Publisher: Amplify Education

Program Title: Amplify Science

Standards Map for Kindergarten Through Grade Eight
Grade 8 Discipline Specific –Next Generation Science Standards

MS-PS1 Matter and its Interactions

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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)	***Phase Change*** unit*:* ● Lesson 1.3 ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 10–13) and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”) ○ **Activity 5,** Student View ○ **Lesson Brief**, Digital Resources, “Modeling Molecules and Phases copymaster” ***Force and Motion*** unit*:* ● Lesson 1.2 ○ **Activity 5,** Student View, and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”) ● Lesson 3.2 ○ **Activity 1,** Student View, and Teacher Support tab (“Instructional Suggestion Pedagogical Goals: Discussing Prior	**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	[DCI, SEP, CCC] ***Chemical Reactions*** unit*:* ● Lesson 1.6, **Activity 3**, screen 2 of 3, Instructional Guide (step 8) and On-the-Fly Assessment (hummingbird icon) [DCI] ***Chemical Reactions*** unit*:* ● Lesson 4.4, **Activity 1**, screens 1–12 of 12, Student View [CCC] ***Phase Change*** unit*:* ● Lesson 1.5, **Activity 3**, Instructional Guide (steps 1–10), Student View, and On-the-Fly Assessment (hummingbird icon) [SEP] ***Phase Change*** unit*:* ● Lesson 1.6, **Activity 4**, Instructional Guide (steps 1–9), Student View, Possible Responses tab, Modeling Tool activity: Methane Lake Freezing, Modeling Tool activity: Methane Lake

		Knowledge About Collision Forces") ○ **Activity 5**, Student View ***Harnessing Human Energy*** unit*:* ● Lesson 3.2, **Activity 2,** Instructional Guide and Student View ***Chemical Reactions*** unit*:* ● Lesson 2.3 ○ **Lesson Brief**, Digital Resources, "Modeling Tool: How the Rust Formed copymaster" ○ **Activity 3**, Instructional Guide (steps 1–7), Student View, and Possible Responses tab ● Lesson 3.4 ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Products of the Reaction copymaster" ○ **Activity 3**, Instructional Guide (steps 1–5), Student View, and Possible Responses tab	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.]	Evaporating, and On-the-Fly Assessment (hummingbird icon)
DCI	**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)	***Chemical Reactions*** unit*:* ● Lesson 1.5 ○ **Activity 2,** screen 3 of 3, Student View and simulation ○ **Activity 3,** screen 2 of 2, Instructional Guide (steps 9–10), Student View, and "Atomic Zoom-In: Comparing Substances at a Very Small Scale" article		

	■ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)		[*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.*]	
CCC	**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)	***Chemical Reactions*** unit*:* ● Lesson 1.5, **Activity 2,** screens 1–2 of 3, Instructional Guide (steps 3–5) and Teacher Support tab ("Background, Crosscutting Concept: Scale, Proportion, and Quantity") ***Light Waves*** unit*:* ● Lesson 2.3, **Activity 4,** Instructional Guide (step 8) and simulation ***Phase Change*** unit*:* ● Lesson 1.3 ○ **Activity 2,** screens 1–2 of 2, Instructional Guide (steps 3–4, 9–13) ○ **Activity 3,** Instructional Guide (step 1) ● Lesson 2.2, **Activity 3,** Instructional Guide and Student View		

Science and Engineering Practices **Disciplinary Core Ideas** **Crosscutting Concepts**	**Publisher Citations**	**Performance Expectation**	**Publisher Citations**

SEP	**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)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 6 ○ **Activity: Testing Final Designs**, Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 5, **Activity: Analyzing Results**, Instructional Guide (steps 1–4) and Engineering Tip: Analyzing Data video ***Magnetic Fields*** unit*:* ● Lesson 3.3 ○ **Activity 2,** screen 1 of 2, Instructional Guide (steps 1–7) and Student View ○ **Lesson Brief**, Digital Resources, "USA Evidence Cards copymaster" ***Light Waves*** unit*:* ● Lesson 2.5, **Activity 3,** screens 1–3 of 3, Instructional Guide and Student View ***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 3,** Instructional Guide (steps 6–11) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 6 ○ **Activity: Testing Final Designs**, Instructional Guide (steps 1–5)	**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*	[SEP, CCC] ***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 4,** Instructional Guide (steps 1–7), Student View, Possible Responses tab, Sorting Tool: Evaluating Evidence, and On-the-Fly Assessment (hummingbird icon) [DCI] ***Chemical Reactions*** unit*:* ● Lesson 2.1, **Activity 4,** Instructional Guide (step 2) and On-the-Fly Assessment (hummingbird icon) ● Lesson 2.2, **Activity 3,** Instructional Guide (step 6) and On-the-Fly Assessment (hummingbird icon) ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Arguments" [SEP] ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" [CCC] ***Chemical Reactions*** unit*:* ● Lesson 1.5, **Activity 3,** Instructional Guide (steps 6–7) and "Atomic Zoom-In: Comparing Substances at a Very Small Scale" article

		○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster”	*point, solubility, flammability, and odor.*]	
SEP	***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-PS1-2)	***Phase Change*** unit*:* ● Lesson 2.3, **Activity 3,** Instructional Guide (step 1) and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (step 2) and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”)		
DCI	**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-PS1-2)	***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 3,** screen 2 of 2, Instructional Guide and Student View ● Lesson 1.5, **Activity 2,** screen 3 of 3, Instructional Guide, Student View, and simulation (Chemical Stockroom mode) ● Lesson 1.4, **Activity 3**, screen 2 of 3, Instructional Guide (steps 9–11) and Teacher Support tab (“Background Science Note: About (Pure) Substances”		
DCI	**PS1.B: Chemical Reactions** ■ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are	***Chemical Reactions*** unit*:* ● Lesson 2.1 ○ **Activity 2,** screens 3 of 3, Instructional Guide and Student View ○ **Activity 3,** screen 2 of 2, Instructional Guide, Student View, and simulation (Laboratory A mode)		

	regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2)	• Lesson 2.2, **Activity 3,** Instructional Guide (steps 1–9) • Lesson 3.4, **Activity 4,** Instructional Guide (steps 1–4), Student View, and Possible Responses tab		
CCC	**Patterns** ■ Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)	***Chemical Reactions*** unit*:* • Lesson 1.5, **Activity 3,** Instructional Guide (steps 6–7) and "Atomic Zoom-In: Comparing Substances at a Very Small Scale" article		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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	***Harnessing Human Energy*** unit*:* • Lesson 3.3 ○ **Activity: Introducing Quality of Evidence**, Instructional Guide (steps 1–8) ○ **Activity 2,** Instructional Guide (steps 1–13) and Student View • **Printable Resources, "**Print Materials (8.5" x 11"), Ed-You-Swivel Evidence Cards, pages 24–28 ***Magnetic Fields*** unit*:* • Lesson 4.1 ○ **Activity 4,** Instructional Guide (steps 1–12) and Student View	**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	[DCI] ***Chemical Reactions*** unit*:* • Lesson 2.1, **Activity 4,** Instructional Guide (step 2) and On-the-Fly Assessment (hummingbird icon) [PE] ***Chemical Reactions*** unit*:* • Lesson 2.1, **Activity 5,** Student View, Teacher Support tab ("Rationale, Pedagogical Goals: Reading about Synthetic Materials," "Assessment: Assessment Opportunity: Student Understanding of Synthetic Materials"), and "Synthetic Materials: Making Substances in the Lab" article

	methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)	○ **Lesson Brief**, Digital Resources, "Science Seminar Evidence Cards A–D copymaster"	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.*]	[DCI] ***Chemical Reactions*** unit*:* ● Lesson 2.2, **Activity 3,** Instructional Guide (step 6) and On-the-Fly Assessment (hummingbird icon) ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Arguments" [SEP] ***Harnessing Human Energy*** unit*:* ● Lesson 3.3, **Activity 2,** Instructional Guide (steps 1–13), Student View, and On-the-Fly Assessment (hummingbird icon) ● **Printable Resources, "**Print Materials (8.5" x 11"), Ed-You-Swivel Evidence Cards, pages 24–28 [CCC] ***Force and Motion Engineering Internship*** unit*:* ● Lesson 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Lesson 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab
DCI	**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)	***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 3,** screen 2 of 2, Instructional Guide and Student View ● Lesson 1.5, **Activity 2,** screen 3 of 3, Instructional Guide and Student View, Possible Responses tab, and simulation (Chemical Stockroom mode)		
DCI	**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) ****Supplemental DCI ESS3.C, LS4.D* (MS-PS1-5)	***Chemical Reactions*** unit*:* ● Lesson 2.1 ○ **Activity 2,** screen 3 of 3, Instructional Guide and Student View ○ **Activity 3,** screen 2 of 2, Instructional Guide, Student View, Possible Responses tab, and simulation (Laboratory A mode) ● Lesson 2.2, **Activity 3,** Instructional Guide (steps 1–9)		

CCC	**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)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 3, **Activity: Revising the Egg Drop Model Designs**, Instructional Guide (steps 6–9) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 1 , **Activity: Reading About Phase Change Materials**, *Futura Chemical Engineer's Dossier*, "Phase Change Materials" article ● Ch.1, Day 4, **Activity: Analyzing Incubator Material**, Instructional Guide (steps 1–11), BabyWarmer design tool, and Teacher Support tab ("Background, Crosscutting Concepts: Structure and Function")		● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" [SEP] ***Magnetic Fields*** unit*:* ● Lesson 4.1 ○ **Activity 4,** Instructional Guide (steps 1–12) and Student View ○ **Lesson Brief**, Digital Resources, "Science Seminar Evidence Cards A–D copymaster"
CCC	***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)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura**, Instructional Guide (steps 2–3) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 5, **Lesson Brief**, Digital Resources, "Meet an Engineer Who Works with Genetic" Equipment" article ***Chemical Reactions*** unit*:* ● Lesson 2.3, **Activity 5,** screen 2 of 2, Student View, Teacher Support tab ("Rationale, Pedagogical Goals: Meeting a Scientist Article" and "Rationale, Pedagogical Goals: Understanding the Nature of Science"), and "Meet a Scientist Who Preserves Artwork" article		

		Phase Change unit*:* ● Lesson 1.2, **Activity: Investigating Methane on Titan**, Instructional Guide (steps 1–6) and Studying a Distant Moon video ***Light Waves*** unit*:* ● Lesson 1.2, **Activity: Interview with a Spectroscopist**, Interview with a Spectroscopist video		
CCC	**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. Thus technology use varies from region to region and over time. (MS-PS1-3)	***Harnessing Human Energy*** unit*:* ● Lesson 1.4, **Activity 3**, "Energy Inventions" article ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura**, Instructional Guide (steps 2–3) and Welcome to Futura video ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura**, Instructional Guide (steps 2–5) and Welcome to Futura video		

Science and Engineering Practices **Disciplinary Core Ideas** **Crosscutting Concepts**	**Publisher Citations**	**Performance Expectation**	**Publisher Citations**

SEP	**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), (MS-PS1-4)	***Phase Change*** unit*:* ● Lesson 1.3, ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 11–13) ○ **Activity 5,** Student View ● Lesson 2.3, **Activity 1,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Modeling Tool activity: Cause of Lake Freezing ***Force and Motion*** unit*:* ● Lesson 1.2, **Activity 5,** Student View and Teacher Support tab ("Background, Pedagogical Goals: Developing Models") ● Lesson 3.2 ○ **Activity 1**, Student View, Teacher Support tab ("Instructional Suggestion, Pedagogical Goals: Discussing Prior Knowledge About Collision Forces") ○ **Activity 5**, Student View ***Harnessing Human Energy*** unit*:* ● Lesson 3.2, **Activity 2,** Instructional Guide and Student View ***Chemical Reactions*** unit*:* ● Lesson 2.3 ○ **Activity 3**, Instructional Guide (steps 1–7) and Student View ○ **Lesson Brief**, Digital Resources, "Modeling	**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	[CCC] ***Force and Motion*** unit*:* ● Lesson 1.6, **Activity 3,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, On-the-Fly Assessment (hummingbird icon), and Teacher Support tab ("Background, Crosscutting Concepts: Cause and Effect") [DCI, SEP] ***Phase Change*** unit*:* ● Lesson 1.6 , **Activity 4,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, Modeling Tool activity: Methane Lake Freezing, Modeling Tool activity: Methane Lake Evaporating, and On-the-Fly Assessment (hummingbird icon) ***Thermal Energy*** unit*:* ● Lesson, 1.4 ○ **Activity 3,** Instructional Guide (steps 1–10), Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Differences in Temperature copymaster" [DCI] ***Thermal Energy*** unit*:* ● Lesson 2.3, **Activity 5,** Teacher Support tab ("Rationale, Pedagogical Goals: Discussing

