing Possible Solutions**<br>• There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3) | 261–266, Science and Engineering Practices Handbook (online) |
| • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) | 261–266, Science and Engineering Practices Handbook (online) |
| **ETS1.C: Optimizing the Design Solution**<br>• Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) | 261–266, Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 174–175, 185, 200–201, 220–221, 236–237, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | 214, 230, 258, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 260–267, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *208–209*, *225–226*, *240–241*, *243–245,* Math Skill Handbook (online) |
| Math 7.EE.B.3 | 261–266, PhET Ohm's Law (online), Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | 261–266 |

*Labs and investigations are in italics.*

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| SEP Science and Engineering Practices | |
|---|---|
| **Developing and Using Models***<br>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.<br>• Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 261–266 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.B: Developing Possible Solutions**<br>• A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | 261–266, Science and Engineering Practices Handbook (online) |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | Science and Engineering Practices Handbook (online) |
| **ETS1.C: Optimizing the Design Solution**<br>• The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | 261–266, Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 213, 229, 257, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *208–209*, *225–226*, *240–241*, *243–245,* Math Skill Handbook (online) |
| Math 7.SP.C.7 | Math Skill Handbook (online) |

| ALSO INTEGRATES: | |
|---|---|
| SEP Asking Questions and Defining Problems | 267 |
| SEP Developing and Using Models | 195, *205–207*, 214, *222–223*, 231, *238–239*, *240–241*, 261–266 |
| SEP Planning and Carrying Out Investigations | *176–177*, *178–179*, *180–181*, *182–183*, *187–188*, *190–191*, *225–226*, *238–239*, *243–245*, *250–251*, *254–255*, 267, Lab *Experiment with Magnets* (online), Lab *Guilty as Charged* (online), Lab *One by One* (online) |

*Labs and investigations are in italics.*

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| | |
|---|---|
| SEP Analyzing and Interpreting Data | 177, *243–245*, 259, 261–266 |
| SEP Using Mathematics and Computational Thinking | *208–209*, *225–226*, *243–245*, 259, PhET *Ohm's Law* (online) |
| SEP Constructing Explanations and Designing Solutions | 174–175, 186, 189, *190–191*, 192, 196, *205–207*, *208–209*, 215–216, 230, 232, 236–237, *243–245*, 246, *247–248*, 252, 261–267 |
| SEP Engaging in Argument from Evidence | 204, 227, 260, 261–266 |
| SEP Obtaining, Evaluating, and Communicating Information | 185 |
| CCC Patterns | *222–223* |
| CCC Energy and Matter | *187–188*, 188–189 |
| CCC Structure and Function | *243–245*, 261–266 |
| CCSS ELA RST.6–8.10 | 185, 193, 213, 229, 257 |
| CCSS ELA WHST.6–8.1 | 260 |
| CCSS ELA WHST.6–8.4 | 193, 229 |
| CCSS ELA WHST.6–8.6 | 193, 213, 229, 257 |
| CCSS ELA WHST.6–8.10 | 193, 260 |
| CCSS ELA SL.8.1 | 185 |
| CCSS ELA SL.8.4 | 213, 257 |
| CCSS MATH MP.4 | *208–209*, PhET *Ohm's Law* (online) |
| CCSS MATH 6.EE.A.2 | PhET *Ohm's Law* (online) |
| CCSS MATH 6.NS.C.5 | *208–209*, 231, PhET *Ohm's Law* (online) |
| CCSS MATH 6.RP.A.1 | *243–245* |
| CCSS MATH 6.RP.A.3 | *243–245* |
| CCSS MATH 6.SP.B.5 | *208–209* |
| CCSS MATH 7.RP.A.2 | *208–209*, *225–226*, PhET *Ohm's Law* (online) |
| CCSS MATH 7.EE.B.4 | PhET *Ohm's Law* (online) |
| CCSS MATH 8.EE.A.2 | *208–209* |

*Labs and investigations are in italics.*

## Performance Expectations at a Glance

In this unit, students will discover and practice the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts needed to perform the following Performance Expectations.

| Performance Expectations | Module: **Introduction to Waves** | Module: **Light** | Module: **Information Technologies** |
|---|---|---|---|
| MS-PS4-1 | ● | | |
| MS-PS4-2 | ● | ● | |
| MS-PS4-3 | | | ● |
| MS-ETS1-2 | ● | | |
| MS-ETS1-4 | | ● | |

## Correlations by Module to the NGSS

MODULE: **Introduction to Waves**

| **MS-PS4** | **Waves and Their Applications in Technologies for Information Transfer** | |
|---|---|---|
| **MS-PS4-1.** | **Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [*Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.*] | 20, 55–60 |
| **SEP Science and Engineering Practices** | | |
| **Using Mathematics 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. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 20, *24–26,* 26–28, *28–29,* 30, *32–34* |
| ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidenc** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1) | | *3, 7, 10–12, 17–18, 22–23, 24–26, 28–29,* 34, 55–60 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| DCI Disciplinary Core Ideas | |
|---|---|
| **PS4.A: Wave Properties**<br>• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) | *10–12,* 13, *17–18,* 18–20, *24–26,* 26–27, 30, 32–34, 61, PhET Interactive Simulation *Wave Interference* (online) |
| **CCC Crosscutting Concepts** | |
| **Patterns***<br>• Graphs and charts can be used to identify patterns in data. (MS-PS4-1)<br>* Other aspects of this CCC are integrated throughout this module and are listed in the *Also Integrates* section. | 10, 13, 19–20, 23, *24–26, 28–29,* 30, 32–33, PhET Interactive Simulation *Wave Interference* (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 31, 51, 55–60, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *22–23, 24–26,* 27–28, *28–29, 40–42,* 50, Math Skill Handbook (online) |
| Math MP.4 | 20, 34, Math Skill Handbook (online) |
| Math 6.RP.A.1 | 27, Math Skill Handbook (online) |
| Math 6.RP.A.3 | 27, Math Skill Handbook (online) |
| Math 7.RP.A.2 | 18–20, *24–26,* 26–27, 28, *28–29,* Math Skill Handbook (online) |
| Math 8.F.A.3 | 20, Math Skill Handbook (online) |

