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.

Continued from previous page.

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 an object, tool, process or system. (MS-PS2-1) * 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 • 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* • 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) * 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 **Influence of Science, Engineering, and Technology on Society and the Natural World** • 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 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-PS2-2)		*15–17,* 40, *41–42,* 95–102, 103
Connections to Nature of Science **Scientific Knowledge is Based on Empirical Evidence** • 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 • 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.

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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)	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 an optimal design can be achieved.**	95–102
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.		95–102
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)		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 • 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.** [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 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. • 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 **Scientific Knowledge is Based on Empirical Evidence** • 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 • 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* • 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) * 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 with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**	95–102
SEP Science and Engineering Practices		
Asking Questions and Defining Problems* 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. • 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) * 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 Problems • 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 **Influence of Science, Engineering, and Technology on Society and the Natural World** • 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 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)		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-ETS1-2) 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	
PERFORMANCE EXPECTATION **MS-ETS1-3.**	**Analyze data from tests to determine similarities and differences among several design solutions to identify the best 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 • 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.

Continued from previous page.

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.

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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. • Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) * 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 Energy • 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 • 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 of 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 Energy • 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 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. • 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 **Scientific Knowledge is Based on Empirical Evidence** • 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 • 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* • Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). (MS-PS3-5) * 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 with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**	261–266
SEP Science and Engineering Practices		
Asking Questions and Defining Problems* 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. • 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) * 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 Problems • 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 **Influence of Science, Engineering, and Technology on Society and the Natural World** • 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.

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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 the 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* 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. • 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) * 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 • 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 Effect • 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 exerting 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 Effect • 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 of 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 Energy • 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 best 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. • 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.	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-ETS1-3)	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 • 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 an optimal design can be achieved.**	261–266

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 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.	261–266
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)	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 • 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.

Continued from previous page.

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.