		Tool: How the Rust Formed copymaster” ● Lesson 3.4 ○ **Activity 3**, Instructional Guide (steps 1–5) and Student View ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Products of the Reaction copymaster” ***Force and Motion*** unit*:* ● Lesson 2.3, **Activity 3,** Student View, Modeling Tool activity: Claim 1, Ch. 2 and Modeling Tool Activity: Claim 2, Ch. 2	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.]	the Everyday and Scientific Meanings of Heat”) ***Phase Change*** unit*:* ● Lesson 2.1, **Activity 2,** screen 2 of 2, Instructional Guide (step 13) ● Lesson 4.4 ○ **Activity 4,** Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Rubrics for Final Written Argument” ***Thermal Energy*** unit*:* ● Lesson 3.3 ○ **Activity: Setting Up the Thermal Energy and Size Demo,** Instructional Guide (steps 1–10) ○ **Activity 2,** Instructional Guide (steps 1–11), Student View, Possible Responses tab, and simulation ○ **Activity 4,** screen 2 of 2, Student View, Possible Responses tab, and “Dumpling Dilemma: Oil or Water?” article ○ **Lesson Brief,** Digital Resources, “Planning and Conducting Investigations of Thermal Energy Transfer copymaster” and “Rubrics for Assessing Students’ Investigations of Thermal Energy Transfer”
DCI	**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) ■ 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)	***Phase Change*** unit*:* ● Lesson 1.3, ○ **Activity 4,** screens 1–2 of 2, Instructional Guide (steps 3–13), Student View, Possible Responses tab, and simulation ○ **Activity 2**, screen 1 of 2, Teacher Support tab (“Background, Science Note: About Molecules and Atoms”) ○ **Activity 3**, Instructional Guide (step 7) and simulation ● Lesson 1.5 ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 4–7), Student View, and “Weird Water Events” article ○ **Activity 4,** Instructional Guide (steps 1–6), Student View, and Modeling Tool activity: Ice Pop		

	■ 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)	● Lesson 3.3, ○ **Activity 4**, screen 2 of 2, Student View and "Pressure and Temperature: Evaporating Water on Mars" article		
DCI	**PS3.A: Definitions of Energy** ■ 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) ■ The temperature of a system is proportional to the average internal kinetic energy and potential energy per	[Term "heat"] ***Thermal Energy*** unit*:* ● Lesson 2.3, **Activity 5,** Teacher Support tab ("Rationale, Pedagogical Goals: Discussing the Everyday and Scientific Meanings of Heat ") ***Phase Change*** unit*:* ● Lesson 2.1, **Activity 2,** screen 2 of 2, Instructional Guide (step 13) [Temperature and kinetic energy] ***Phase Change*** unit*:* ● Lesson 2.2 ○ **Activity 3,** Instructional Guide (steps 1–5), Student View, and simulation. ○ **Activity: Playing Zooming in on Phase Change unit:** Zooming in on Phase Change video ○ **Activity 4,** screen 1–2 of 2, Instructional Guide (steps 1–8) and Student View [Role of potential energy in temperature] ***Phase Change Engineering Internship*** unit*:*		

	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)	• Ch.1, Day 2, **Activity 2,** Instructional Guide (steps 5–12) and *Futura Chemical Engineer's Dossier*, "Temperature Plateau" article
		
		[Temperature is not…]
		Thermal Energy unit*:*
		• Lesson 3.2, **Activity 2,** Instructional Guide (steps 1–8), Student View, and "Thermal Energy is NOT Temperature" article
		
		[Type and number of atoms or molecules]
		Thermal Energy unit*:*
		• Lesson 3.3
		  ○ **Activity: Setting Up the Thermal Energy and Size Demo,** Instructional Guide (steps 1–10)
		  ○ **Activity 2,** Instructional Guide (steps 1–11), Student View, Possible Responses tab, and simulation
		  ○ **Activity 4,** screen 2 of 2, Student View, Possible Responses tab, and "Dumpling Dilemma: Oil or Water?" article
		  ○ **Lesson Brief,** Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer"		

CCC	**Cause and Effect**	***Thermal Energy*** unit*:*		

	■ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)	● Lesson 3.3, **Activity: Setting Up the Thermal Energy and Size Demo**, Instructional Guide (step 10) ***Force and Motion*** unit*:* ● Lesson 1.3, **Activity 5,** Student View and Sorting Tool activity: Cause and Effect ● Lesson 1.6, **Activity 3,** Teacher Support tab (“Background, Crosscutting Concepts: Cause and Effect”) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs**, Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data sheet copymaster”		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**Developing and Using Models** ● Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and	***Phase Change*** unit*:* ● Lesson 1.3 ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 10–13) and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”)	**MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a**	[DCI, SEP, CCC] ***Chemical Reactions*** unit*:* ● Lesson 3.4 ○ **Activity 3,** Instructional Guide (steps 1–5) and Student View ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Products of the Reaction copymaster”