| MS-PS4 | Waves and Their Applications in Technologies for Information Transfer | |
|---|---|---|
| **MS-PS4-2.** | **Develop and use a model to describe that waves are reflected absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [*Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.*] | *40–42, 46–47,* 55–60 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models***<br>Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.<br>• Develop and use a model to describe phenomena. (MS-PS4-2)<br>* = Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 7, 20, 30, 37, *40–42,* 44, *48–50,* 52, 55–60 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| DCI Disciplinary Core Ideas | |
|---|---|
| **PS4.A: Wave Properties**<br>• A sound wave needs a medium through which it is transmitted. (MS-PS4-2) | 14, 31, 33–34, 43, *43–44,* 44, *46–47,* 47, 52–54 |
| **CCC Crosscutting Concepts** | |
| **Structure and Function**<br>• 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-PS4-2) | 31, *40–42, 43–44,* 44, *46–47, 48–50,* 50, 51, 53–54, 55–60 |
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 31, 51, 55–60, Literacy Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | 55–60 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence**<br>Engaging in argument from evidence in 6–8 builds on 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.<br>• Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) | | 55–60 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions**<br>• There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | | 55–60 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 8–9, 21, 31, 38–39, 51, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | | 31, 43, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | | 31, 51, 55–60, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | | 16, 21, 31, 51, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

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| | |
|---|---|
| CCSS ELA WHST.6–8.1 | 132 |
| CCSS ELA WHST.6–8.10 | 140, 149 |
| CCSS ELA SL.8.1 | 63, 67, 70, 73, 81, 131 |
| CCSS ELA SL.8.4 | 101, 119, 139, 143–148 |

## MODULE: Information Technologies

| MS-PS4 | Waves and Their Applications in Technologies for Information Transfer | |
|---|---|---|
| MS-PS4-3. | **Integrate qualitative scientific and technical information t support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [*Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.*] | 195–198 |
| **SEP Science and Engineering Practices** | | |
| **Obtaining, Evaluating, and Communicating Information*** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. • Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 165, 181, 195–198, 199, Animation *Cell Phones* (online), Video *GPS Satellites* (online) |
| **DCI Disciplinary Core Ideas** | | |
| **PS4.C: Information Technologies and Instrumentation** • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3) | | 162–163, *174–175,* 176, *177,* 178, *179–180,* 181, *182–185,* 186, *187,* 188–190, 192–194, 195–198, 199 |
| **CCC Crosscutting Concepts** | | |
| **Structure and Function** • Structures can be designed to serve particular functions. (MS-PS4-3) | | *162,* 162–163, 165, 176, 186, 188–189, 194 |
| ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Scienc , Engineering, and Technology on Society and the Natural World** • Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) | | 186, 189–191 |

*Labs and investigations are in italics.*

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| **CCSS Math Connections** | |
|---|---|
| MP.2 | *22–23, 24–26,* 27–28, *28–29, 40–42,* 50, Math Skill Handbook (online) |
| 7.EE.3 | *46–47,* Math Skill Handbook (online ) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 7, 51, 61 |
| SEP Planning and Carrying Out Investigations | 55–61 |
| SEP Analyzing and Interpreting Data | *22–23*, 33 |
| SEP Using Mathematics and Computational Thinking | *46–47,* 53 |
| SEP Constructing Explanations and Designing Solutions | 8–9, *10–12,* 16, *17–18, 22–23, 24–26,* 38–39, *40–42, 43–44,* 44, *46–47,* 53–54, 55–60, 61 |
| SEP Engaging in Argument from Evidence | 50 |
| SEP Obtaining, Evaluating, and Communicating Information | 16, 21, 31, 51, 55–60 |
| DCI LS1.D: Information Processing | 45 |
| DCI PS3.C: Relationship Between Energy and Forces | *17–18, 28–29,* 30 |
| DCI ETS1.A: Defining and Delimiting Engineering Problems | 55–60 |
| CCC Patterns | *10–12,* 12, 16, 20, 30, *40–42, 48–50* |
| CCC Cause and Effect | 16, 28 |
| CCC Scale Proportion, and Quantity | 16, 33 |
| CCC Systems and System Models | 32, 34 |
| CCC Energy and Matter | *10–12,* 16, *17–18,* 20, *22–23, 24–26,* 28, *28–29,* 33–34, 44, 52, 55–60, 61 |
| CCC Stability and Change | 16 |
| CCSS ELA RST.6–8.2 | 21 |
| CCSS ELA RST.6–8.3 | *10–12, 17–18, 22–23, 24–26, 28–29, 40–42, 46–47, 48–50* |
| CCSS ELA RST.6–8.10 | 16, 21, 31 |
| CCSS ELA WHST.6–8.2 | 16, 31, 51 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| CCSS ELA WHST.6–8.4 | 16, 31, 51 |
| CCSS ELA WHST.6–8.8 | 55–60 |
| CCSS ELA SL.8.4 | 55–60 |

## MODULE: Light

| MS-PS4 | Waves and Their Applications in Technologies for Information Transfer | |
|---|---|---|
| MS-PS4-2 | **Develop and use a model to describe that waves are reflected absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [*Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves*.] | *98–99*, *110–111*, 137, 143–148 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-PS4-2) *Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *75–76*, 80, 82, 84, 97, *98–99*, *110–111*, 118, 120, 137, 142, 143–148 |
| **DCI Disciplinary Core Ideas** | | |
| **PS4.A: Wave Properties** • A sound wave needs a medium through which it is transmitted. (MS-PS4-2) | | 73–74 |
| **PS4.B: Electromagnetic Radiation** • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) | | *77–79*, 79–80, 84, *90–91*, 92–93, *94–95*, 96–97, *98–99*, 100–104, *110–111*, 112, *134–135,* 136–137, 140–142, 143–148, 149 |
| • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air, and glass) where the light path bends. (MS-PS4-2) | | *75–76*, 76, 84, *90–91*, 92–93, 96–97, 100–103, *110–111*, 112–113, *114–115*, 116, 118–119, 120, *130*, 131–132, 149 |
| • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) | | 72, 81, 113, *128–129*, 129, *130*, 131–132, *134–135,* 136–137, 140–142, 149 |
| • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) | | 73–74, 96, 101, 113, 143–148, 149 |

*Labs and investigations are in italics.*

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| CCC Crosscutting Concepts | |
|---|---|
| **Structure and Function**<br>• 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-PS4-2) | 79–81, 84, 97, 117, 119, 121, 132–133, 139 |
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 139, 143–148, Literacy Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | 143–148 |
| SEP Science and Engineering Practices | | |
| **Developing and Using Models*** <br>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.<br>• Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 143–148 |
| DCI Disciplinary Core Ideas | | |
| **ETS1.B: Developing Possible Solutions**<br>• A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | | 143–148 |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | | |
| **ETS1.C: Optimizing the Design Solution**<br>The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | | 143–148 |
| **CCSS ELA/Literacy Connections** | | |
| ELA SL.8.5 | | 139, 143–148, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

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| **CCSS Math Connections** | |
|---|---|
| MP.2 | *90–91,* Math Skill Handbook (online) |
| 7.SP | Math Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 63, 149 |
| SEP Developing and Using Models | 103–104, 121, *130*, 143–148 |
| SEP Planning and Carrying Out Investigations | *75–76, 77–79, 128–129, 134–135*, 143–148 |
| SEP Analyzing and Interpreting Data | *77–79, 90–91* |
| SEP Constructing Explanations and Designing Solutions | 68–69, 76, 88–89, 104, 108–109, 122, 126–127, *128–129*, *134–135*, 137, 140, 149, Lab *Back to Back* (online) |
| SEP Engaging in Argument from Evidence | 83, 113, 132, 143–148 |
| SEP Obtaining, Evaluating, and Communicating Information | 73, 83, 143–148 |
| Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena | 92 |
| DCI LS1.D: Information Processing | 117, 133 |
| CCC Patterns | 74, 83, *90–91* |
| CCC Cause and Effect | 121 |
| CCC Systems and System Models | 120 |
| Connections to Nature of Science Science is a Way of Knowing | 131 |
| Connections to Nature of Science Science is a Human Endeavor | 119, 139 |
| Connections to Science, Technology, Society, and the Environment Influence of Engineering, Technology, and Science on Society and the Natural World | 81 |
| CCSS ELA RST.6–8.1 | 68–69, 73, 88–89, 108–109, 126–127, 131 |
| CCSS ELA RST.6–8.3 | *75–76, 77–79, 90–91, 94–95, 98–99, 110–111, 114–115, 128–129* |
| CCSS ELA RST.6–8.6 | 131 |
| CCSS ELA RST.6–8.7 | 93, 97, 102, 120 |
| CCSS ELA RST.6-8.10 | 73, 81 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| ***Connections to Nature of Science***<br>**Science is a Human Endeavor***<br>• Advances in technology influence the progress of science and science has influenced advances in technology. (MS2-PS4-3)<br>* Other aspects of this Connections to Nature of Science are integrated throughout this module and are listed in the *Also Integrates* section. | 189–190, 195–198, 199 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 156–157, 172–173, 195–198, Literacy Skill Handbook (online) |
| ELA RST.6–8.2 | 189, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 192, 195–198, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | 189, 195–198, Literacy Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 199 |
| SEP Developing and Using Models | *158–159, 160–161,* 167, 181, *182–185,* 193 |
| SEP Planning and Carrying Out Investigations | *160–161,* 199 |
| SEP Analyzing and Interpreting Data | 167, *174–175, 179–180* |
| SEP Using Mathematics and Computational Thinking | *174–175,* 176, 178, *179–180,* 181, 188 |
| SEP Constructing Explanations and Designing Solutions | 156–157, *164,* 168, 172–173, 176, 190, 194, 195–198, 199 |
| SEP Engaging in Argument from Evidence | 163 |
| SEP Obtaining, Evaluating, and Communicating Information | 163 |
| Connections to Nature of Science Scientific Investigations Use a Variety of Methods | 189 |
| CCC Cause and Effect | 178 |
| CCC Systems and System Models | *182–185,* 193 |
| Connections to Nature of Science Science is a Human Endeavor | 189–191 |
| Connections to Science, Technology, Society, and the Environment Interdependence of Science, Engineering, and Technology | 189–191 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| CCSS ELA RST.6–8.3 | *174–175, 179–180* |
| CCSS ELA RST.6–8.7 | 166, 192 |
| CCSS ELA RST.6–8.10 | 165, 189, 191 |
| CCSS ELA WHST.6–8.7 | 191 |
| CCSS ELA WHST.6–8.8 | 165, 195–198 |
| CCSS Math MP.2 | *174–175,* 176, 178, *179–180,* 181, 188, 193 |
| CCSS Math 6.SP.B.4 | *174–175, 179–180* |
| CCSS Math 6.SP.B.5 | *174–175 , 179–180* |
| CCSS Math 8.EE.A.3 | 186 |

*Labs and investigations are in italics.*

## Performance Expectations at a Glance

In this unit, students will discover and practice the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts needed to perform the following Performance Expectations.

| Performance Expectations | Module: **Energy and Matter** | Module: **Classification and tates of Matter** |
|---|---|---|
| MS-PS1-1 | | ● |
| MS-PS1-4 | | ● |
| MS-PS3-3 | ● | |
| MS-PS3-4 | ● | |
| MS-PS3-5 | ● | |
| MS-ETS1-1 | ● | |
| MS-ETS1-2 | ● | |
| MS-ETS1-3 | ● | |
| MS-ETS1-4 | ● | |

## Correlations by Module to the NGSS

MODULE: **Energy and Matter**

| MS-PS3 | Energy | |
|---|---|---|
| **MS-PS3-3.** | **Apply scientific principles to design, construct, and test a devic that either minimizes or maximizes thermal energy transfer.** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [*Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.*] | 91–98 |
| **SEP Science and Engineering Practices** | | |
| **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 ideas, principles, and theories. • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *84–85,* 91–98, Lab *Build Your Own Thermometer* (online) |