	predict more abstract phenomena and design systems. ● Develop a model to describe unobservable mechanisms.	○ **Lesson Brief**, Digital Resources, “Modeling Molecules and Phases copymaster” ○ **Activity 5,** Student View ***Force and Motion*** unit*:* ● Lesson 1.2, **Activity 5,** Student View and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”) ***Magnetic Fields*** unit*:* ● Lesson 1.3 ○ **Activity 4, I**nstructional Guide (steps 1–13), Student View, and Teacher Support tab (“Background, Pedagogical Goals: *Magnetic Fields* Modeling Tool” and “Instructional Suggestion, Modeling Tool: Extra Support”) ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Attracting and Repelling Magnets copymaster” ● Lesson 1.6 ○ **Activity 4,** Instructional Guide (steps 1–4) and Student View ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Attracting and Repelling Magnets copymaster” ***Chemical Reactions*** unit*:* ● Lesson 3.4	**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.*]	[DCI, CCC] ***Chemical Reactions*** unit*:* ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Rubrics for Assessing Students’ Final Written Arguments” ● Lesson 4.4 ○ **Activity 2,** Student View and Possible Responses tab ○ **Activity 3,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “End-of-Unit Assessment Answer Key and Scoring Guide” [SEP] ***Phase Change*** unit*:* ● Lesson 1.6, **Activity 4,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, Modeling Tool activity: Methane Lake Freezing, Modeling Tool activity: Methane Lake Evaporating, and On-the-Fly Assessment (hummingbird icon)

		○ **Activity 3,** Instructional Guide (steps 1–5) and Student View ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Products of the Reaction copymaster”		
SEP	***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)	***Phase Change*** unit*:* ● Lesson 1.2, **Activity 4,** Student View, Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”), and "Air Pressure and Boyle's Law" article		
DCI	**PS1.B: Chemical Reactions** ■ The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	***Chemical Reactions*** unit*:* ● Lesson 3.2 ○ **Activity 1,** Student View ○ **Activity 2,** Instructional Guide (steps 1–6), Student View, and simulation ○ **Activity 3,** screen 1 of 2, Student View and “What Happens When Fuels Burn?” article ● Lesson 3.3, **Activity 2,** Instructional Guide (steps 1–7) and Student View		
CCC	**Energy and Matter** ■ Matter is conserved because atoms are conserved in physical and chemical	***Chemical Reactions*** unit*:* ● Lesson 3.2 ○ **Activity 1,** Student View ○ **Activity 2,** Instructional Guide (steps 1–6), Student View, and simulation ○ **Activity 3,** screen 1 of 2,		

	processes. (MS-PS1-5)	Student View and "What Happens When Fuels Burn?" article ○ **Activity 4,** Instructional Guide (step 7)		
Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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)	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 5 ○ **Activity: Introducing The Design Cycle**, Instructional Guide (steps 1–5) and The Design Cycle video ○ **Activity: Testing Incubator Designs**, Instructional Guide (steps 1–3) and BabyWarmer Design Tool ● Ch.1, Day 6 ○ **Activity: Testing Final Designs**, Instructional Guide (steps 1–5) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 3, **Activity: Introducing The Design Cycle**, Instructional Guide (steps 1–3) and The Design Cycle video ● Ch.1, Day 4 ○ **Activity: Investigating**	**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.	[SEP, DCI] ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" [DCI] ***Chemical Reactions*** unit*:* ● Lesson 2.5 ○ **Activity 4**, Student View, Teacher Support tab ("Rationale, Pedagogical Goals: Reading About Endothermic and Exothermic Reactions," "Assessment, Assessment Opportunity: Student Understanding of Energy in Chemical Reactions unit") and "Endothermic and Exothermic Reactions" article

		SupplyDrop, Instructional Guide (steps 1–8) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 6 ○ **Activity: Testing Final Designs**, Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster"	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*.]	[CCC] ***Light Waves*** unit*:* ● Lesson 3.3, **Activity 3,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ***Harnessing Human Energy*** unit*:* ● Lesson 2.2, **Activity 4,** Instructional Guide (steps 1–8) and Sorting Tool activity: Introducing Energy Transfer
DCI	**PS1.B: Chemical Reactions** ■ Some chemical reactions release energy, others store energy. (MS-PS1-6)	***Chemical Reactions*** unit*:* ● Lesson 2.5, **Activity 4,** Student View and "Endothermic and Exothermic Reactions" article		
DCI	**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)	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ○ **Activity: Analyzing Designs,** Instructional Guide (steps 1–6) ● Ch.1, Day 6 ○ **Activity: Testing Final Designs**, Instructional Guide (steps 1–5)		

		○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 4 ○ **Activity: Investigating SupplyDrop,** Instructional Guide (steps 1–8) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster” ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5,) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster”		
DCI	**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	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 1, **Lesson Brief**, Digital Resources, “Video: Engineering Tips: Optimal Designs” ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs**, Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ○ **Activity: Analyzing Designs**, Instructional Guide (steps 1–6)		

	the new design. (secondary to MS-PS1-6) ■ 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)	● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster" ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 4 ○ **Activity: Investigating SupplyDrop,** Instructional Guide (steps 1–8) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 5 ○ **Activity: Analyzing Results**, Instructional Guide (step 1–4) and Engineering Tip: Analyzing Data video ○ **Lesson Brief**, Digital Resources, "Results Analysis copymaster" ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster"		
CCC	**Energy and Matter** ■ The transfer of energy can be tracked as energy flows through a	***Harnessing Human Energy*** unit*:* ● Lesson 2.2, **Activity 4,** Instructional Guide (steps 1–8) and Sorting Tool activity: Introducing Energy Transfer		

	designed or natural system. (MS-PS1-6)	***Light Waves*** unit*:* ● Lesson 1.2, **Activity 3,** Instructional Guide (steps 1–15) and Student View ***Thermal Energy*** unit*:* ● Lesson 2.3, **Activity 4,** Instructional Guide (steps 4–12)		

MS-PS2 Motion and Stability: Forces and Interactions

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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)	***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief,** Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab ***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5)	**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	[DCI] ***Force and Motion*** unit*:* ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument" ● Lesson 4.4 ○ **Activity 2,** Student View and Possible Responses tab ○ **Activity 3,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "End-of-Unit Assessment Answer Key and Scoring Guide" [SEP]