*Labs and investigations are in italics.*

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| DCI Disciplinary Core Ideas | |
|---|---|
| **PS3.A: Definitions of Energ**<br>• Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3), (MS-PS3-4) | 17–18, *21–24,* 24, 26–28, *37–39,* 42, *45–*46, 46, *47–*48, 48 |
| **PS3.B: Conservation of Energy and Energy Transfer**<br>• Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) | *58–59,* 60–61, 70 |
| **ETS1.A: Defining and Delimiting an Engineering Proble**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3) | 91–98 |
| **ETS1.B: Developing Possible Solutions**<br>• A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3) | 91–98 |
| **CCC Crosscutting Concepts** | |
| **Energy and Matter***<br>• The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 59–61, *62–63,* 68, 70 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.3 | *10–11, 21–24*, *34–36, 58–59, 62–63, 64, 76–78, 79–80,* 91–98, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 25, 49, 87, Literacy Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS3 | Energy | |
|---|---|---|
| **MS-PS3-4.** | **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [*Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.*] | *76–78, 79–80, 84–85,* 91–98 |
| **SEP Science and Engineering Practices** | | |
| **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. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 69, *84–85,* 91–98 |
| ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidenc** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-4) | | *10–11*, *21–24,* 27, 37–*39, 84–85* |
| **DCI Disciplinary Core Ideas** | | |
| **PS3.A: Definitions of Energ** • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-4) | | 17–18, *21–24,* 24, 27–28, *37–39,* 42, *45,* 46, *47,* 48, Lab *Build Your Own Thermometer* (online) |
| **PS3.B: Conservation of Energy and Energy Transfer** • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) | | 59, *76–78,* 78, *79–80, 81,* 82–83, 86, 88, 91–98 |

*Labs and investigations are in italics.*

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| SEP Science and Engineering Practices | |
|---|---|
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.<br>• Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | *62–63*, 91–98 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.B: Developing Possible Solutions**<br>• There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3) | 91–98 |
| • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) | Science and Engineering Practices Handbook (online) |
| **ETS1.C: Optimizing the Design Solution**<br>• Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) | 91–98 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 15, 32–32, 56–57, 74–75, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | *47*–48, 50, 88, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 48, 91–98, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 34–36, 47–48, 76–78,* Math Skill Handbook (online) |
| Math 7.EE.B.3 | *91–98,* Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | 91–98 |

*Labs and investigations are in italics.*

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| CCC Crosscutting Concepts | |
|---|---|
| **Scale, Proportion, and Quantity*** <br>• 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-PS3-4) <br>* Other aspects of this CCC are integrated throughout this module and are listed in the *Also Integrates* section. | 17–18, 26–28, *76–78*, 78, *81* |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.3 | *10–11, 21–24*, *34–36, 58–59, 62–63, 64, 76–78, 79–80,* 91–98, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 25, 49, 87, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 34–36, 47–48, 76–78,* Math Skill Handbook (online) |
| Math 6.SP.B.5 | *36–38,* Math Skill Handbook (online) |

| MS-PS3 | Energy | |
|---|---|---|
| **MS-PS3-5.** | **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [*Assessment Boundary: Assessment does not include calculations of energy.*] | 91–98 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence*** <br>Engaging in argument from evidence in 6–8 builds on 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 worlds. <br>• Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) <br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 24, 28, 44, 88–90, 91–98, Feature *Insulating the Home* (online) |

*Labs and investigations are in italics.*

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| | |
|---|---|
| ***Connections to Nature of Science***<br>**Scientific Knowledge is Based on Empirical Evidenc**<br>• Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-5) | *10–11*, *21–24,* 27, 37–*39, 84–85* |
| **DCI Disciplinary Core Ideas** | |
| **PS3.B: Conservation of Energy and Energy Transfer**<br>• When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) | *13*, 14, *16*, 17, *19*, *20*, 21, 26–27, 61, 91–98 |
| **CCC Crosscutting Concepts** | |
| **Energy and Matter***<br>• Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). (MS-PS3-5)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 14, 24, 28, 42–43, *47*, 48 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 15, 32–32, 56–57, 74–75, Literacy Skill Handbook (online) |
| ELA WHST.6–8.1 | 24, 28, 44, 90, 91–98, Feature *Insulating the Home* (online), Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 34–36, 47–48, 76–78,* Math Skill Handbook (online) |
| Math 6.RP.A.1 | *81,* Math Skill Handbook (online) |
| Math 7.RP.A.2 | *37–39, 76–78, 78,* Math Skill Handbook (online) |
| Math 8.F.A.3 | *37–39, 76–78, 78,* Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-1.** | **Define the criteria and constraints of a design problem wit sufficient precision to ensure a successful solution, taking in account relevant scientific principles and potential impacts o people and the natural environment that may limit possible solutions.** | 91–98 |

*Labs and investigations are in italics.*

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| SEP Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarifying arguments and models.<br>• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 91–98 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.A: Defining and Delimiting Engineering Problem**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | 25, 91–98 |
| **CCC Crosscutting Concepts** | |
| ***Connections to Science, Technology, Society and the Environment***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) | 91–98 |
| • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1) | 25, 66, 91–98, Lab *Build Your Own Thermometer* (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 15, 32–32, 56–57, 74–75, Literacy Skill Handbook (online) |
| ELA WHST.6–8.8 | 66 , Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 34–36, 47–48, 76–78,* Math Skill Handbook (online) |
| Math 7.EE.B.3 | *91–98,* Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | 91–98 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| SEP Science and Engineering Practices | |
|---|---|
| **Engaging in Argument from Evidence*** Engaging in argument from evidence in 6–8 builds on 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. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 91–98 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | 91–98 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 15, 32–32, 56–57, 74–75, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | 48, 91–98, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | 25, 49, 87, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | 15, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 34–36, 47–48, 76–78,* Math Skill Handbook (online) |
| Math 7.EE.B.3 | *91–98,* Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-3.** | **Analyze data from tests to determine similarities and differences among several design solutions to identify the bes characteristics of each that can be combined into a new solution to better meet the criteria for success.** | 91–98 |

*Labs and investigations are in italics.*

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| SEP Science and Engineering Practices | |
|---|---|
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 91–98 |
| **DCI Disciplinary Core Ideas** | |
| **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | Science and Engineering Practices Handbook (online) |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | 91–98 |
| **ETS1.C: Optimizing the Design Solution** •The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | |
| ELA SL.8.5 | 91–98, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | *19, 20, 36–38, 47, 78,* Math Skill Handbook (online) |
| Math 7.SP.C.7 | Math Skill Handbook (online) |

| ALSO INTEGRATES: | |
|---|---|
| SEP Asking Questions and Defining Problems | 25, *84–85,* 87, 99 |
| SEP Developing and Using Models | *10–11*, 14, 17, 26–27, 43, 48, 55, 60–61, *62–63,* 68, 70, 78, 91–98, PhET Interactive Simulation *Energy Forms and Change* (online) |
| SEP Planning and Carrying Out Investigations | *58–59, 62–63, 64,* 69, *76–78, 79–80, 84–85,* 91–98 |
| SEP Analyzing and Interpreting Data | *34–36, 37–39, 45–46,* 51, *58–59, 64, 76–78, 79–80,* 89, 91–98 |
| SEP Using Mathematics and Computational Thinking | *34–36, 76–78, 81* |

*Labs and investigations are in italics.*

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| | |
|---|---|
| SEP Constructing Explanations and Designing Solutions | 8–9, 18, 27–28, 32–33, 41, 52, 56–57, 65, 74–75, *84–85,* 86, 91–98, 99 |
| SEP Engaging in Argument from Evidence | 24–25, 28, 44, 90, 91–98, Feature *Insulating the Home* (online) |
| SEP Obtaining, Evaluating, and Communicating Information | 15, 87, 91–98 |
| Connections to Nature of Science Scientific Investigations Use a Variety of Methods | 69, *84–85*, 91–98 |
| Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence | 15 |
| DCI ESS2.A: Earth's Materials and Systems | 65 |
| DCI ESS2.C: The Roles of Water in Earth's Surface Processes | 40, 67 |
| DCI ESS2.D: Weather and Climate | 82 |
| DCI PS1.A: Structure and Properties of Matter | *10–11,* 11, *13,*14–15, *16,* 17–18, *19,* 19, *20,* 20, 25–28, *34–36,* 37, *37–39,* 40–41, *41–42,* 42–44, *45–46,* 46, *47–48,* 49–52 |
| DCI PS2.A: Forces and Motion | 12, 14, 17–18 |
| CCC Patterns | *34–36, 37–39,* 41, *45–*46, *58–59, 67, 76–*78, *81,* 91–98 |
| CCC Cause and Effect | *10–11, 21–24* |
| CCC Scale Proportion, and Quantity | *10–11,* 14, 17, 26–28 |
| CCC Systems and System Models | 59, 60, 61, *62–63*, 91–98 |
| CCC Energy and Matter | 14, 17, 18, 65, *67*, 67, 83, 86, 89 |
| CCC Structure and Function | 49, 87, 91–98 |
| CCC Stability and Change | *10–11* |
| Connections to Science, Technology, Society, and the Environment Interdependence of Science, Engineering, and Technology | 25, 87 |
| CCSS ELA RST.6–8.2 | 15 |
| CCSS ELA RST.6–8.6 | 91–98 |
| CCSS ELA RST.6–8.10 | 15, 25, 49, 66, 87 |
| CCSS ELA WHST.6–8.3 | *84–85,* 91–98 |
| CCSS ELA WHST.6–8.5 | 91–98 |
| CCSS ELA WHST.6–8.6 | 66 |
| CCSS ELA WHST.6–8.8 | 66 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| CCSS ELA WHST.6–8.10 | 91–98 |
| CCSS ELA SL.6.4 | 25, 87, 91–98 |
| CCSS ELA SL.6.5 | 25, 66 |
| CCSS Math 6.NS.C.5 | 49 |

## MODULE: Classification and States of Matter

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-1.** | **MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [*Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.*] | 195–202 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to predict and/or describe phenomena. (MS–PS1–1) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *110–111, 120–121,* 124, 124, 135, 138, *139–140,* 141, *142–143,* 145, 147, 152, *165, 176–177, 182–183,* 190, 195–202, PhET Interactive Simulation *States of Matter: Basics* (online) |
| **DCI Disciplinary Core Ideas** | | |
| **PS1.A: Structure and Properties of Matter** • Substances are made from 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. (MS-PS1-1) | | 117–119, *120–121,* 121, 124–125, *176–177,* 177, 180–181, *182–183, 184–185,* 186, *186–187,* 187, *187–188,* 188, 190, 192, 195–202 |
| • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) | | 181, 183–184, 186, *186–187,* 189–190 |
| **CCC Crosscutting Concepts** | | |
| **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. (MS-PS1-1) | | *113,* 114–116, 135, 138, *142–143,* 145, 147, 152, *165, 176–177,* 180–181, *182–183,* 195–202, PhET Interactive Simulation *States of Matter: Basics* (online) |

*Labs and investigations are in italics.*

| CCSS ELA/Literacy Connections | |
|---|---|
| ELA RST.6–8.7 | 117, 123, 135, 141, 145, 150, Literacy Skill Hanbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 114–115, *120–121,* Math Skill Handbook (online) |
| Math MP.4 | *120–121, 158–159, 161–163,* Math Skill Handbook (online) |
| Math 6.RP.A.3 | *120–121,* Math Skill Handbook (online) |

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-4.** | **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.] | 195–202 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to predict and/or describe phenomena. (MS-PS1-4) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *110–111, 120–121,* 123, 124, 135, 138, *139–140,* 141, *142–143, 145, 147, 152,* 195–202, PhET Interactive Simulation *States of Matter: Basics* (online) |
| **DCI Disciplinary Core Ideas** | | |
| **PS1.A: Structure and Properties of Matter** • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) | | *108–109, 110–111,* 112, 117, 119, 122, 134, 140–141, 143–147, 178, 195–202 |
| • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) | | *108–109, 110–111,* 112, 124–125, 140–141, 143–147, 194–202 |
| • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) | | 144–147, 151, 195–202, PhET Interactive Simulation *States of Matter: Basics* (online), Video *Melting* (online) |