		○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster" ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab	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.*]	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" [CCC] ***Magnetic Fields*** unit*:* ● Lesson 2.4, **Activity 4,** Instructional Guide (steps 1–8), Student View, Possible Responses tab, Modeling Tool: Spacecraft Launch Energy copymaster, and On-the-Fly Assessment (hummingbird icon) ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument"
DCI	**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)	***Force and Motion*** unit*:* ● Lesson 3.2 ○ **Activity 2,** screens 1–2 of 2, Instructional Guide (steps 1–10) and Student View ○ **Activity 3,** screens 1–3 of 3, Instructional Guide (steps 1–10) and Student View ● Lesson 3.3, **Activity 2,** "Crash! Forces in Collisions" article ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Reading About Collisions and Impact Forces,** Instructional Guide (steps 6–10), *Futura Mechanical Engineer's Dossier*, "Collisions and Impact Forces" article, and Tennis Ball Collision video ● Ch.1, Day 3, **Activity 3,** *Futura Mechanical Engineer's Dossier*, "Velocity, Mass, and Impact Forces" article		
CCC	**Systems and System Models** ■ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and	***Magnetic Fields*** unit*:* ● Lesson 1.3, **Activity 4,** screen 1 of 2, Instructional Guide (steps 1–5) and Teacher Support tab ("Background, Crosscutting Concepts: Systems and System Models") ***Harnessing Human Energy*** unit*:*		

	energy and matter flows within systems. (MS-PS2-1)	• Lesson 2.1, **Activity 3,** screen 2 of 3, Instructional Guide (step 4) and Student View		
CCC	***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)	***Phase Change Engineering Internship*** unit*:* • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–12), Welcome to Futura video, and Teacher Support tab ("Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria") • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9) and Teacher Support tab ("Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria")		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**Planning and Carrying Out Investigations**	***Magnetic Fields*** unit*:*	**MS-PS2-2.**	[DCI]

	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)	● Lesson 3.1, **Activity 2,** Instructional Guide (steps 1–13) and Student View ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Assessing Students' Investigations of Forces on Different Objects" ***Thermal Energy*** unit*:* ● Lesson 3.3 ○ **Lesson Brief** ■ Materials and Preparation, Preparation Before the Day of the Lesson, step 10, ■ Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer" ○ **Activity 4,** "Dumpling Dilemma: Oil or Water?" article	**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 First 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*	***Force and Motion*** unit*:* ● Lesson 1.6 ○ **Activity 3,** Instructional Guide (steps 3–11), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Activity 4,** Student View ● Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–13), Student View, Possible Responses tab, Modeling Tool activity: Claim 1, Modeling Tool activity: Claim 2, Ch. 2 and On-the-Fly Assessment (hummingbird icon) [DCI, SEP] ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16 and Student View, Possible Responses tab ○ **Lesson Brief**, Digital Resources, " Rubrics for Assessing Students' Investigations of Forces on Different Objects [CCC] ***Thermal Energy*** unit*:* ● Lesson 2.4, **Activity 4,** Instructional Guide (steps 1–4), Student View, and On-the-Fly Assessment (hummingbird icon) ***Phase Change*** unit*:* ● Lesson 3.2 ○ **Activity 3,** Instructional Guide (steps 2–8), Student

SEP	***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)	***Force and Motion*** unit*:* ● Lesson 3.4, **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ● Lesson 4.3, **Activity 6,** Student View ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Differences in Temperature Change copymaster" ***Phase Change*** unit*:* ● Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–3), Student View, Possible	*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.*]	View, and "Liquid Oxygen" article ○ **Activity 4,** Instructional Guide (steps 1–9), Student View, and simulation [SEP] ***Thermal Energy*** unit*:* ● Lesson 3.3 ○ **Lesson Brief** ■ Materials and Preparation, Preparation Before the Day of the Lesson, step 10 ■ Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer") ○ **Activity 4,** "Dumpling Dilemma: Oil or Water?" article ***Magnetic Fields*** unit*:* ● Lesson 3.1, **Activity 2,** Instructional Guide (steps 1–13) and Student View

		Responses tab, and Teacher Support tab (“Instructional Suggestion, Going Further: Correlation and Causation”)		
DCI	**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) ■ 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	***Force and Motion*** unit*:* ● Lesson 1.3, **Activity 3,** screens 1–4 of 4, Instructional Guide (steps 3–18) and Student View ● Lesson 1.5 ○ **Activity 2**, Instructional Guide (steps 1–7), Student View, Possible Responses tab, and simulation ○ **Activity 3**, screens 1–3 of 3, Instructional Guide (steps 1–13), Student View, Possible Responses tab, Modeling Tool activity: Forces Move Objects, and Modeling Tool activity: Different Velocity Changes ● Lesson 2.1 ○ **Activity 2,** screens 1–3, Instructional Guide (steps 1–18), Student View, and Possible Responses tab ○ **Activity 3,** screen 1–2 of 3, Student View ● Lesson 2.2, **Activity 2,** “Designing Wheelchairs for All Shapes and Sizes” article (paragraphs 4–6) ● Lesson 1.2, **Activity 4**, screen 2 of 2, Instructional Guide (steps 7–8) ● Lesson 3.2, **Activity 2,** Instructional Guide (step 3)		

	also be shared. (MS-PS2-2)			
CCC	**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)	***Phase Change*** unit*:* ● Lesson 3.2 ○ **Activity 3,** Instructional Guide (steps 2–8), Student View, and "Liquid Oxygen" article ○ **Activity 4,** Instructional Guide (steps 1–9), Student View, and simulation ***Thermal Energy*** unit*:* ● Lesson 2.4, **Activity 4,** Instructional Guide (steps 1–4), Student View, and Teacher Support tab ("Background, Crosscutting Concept: Stability and Change") ***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 2,** Instructional Guide, Student View, and "Crash!" article (paragraphs 3 and 4)		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**Asking Questions and Defining Problems** Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences	***Magnetic Fields*** unit*:* ● Lesson 3.5 ○ **Activity 6,** Student View ○ **Lesson Brief**, Digital Resources, "Family Homework Experience: Asking Questions about	**MS-PS2-3. Ask questions about data to determine the factors that affect the**	[SEP] ***Magnetic Fields*** unit*:* ● Lesson 3.5 ○ **Activity 6,** Student View ○ **Lesson Brief**, Digital Resources, "Family Homework Experience:

	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)	Magnetic Forces copymaster")	**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*	Asking Questions about Magnetic Forces copymaster" ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16), Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Assessing Students' Investigations of Forces on Different Objects" ● Lesson 2.2, **Activity 2,** On-the-Fly Assessment (hummingbird icon) ***Thermal Energy*** unit*:* ● Lesson 3.3, **Lesson Brief**, Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer"
DCI	**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)	[Magnetic forces attractive or repulsive] ***Magnetic Fields*** unit*:* ● Lesson 1.2 ○ **Activity 3,** Instructional Guide (steps 4–7) and Student View ○ **Activity 4,** screen 2 of 2, Instructional Guide (steps 4–5), Student View, and simulation ○ **Lesson Brief**, Digital Resources, "Exploring and Simulating Magnets copymaster" ○ **Activity 5,** screens 1–2 of 2, Instructional Guide (steps 1–7) [Magnetic forces, strength and distance] ***Magnetic Fields*** unit*:*		[DCI] ***Magnetic Fields*** unit*:* ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument" ● Lesson 4.4 ○ **Activity 2,** Student View and Possible Responses tab

		● Lesson 3.2, **Activity 2,** Instructional Guide (steps 1–10), Student View, and simulation [Electromagnetic forces] ***Magnetic Fields*** unit*:* ● Lesson 3.5 ○ **Activity: How an Electromagnet Works,** Instructional Guide (steps 1–2) and "How an Electromagnet Works" video ○ **Activity 2,** Instructional Guide (steps 1–4) ○ **Activity 3**, Student View and simulation ● Lesson 1.5, **Activity 5,** Student View and "Painting with Static Electricity" article [Electric forces] ***Magnetic Fields*** unit*:* ● Lesson 3.2, **Activity 4,** "Escaping a Black Hole" article (paragraph 3) ● Lesson 4.1 ○ **Activity 3,** Instructional Guide (steps 1–8) and Student View ○ **Lesson Brief**, Digital Resources, "Roller Coaster Design Claims copymaster"	*limited to proportional reasoning and algebraic thinking.]*	○ **Activity 3,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "End-of-Unit Assessment Answer Key and Scoring Guide" [CCC] ***Force and Motion*** unit*:* ● Lesson 1.6, **Activity 3,** Instructional Guide (steps 1–10), Student View, and On-the-Fly Assessment (hummingbird icon) ● Lesson 3.2, **Activity 4,** Instructional Guide (steps 1–4), Student View, and On-the-Fly Assessment (hummingbird icon)
CCC	**Cause and Effect** ■ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3)	***Thermal Energy*** unit*:* ● Lesson 3.3, **Activity: Setting Up the Thermal Energy and Size Demo,** Instructional Guide (step 10) ***Force and Motion*** unit*:*		

		• Lesson 1.3, **Activity 5,** Student View and Sorting Tool activity: Cause and Effect
		• Lesson 1.6. **Activity 3,** Teacher Support tab ("Background, Crosscutting Concepts: Cause and Effect")
		
		Phase Change Engineering Internship unit*:*
		• Ch.1, Day 5
		  ○ **"Testing Incubator Designs" Activity,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool
		  ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data sheet copymaster"		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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.	***Force and Motion*** unit*:* • Chapter 4, Chapter Overview • Lesson 4.2, **Activity 3,** Instructional Guide (steps 1–11) and Student View • Lesson 4.3, **Activity 4,** Instructional Guide (steps 1–5 and Student View ***Magnetic Fields*** unit*:* • Chapter 4, Chapter Overview • Lesson 4.3 ○ **Activity 3,** Instructional Guide	**MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of**	[CCC] ***Magnetic Fields*** unit*:* • Lesson 1.3, **Activity 4,** screen 1 of 2, Instructional Guide (steps 1–5) and Teacher Support tab ("Background, Crosscutting Concepts: Systems and System Models") [DCI] ***Magnetic Fields*** unit*:* • Lesson 3.2, **Activity 4,** screen 2 of 2, Student View, "Escaping a Black Hole" article, and Teacher

	■ 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)	(steps 1–13) and Student View ○ **Activity 4,** Student View and Possible Responses tab ***Light Waves*** unit*:* ● Chapter 4, Chapter Overview ● Lesson 4.2, **Activity 3,** Instructional Guide (steps 1–12) and Student View ● Lesson 4.3, **Activity 4,** Instructional Guide (steps 1–3), Student View, and Possible Responses tab ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 7, **"Introducing the Proposal" Activity,** Instructional Guide (steps 1–4) ● Ch.1, Day 9, **"Finalizing the Proposal" Activity,** Instructional Guide (steps 1–2) and Possible Responses tab	**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.*]	Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Gravity") [SEP, CCC] ***Magnetic Fields*** unit*:* ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument" [SEP] ***Force and Motion*** unit*:* ● Lesson 4.3 ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument"
SEP	***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)	***Force and Motion*** unit*:* ● Lesson 3.4, **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ● Lesson 4.3, **Activity 6,** Student View ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher		

		Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Differences in Temperature Change copymaster” ***Force and Motion*** unit*:* ● Lesson 4.3 ○ **Activity 2,** Instructional Guide (steps 1–11), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Reasoning Tool copymaster” ***Phase Change*** unit*:* ● Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–3), Student View, Possible Responses tab, and Teacher Support tab (“Instructional		

		Suggestion, Going Further: Correlation and Causation")		
DCI	**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) *********Supplemental ESS1.A, ESS1.B*	***Magnetic Fields*** unit*:* ● Lesson 3.2, **Activity 4,** screen 2 of 2, Student View and "Escaping a Black Hole" article		
CCC	**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)	***Magnetic Fields*** unit*:* ● Lesson 1.3, **Activity 4,** screen 1 of 2, Instructional Guide (steps 1–5) and Teacher Support tab ("Background, Crosscutting Concepts: Systems and System Models") ***Harnessing Human Energy*** unit*:* ● Lesson 2.1, **Activity 3,** screen 2 of 3, Instructional Guide (step 4) and Student View		