*Labs and investigations are in italics.*

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| | |
|---|---|
| **PS3.A: Definitions of Energ**<br>• The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4) | *113,* 116, 138 |
| • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4) | *113,* 114–116, 124, 126, 144–147, 195–202, PhET Interactive Simulation *States of Matter: Basics* (online), Video *Melting* (online) |
| **CCC Crosscutting Concepts** | |
| **Cause and Effec**<br>• Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) | 135, 143, 147, 164, 169–170, 195–202 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6-8.7 | 117, 123, 135, 141, 145, 150, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math 6.NS.C.5 | Math Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 105, 203 |
| SEP Developing and Using Models | *113,* 117, *119–120,* 125, 135, 141, 145, 193 |
| SEP Planning and Carrying Out Investigations | *108–109, 136–137,* 203 |
| SEP Analyzing and Interpreting Data | 124, *158–159, 161–163, 178–180, 184–185* |
| SEP Using Mathematics and Computational Thinking | *132–133,* 164, 170 |
| SEP Constructing Explanations and Designing Solutions | 106–107, *108–109,* 112, 126, 130–131, 135, 141, 147–148, 152, 156–157, 166, 169, 174–175, *178–180, 184–185,* 195–202 |
| SEP Engaging in Argument from Evidence | 152, 181, 190 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| SEP Obtaining, Evaluating, and Communicating Information | 123A–123B, 191 |
| Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena | 160 |
| DCI ESS2.C: The Role of Water on Earth's Surface Processes | 148 |
| DCI PS3.A: Definitions of Energy | *113,* 114, 116, 129, *132–133,* 134–135, 145–149, 195–202, 203 |
| CCC Patterns | *108–109,* 109, *110–111,* 112, *113,* 114–116, *122, 158–159, 161–163, 178–180, 184–185* |
| CCC Systems and System Models | *110–111, 113,* 138, 147, 151, 181, 190 |
| CCC Energy and Matter | *113,* 114–116, 126, 135, 138, 145, 147–148, 166, 195–202 |
| CCC Structure and Function | *110–111,* 112, *178–180, 184–185,* 189–191, 193 |
| CCSS ELA SL.7.4 | 191 |
| CCSS ELA SL.7.6 | 191 |
| CCSS ELA SL.8.5 | 149, 191, 195–202 |
| CCSS ELA RST.6–8.1 | 106–107, 130–131, 156–157, 174–175, 189 |
| CCSS ELA RST.6–8.3 | *108–109, 132–133, 136–137, 139–140, 142–143, 158–159, 161–163, 178–180, 184–185* |
| CCSS ELA RST.6–8.10 | 123A–123B, 149, 167, 189, 191 |
| CCSS ELA WHST.6–8.2 | 167 |
| CCSS ELA WHST.6–8.4 | 123A–123B, 167 |
| CCSS ELA WHST.6–8.6 | 118, 123A–123B, 149, 167 |
| CCSS ELA WHST.6–8.7 | 123A–123B, 149, 167 |
| CCSS ELA WHST.6–8.9 | 191 |
| CCSS Math 6.RP.A.1 | *120–121* |
| CCSS Math 6.RP.A.2 | *120–121* |
| CCSS Math 6.RP.A.3 | *120–121* |
| CCSS Math 7.RP.A.2 | *132–133,* 134, 141, *158–159, 161–163,* 163–164 |
| CCSS Math 8.EE.A.3 | 118 |

*Labs and investigations are in italics.*

## Performance Expectations at a Glance

In this unit, students will discover and practice the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts needed to perform the following Performance Expectations.

| Performance Expectations | Module: **Matter: Properties and Changes** | Module: **Materials Science** |
|---|---|---|
| MS-PS1-2, | ● | |
| MS-PS1-3, | | ● |
| MS-PS1-5, | ● | |
| MS-PS1-6, | ● | |
| MS-ETS1-1, | ● | ● |
| MS-ETS1-2, | ● | ● |
| MS-ETS1-3, | ● | |
| MS-ETS1-4 | ● | ● |

## Correlations by Module to the NGSS

### MODULE: Matter: Properties and Changes

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-2.** | **Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [*Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.*] | *38–39*, 73–78 |
| **SEP Science and Engineering Practices** | | |
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *10–11*, *15–17*, *22–23*, 31, *41–42*, *60–61*, *64–67*, 73–78 |

*Labs and investigations are in italics.*

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| | |
|---|---|
| ***Connections to Nature of Science***<br>**Scientific Knowledge is Based on Empirical Evidenc**<br>• Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) | 43, 67 |
| **DCI Disciplinary Core Ideas** | |
| **PS1.A: Structure and Properties of Matter**<br>• Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) | 10, *10–11*, 12–13, *15–17*, 18–19, *20*, 21, *22–23*, 24, *25–27*, 27–28, 30–32 |
| **PS1.B: Chemical Reactions**<br>• Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2) | *38–39*, 40, *43*, 44, *44–45*, 46, 50–52, 73–78 |
| **CCC Crosscutting Concepts** | |
| **Patterns**<br>• Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) | 12–14, 18–19, 40, *41–42*, *43*, 44, *44–45*, 46, 73–78 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 8–9, 36–37, 56–57, 63, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | 30, *47*, 50, 59, 70–72, 73–78, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |
| Math 6.RP.A.3 | *20* , Math Skill Handbook (online) |
| Math 6.SP.B.4 | Math Skill Handbook (online) |
| Math 6.SP.B.5 | *15–17,* Math Skill Handbook (online) |

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-5.** | **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [*Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.*] | *41–42, 47*, 73–78 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| | |
|---|---|
| **SEP Science and Engineering Practices** | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. (MS-PS1-5) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | 14, *41–42*, *47*, 59, 70, 72, 73–78 |
| ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5) | 43, 67 |
| **DCI Disciplinary Core Ideas** | |
| **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-5) | *38–39*, 40, *43*, 44, *44–45*, 46, 50–52, 73–78 |
| • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) | *41–42*, *43*, 43–44, *44–45*, 46, *47*, 49–52, 73–78 |
| **CCC Crosscutting Concepts** | |
| **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5) | *41–42*, *43*, 43–44, *44–45*, 46, 49–52, 73–78 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.7 | 30, *47*, 50, 59, 70–72, 73–78, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |
| Math MP.4 | *15–17*, 18–19, *47*, 48, 51, Math Skill Handbook (online) |
| Math 6.RP.A.3 | *20,* Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-6.** | **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [*Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device*.] | *64–67*, 73–78 |
| **SEP Science and Engineering Practices** | | |
| **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. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *64–67*, 73–78 |
| **DCI Disciplinary Core Ideas** | | |
| **PS1.B: Chemical Reactions** • Some chemical reactions release energy, others store energy. (MS-PS1-6) | | 40, *58*, 59, *60–61*, 62–63, *64–67*, 67–72 |
| **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) | | *64–67*, 73–78 |
| **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) | | *64–67*, 73–78 |
| • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS-PS1-6) | | *64–67*, 73–78 |
| **CCC Crosscutting Concepts** | | |
| **Energy and Matter** • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6) | | 59, 62–63, *64–67*, 67–68, 73–78 |

*Labs and investigations are in italics.*

*Continued from previous page.*

| CCSS ELA/Literacy Connections | |
|---|---|
| ELA RST.6–8.3 | *10–11*, *22–23*, *25–27*, *38–39*, *60–61*, Literacy Skill Handbook (online) |
| ELA WHST.6–7 | 49, 69, Literacy Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| MS-ETS1-1. | **Define the criteria and constraints of a design problem wit sufficient precision to ensure a successful solution, taking in account relevant scientific principles and potential impacts o people and the natural environment that may limit possible solutions.** | *64–67*, 73–78 |
| **SEP Science and Engineering Practices** | | |
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarifying arguments and models.<br>• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *64–67*, 73–78 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.A: Defining and Delimiting Engineering Problem**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | *64–67*, 73–78 |
| **CCC Crosscutting Concepts** | | |
| ***Connections to Science, Technology, Society and the Environment***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) | | 49A–49B |
| • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1) | | 49A–49B |

*Labs and investigations are in italics.*

## MODULE: Materials Science

| MS-PS1 | Matter and its Interactions | |
|---|---|---|
| **MS-PS1-3.** | **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [*Assessment Boundary: Assessment is limited to qualitative information.*] | *118*, 125–130 |
| **SEP Science and Engineering Practices** | | |
| **Obtaining, Evaluating, and Communicating Information*** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *91–92,* 97, *116, 117, 118, 121,* 125–130 |
| **DCI Disciplinary Core Ideas** | | |
| **PS1.A: Structure and Properties of Matter** • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) | | *88–90,* 90, *93–94,* 97, 131 |
| **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) | | *93–94, 95,* 95, 96, *113–114,* 115, 125–130 |
| **CCC Crosscutting Concepts** | | |
| **Structure and 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. (MS-PS1-3) | | 85, *88–90,* 90, *91–92,* 93, 96–97, 99–100, 119, 125–130, 131 |
| ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology*** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3) * Other aspects of this Connections to Engineering, Technology, and Applications of Science are integrated throughout this module and are listed in the *Also Integrates* section. | | *95*, 96–97, 119–120, 125–130 |

*Labs and investigations are in italics.*

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| **CCSS ELA/Literacy Connections** | |
|---|---|
| ELA RST.6–8.1 | 8–9, 36–37, 56–57, 63, Literacy Skill Handbook (online) |
| ELA WHST.6–8.8 | 29, 69, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | |
| Math MP.2 | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |

| **MS-ETS1** | **Engineering Design** | |
|---|---|---|
| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | *64–67*, 73–78 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence*** Engaging in argument from evidence in 6–8 builds on 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. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *64–67*, 73–78 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | | *64–67*, 73–78 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 8–9, 36–37, 56–57, 63, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | | 14, 18, *41–42*, *64–67*, 73–78, Literacy Skill Handbook (online) |
| ELA WHST.6–8.7 | | 49, 69, Literacy Skill Handbook (online) |
| ELA WHST.6–8.9 | | 63, 69, 73–78, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |
| Math 7.EE.B.3 | | 73–78, Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-ETS1 | Engineering Design | |
|---|---|---|
| MS-ETS1-3. | **Analyze data from tests to determine similarities and differences among several design solutions to identify th best characteristics of each that can be combined into a new solution to better meet the criteria for success.** | *64–67*, 73–78 |
| **SEP Science and Engineering Practices** | | |
| **Analyzing and Interpreting Data*** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *10–11*, *15–17*, *22–23*, 31, *41–42*, *60–61*, *64–67*, 73–78 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3) | | *64–67*, 73–78 |
| • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) | | *64–67*, 73–78 |
| **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) | | *64–67*, 73–78 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 8–9, 36–37, 56–57, 63, Literacy Skill Handbook (online) |
| ELA RST.6–8.7 | | 30, *47*, 50, 59, 70–72, 73–78, Literacy Skill Handbook (online) |
| ELA RST.6–8.9 | | 14, 18, *41–42*, *64–67*, 73–78, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |
| Math 7.EE.B.3 | | 73–78, Math Skill Handbook (online) |

*Labs and investigations are in italics.*

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | 73–78 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *41–42*, 73–78 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | | *64–67*, 73–78 |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | | *64–67*, 73–78 |
| **ETS1.C: Optimizing the Design Solution** • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | | *64–67*, 73–78 |
| **CCSS ELA/Literacy Connections** | | |
| ELA SL.8.5 | | 69, 73-78, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | 14, *15–17*, 18–19, *20*, 51, Math Skill Handbook (online) |
| Math 7.SP.C.7 | | Math Skill Handbook (online) |

| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 79 |
| SEP Developing and Using Models | 73–78 |
| SEP Planning and Carrying Out Investigations | *10–11*, *15–17*, *22–23*, *25–27*, 28, *41–42*, *64–67*, 73–78, 79 |

*Labs and investigations are in italics.*

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|---|---|
| SEP Analyzing and Interpreting Data | *15–17*, *20*, *64–67*, 73–78 |
| SEP Using Mathematics and Computational Thinking | *15–17*, *20*, 48, 51, Lab *Density Column* (online), Lab *Do heavy objects always sink and light objects always float?* (online) |
| SEP Constructing Explanations and Designing Solutions | 8–9, 19, 32, 36–37, *44–45*, 52, 56–57, 68, 72, 73–78 |
| SEP Engaging in Argument from Evidence | 62, *64–67*, 73–78 |
| SEP Obtaining, Evaluating, and Communicating Information | 63, 73–78 |
| DCI PS3.D: Energy in Chemical Processes and Everyday Life | 63, 68, 71 |
| DCI LS1.C: Organization for Matter and Energy Flow in Organisms | 63, 68, 71 |
| DCI LS2.B: Cycle of Matter and Energy Transfer in Ecosystems | 68 |
| DCI ESS2.A: Earth's Materials and Systems | 46 |
| CCC Cause and Effect | *38–39* |
| CCC Scale Proportion, and Quantity | *47*, 48, 51 |
| CCC Systems and System Models | *47*, 48, 51, *58*, 59, 73–78 |
| CCC Structure and Function | *47*, 73–78 |
| CCC Stability and Change | *38–39* |
| CCSS ELA RST.6–8.10 | 29, 49, 49A-49-B, 63, 69 |
| CCSS ELA WHST.6–8.1 | 14 |
| CCSS ELA WHST.6–8.2 | 49 |
| CCSS ELA WHST.6–8.4 | 49 |
| CCSS ELA WHST.6–8.6 | 29 |
| CCSS ELA WHST.6–8.10 | 14, 29 |
| CCSS ELA SL.7.4 | 69 |
| CCSS ELA SL.7.5 | 69, 73–78 |
| CCSS MATH 7.EE.B.4 | *20,* 31 |
| CCSS MATH 7.RP.A.2 | *15–17*, *20* |