Science and Engineering Practices **Disciplinary Core Ideas** **Crosscutting Concepts**	**Publisher Citations**	**Performance Expectation**	**Publisher Citations**

SEP	**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)	***Magnetic Fields*** unit*:* ● Lesson 1.3 ○ **Activity 3,** Instructional Guide (steps 1–9) ○ **Lesson Brief**, Digital Resources, "Magnet Tests Evidence Cards copymaster" ● Lesson 3.1, **Activity 2,** Instructional Guide (steps 1–13), Student View, and Possible Responses tab ● Lesson 4.1 ○ **Activity 4,** Instructional Guide (steps 1–12) and Student View ○ **Lesson Brief**, Digital Resources, "Science Seminar Evidence Cards A–D copymaster" ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Assessing Students' Investigations of Forces on Different Objects" ● Lesson 4.3 ○ **Activity 5,** Instructional Guide (steps 1–9), Student	**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.]	[DCI] ***Magnetic Fields*** unit*:* ● Lesson 1.5, **Activity 5,** Student View, "Painting with Static Electricity" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Electric Fields") ● Lesson 3.2 ○ **Activity 3,** Instructional Guide (steps 1–7), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Activity 4,** screen 2 of 2, Student View, "Escaping a Black Hole" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Gravity") [CCC] ***Force and Motion*** unit*:* ● Lesson 1.6, **Activity 3,** Instructional Guide (steps 1–10), Student View, and On-the-Fly Assessment (hummingbird icon) ● Lesson 3.2, **Activity 4,** Instructional Guide (steps 1–4), Student View, and On-the-Fly Assessment (hummingbird icon) [SEP] ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16),

		View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Kinetic Energy and Mass, Kinetic Energy and Velocity copymaster," and simulation ***Thermal Energy*** unit*:* ● Lesson 3.3, **Lesson Brief**, Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer"	[*Assessment Boundary: Assessment is limited to electric and* ***Magnetic Fields*** unit*: and is limited to qualitative evidence for the existence of fields*.]	Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Assessing Students' Investigations of Forces on Different Objects" ***Thermal Energy*** unit*:* ● Lesson 3.3, **Lesson Brief**, Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer"
DCI	**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)	[Magnetic fields] ***Magnetic Fields*** unit*:* ● Lesson 1.4, **Activity 2,** "Earth's Geomagnetism" article (paragraphs 1 and 2) ● Lesson 1.5 ○ **Activity 1,** Student View, Possible Responses tab, and simulation ○ **Activity 2,** screen 2 of 2, Instructional Guide (step 10) and Student View ○ **Activity 3,** Student View and simulation ○ **Activity 4,** Instructional Guide (steps 1–5), Student View, Modeling Tool: Attracting and "Repelling Magnets copymaster" ○ **Activity 5,** Student View, "Painting with		

		Static Electricity" article [Gravitational fields] ***Magnetic Fields*** unit*:* ● Lesson 3.2, **Activity 4,** screen 2 of 2, Student View and "Escaping a Black Hole" article [Electric fields] ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Lesson Brief**, Digital Resources, *Futura Mechanical Engineer's Dossier*, Ch. 6, "Additional Resources: Physics of Falling" article		
CCC	**Cause and Effect** ■ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-5)	***Thermal Energy*** unit*:* ● Lesson 3.3, **Activity: Setting Up the Thermal Energy and Size Demo,** Instructional Guide (step 10) ***Force and Motion*** unit*:* ● Lesson 1.3, **Activity 5,** Student View and Sorting Tool activity: Cause and Effect ● Lesson 1.6, **Activity 3,** Teacher Support tab ("Background, Crosscutting Concepts: Cause and Effect") ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool		

		○ **Lesson Brief**, Digital Resources, "BabyWarmer Data sheet copymaster"		

MS-PS3 Energy

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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)	***Force and Motion*** unit*:* ● Lesson 4.3 ○ **Activity 5,** Instructional Guide (steps 1–9), Student View,simulation, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Kinetic Energy and Mass copymaster" and "Kinetic Energy and Velocity copymaster"	**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	[CCC] ***Force and Motion*** unit*:* ● Lesson 2.1, **Activity 2,** Instructional Guide (steps 1–14), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) [DCI, CCC] ***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 4,** screen 2 of 2, Student View, "Wrecking Ball" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Speed in Relation to Kinetic Energy") [SEP, DCI] ***Force and Motion*** unit*:* ● Lesson 4.3, ○ **Activity 5,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, simulation, and Teacher Support tab ("Assessment, Assessment Opportunity:
DCI	**PS3.A: Definitions of Energy** ■ Motion energy is properly called kinetic energy; it is	***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 4,** screen 2 of 2, Student View and "Wrecking Ball" article (paragraph 5)		

	proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)	• Lesson 4.3, **Activity 5,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, simulation, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Velocity in Relation to Kinetic Energy") ***Harnessing Human Energy*** unit*:* • Lesson 1.3, **Activity 2,** screens 1–3 of 3, Instructional Guide (steps 1–9, 12–17), Student View and Sorting Tool activity: Types of Energy	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.]	Student Understanding of Mass and Velocity in Relation to Kinetic Energy")
CCC	**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)	***Thermal Energy*** unit*:* • Lesson 3.2, **Activity 2,** Instructional Guide (steps 1–9), Student View, and "Thermal Energy Is NOT Temperature" article ***Force and Motion*** unit*:* • Lesson 1.4, **Activity 3,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") • Lesson 2.1, **Activity 3,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") ***Magnetic Fields*** unit*:* • Lesson 2.2, **Activity 2,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") ***Phase Change*** unit*:*		