*Labs and investigations are in italics.*

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|---|---|
| **Influence of Scienc , Engineering and Technology on Society and the Natural World**<br>• The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3) | *106–107*, 108–109, *109*, 110, *110–111,* 117A-117B, 120, 125–130 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 86–87, 104–105, 117, 119, *Literacy Skill Handbook* |
| ELA WHST.6–8.8 | *91–92*, 97, *116*, *118*, 124, *Literacy Skill Handbook* |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-1.** | **Define the criteria and constraints of a design problem wit sufficient precision to ensure a successful solution, taking in account relevant scientific principles and potential impacts o people and the natural environment that may limit possible solutions.** | 125–130 |
| **SEP Science and Engineering Practices** | | |
| **Asking Questions and Defining Problems**<br>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, clarifying arguments and models.<br>• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)<br>* Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | 125–130 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.A: Defining and Delimiting Engineering Problem**<br>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | 125–130 |
| **CCC Crosscutting Concepts** | | |
| ***Connections to Science, Technology, Society and the Environment***<br>**Influence of Scienc , Engineering, and Technology on Society and the Natural World**<br>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) | | 91, *91–92*, 103, 108, *109*, 110, *110–111*, 112, 115, 117A-117B, *118,* 122–124, 125–130, 131 |

*Labs and investigations are in italics.*

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|---|---|
| • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1) | *106–107*, 108–109, *109*, 110, *110–111,* 117A-117B, 120, 125–130 |
| **CCSS ELA/Literacy Connections** | |
| ELA RST.6–8.1 | 86–87, 104–105, 117, 119, *Literacy Skill Handbook* |
| ELA WHST.6–8.8 | *91–92* , 97, *116* , *118,* 121, *Literacy Skill Handbook* |
| **CCSS Math Connections** | |
| Math MP.2 | 99, Math Skill Handbook (online) |
| Math 7.EE.B.3 | Math Skill Handbook (online) |

| **MS-ETS1** | **Engineering Design** | |
|---|---|---|
| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | *106–107,* 125–130 |
| **SEP Science and Engineering Practices** | | |
| **Engaging in Argument from Evidence*** Engaging in argument from evidence in 6–8 builds on 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. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *106–107,* 125–130 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) possible solutions. (MS-ETS1-1) | | 125–130 |
| **CCSS ELA/Literacy Connections** | | |
| ELA RST.6–8.1 | | 96–97, 104–105, 117, 119, *Literacy Skill Handbook* |
| ELA RST.6–8.9 | | 108, *Literacy Skill Handbook* |
| ELA WHST.6–8.7 | | *91–92, Literacy Skill Handbook* |

*Labs and investigations are in italics.*

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|---|---|
| ELA WHST.6–8.9 | *91–92, 97, 116, 118, Literacy Skill Handbook* |
| **CCSS Math Connections** | |
| Math MP.2 | 99, Math Skill Handbook (online) |
| Math 7.EE.B.3 | Math Skill Handbook (online) |

| MS-ETS1 | Engineering Design | |
|---|---|---|
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that a optimal design can be achieved.** | *106–107,* 125–130 |
| **SEP Science and Engineering Practices** | | |
| **Developing and Using Models*** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) * Other aspects of this SEP are integrated throughout this module and are listed in the *Also Integrates* section. | | *106–107,* 125–130 |
| **DCI Disciplinary Core Ideas** | | |
| **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | | Science and Engineering Practices Handbook (online) |
| • Models of all kinds are important for testing solutions. (MS-ETS1-4) | | *106–107,* 125–130 |
| **ETS1.C: Optimizing the Design Solution** The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) | | Science and Engineering Practices Handbook (online) |
| **CCSS ELA/Literacy Connections** | | |
| ELA SL.8.5 | | 125–130, Literacy Skill Handbook (online) |
| **CCSS Math Connections** | | |
| Math MP.2 | | 99, Math Skill Handbook (online) |
| Math 7.SP.C.7 | | Math Skill Handbook (online) |

*Labs and investigations are in italics.*

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| **ALSO INTEGRATES:** | |
|---|---|
| SEP Asking Questions and Defining Problems | 131 |
| SEP Developing and Using Models | 96, 115 |
| SEP Planning and Carrying Out Investigations | *88–90, 93–94, 106–107, 113–114,* 131 |
| SEP Analyzing and Interpreting Data | *88–90,* 99, *106–107* |
| SEP Constructing Explanations and Designing Solutions | 86–*87*, 100, 104–105, 108, *113–114,* 115, 124, 125–130, 131 |
| SEP Engaging in Argument from Evidence | 112 |
| SEP Obtaining, Evaluating, and Communicating Information | 123, 125–130 |
| DCI ESS3.A: Natural Resources | 108, 110 |
| DCI ESS3.C: Human Impacts on Earth Systems | 112 |
| DCI LS2.A: Interdependent Relationships in Ecosystems | 112 |
| DCI LS4.D: Interdependent Relationships in Ecosystems | 112 |
| CCC Patterns | *88–90* |
| CCC Systems and System Models | 115 |
| CCC Energy and Matter | 96 |
| CCC Stability and Change | 112 |
| Connections to Nature of Science Science is a Human Endeavor | 97 |
| Connections to Nature of Science Science Addresses Questions About the Natural and Material World | 120 |
| Connections to Science, Technology, Society, and the Environment Interdependence of Science, Engineering, and Technology | 120 |
| CCSS ELA RST.6–8.3 | *88–90, 93–94, 113–114* |
| CCSS ELA RST.6–8.6 | 117, 119 |
| CCSS ELA RST.6–8.7 | *91–92,* 97–98, 122 |
| CCSS ELA RST.6–8.8 | 117 |
| CCSS ELA RST.6–8.10 | 97, 117, 117A–117B, 119, 121 |
| CCSS ELA WHST.6–8.1 | 112 |
| CCSS ELA WHST.6–8.2 | *118* |
| CCSS ELA WHST.6–8.5 | *118* |

*Labs and investigations are in italics.*

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|---|---|
| CCSS ELA WHST.6–8.6 | *116, 118* |
| CCSS ELA SL.7.1 | 117, 119 |
| CCSS ELA SL.7.4 | 125–130 |
| CCSS ELA SL.7.5 | 125–130 |

*Labs and investigations are in italics.*