		• Lesson 1.3, **Activity 2,** Teacher Support tab (“Background, Crosscutting Concept: Scale, Proportion, and Quantity”) • Lesson 3.3, **Activity 3,** Student View, Possible Responses tab, and Modeling Tool activity: Methane Lake 2002–2007		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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)	***Phase Change*** unit*:* • Lesson 1.3 ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 10–13) and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”) ○ **Lesson Brief**, Digital Resources, “Modeling Molecules and Phases copymaster” ○ **Activity 5,** Student View ***Force and Motion*** unit*:* • Lesson 1.2, **Activity 5,** Student View and Teacher Support tab (“Background, Pedagogical Goals: Developing Models”) ***Magnetic Fields*** unit*:* • Lesson 1.3 ○ **Activity 4,** screens 1–2 of 2, Instructional Guide (steps 1–13), Student	**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	[DCI, SEP, CCC] ***Magnetic Fields*** unit*:* • Lesson 2.4 ○ **Activity 4,** Instructional Guide (steps 1–8), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Spacecraft Launch Energy copymaster” [DCI, CCC] ***Magnetic Fields*** unit*:* • Lesson 3.3 ○ **Activity 3,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, “Modeling Tool:

		View, and Teacher Support tab ("Background, Pedagogical Goals: *Magnetic Fields* Modeling Tool" and "Instructional Suggestion, Modeling Tool: Extra Support") ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Attracting and Repelling Magnets copymaster" ● Lesson 1.6 ○ **Activity 4,** Instructional Guide (steps 1–4) and Student View ○ **Lesson Brief,** Modeling Tool: "Attracting and Repelling Magnets copymaster" ***Chemical Reactions*** unit*:* ● Lesson 3.4 ○ **Activity 3,** Instructional Guide (steps 1–5) and Student View ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Products of the Reaction copymaster"	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 representation	Spacecraft Launches copymaster" ● Lesson 4.3, ○ **Activity 4,** Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Final Written Argument" [DCI] ***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 4,** Student View, "Wrecking Ball" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Speed in Relation to Kinetic Energy")
DCI	**PS3.A: Definitions of Energy** ■ A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)	***Magnetic Fields*** unit*:* ● **Unit Guide**, Unit Overview ● Lesson 2.1 ○ **Activity 1,** Student View and Possible Responses tab ○ **Activity 2**, "The Potential for Speed" article ○ **Activity 4,** Student View and simulation ● Lesson 2.3		

		○ **Activity 1,** Student View, Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Potential and Kinetic Energy copymaster" ○ **Activity 2,** Instructional Guide (steps 1–10), Student View, Possible Responses tab, and simulation ○ **Activity 3,** Instructional Guide (steps 1–11), Student View, and Possible Responses tab	s, diagrams, pictures, and written descriptions of systems.] [*Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.*]	
DCI	**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)	***Magnetic Fields*** unit*:* ● Lesson 2.1, **Activity 2,** 'The Potential for Speed" article ● Lesson 2.3, **Activity 2,** screen 2 of 3, Instructional Guide (steps 5–8) and Student View ***Force and Motion*** unit*:* ● Lesson 3.1, **Activity 2**, "Crash! Forces in Collision" article and Teacher Support tab ("Background, Science Note: About Collisions") ● Lesson 3.3, **Activity 4,** Student View, "Wrecking Ball" article, and Teacher Support tab ("Rationale, Pedagogical Goals: Additional Reading About Kinetic Energy")		
CCC	**Systems and System Models** ▪ Models can be used to represent systems and their interactions – such as inputs,	***Magnetic Fields*** unit*:* ● Lesson 1.3, **Activity 4,** screen 1 of 2, Instructional Guide (steps 1–5) and Teacher Support tab ("Background, Crosscutting Concepts: Systems and System Models")		

	processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)	***Harnessing Human Energy*** unit*:* • Lesson 2.1, **Activity 3,** screen 2 of 3, Instructional Guide (step 4) and Student View		

MS-PS3 Energy

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**

SEP	**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,
		Force and Motion Engineering Internship unit*:*
		• **Unit Guide**, Unit Overview
		• Ch.1, Day 6
		  ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool
		  ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster"
		• Lesson 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab
		
		Phase Change Engineering Internship unit*:*
		• **Unit Guide**, Unit Overview
		• Ch.1, Day 6
		  ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5)
			MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* [Clarification Statement: Examples of devices could include an insulated box,	[DCI]
				Thermal Energy unit*:*
				• Lesson 3.3, **Activity 4,** screens 1–2 of 2, Student View, Possible Responses tab, "Dumpling Dilemma: Oil or Water?" article, and Teacher Support tab ("Rationale, Pedagogical Goals: Additional Reading About Thermal Energy and Temperature" and "Assessment, Assessment Opportunity: Student Understanding of How the Nature of a Material Affects Energy Transfer")
				• Lesson 4.3
				  ○ **Activity 4,** Student View and Possible Responses tab
				  ○ **Lesson Brief**, Digital Resources, "Thermal Energy Rubrics for Assessing Students' Final Written Arguments"
				
				[SEP, DCI]

	construct, and test a design of an object, tool, process or system. (MS-PS3-3)	○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab	a solar cooker, and a Styrofoam cup.] [*Assessment Boundary: Assessment does not include calculating the total amount of **Thermal Energy** transferred.*]	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9 ○ **Activity: Finalizing the Proposal,** Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Printable Proposal Rubric copymaster” [PE] ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 4: ○ **Activity: Analyzing Incubator Materials,** Instructional Guide (steps 8–11), Possible Responses tab, and BabyWarmer Design Tool ○ **Activity 2,** Instructional Guide (steps 1–6), *Futura Chemical Engineer’s Dossier*, "Insulating Materials" article ○ **Lesson Brief**, Digital Resources, “Insulating Materials Analysis copymaster” [PE, SEP, DCI] ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric” [CCC] ***Light Waves*** unit*:* ● Lesson 3.3, **Activity 3,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-
DCI	**PS3.A: Definitions of Energy** ■ 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)	***Thermal Energy*** unit*:* ● Lesson 2.1, **Activity 2,** screens 1–2 of 3, Student View and Instructional Guide (steps 6–9) ● Lesson 3.1 ○ **Activity 1,** Student View ○ **Activity 2**, Instructional Guide (steps 1–9), Student View, and “Thermal Energy is NOT Temperature” article ● Lesson 3.3 ○ **Lesson Brief**, Digital Resources, “Planning and Conducting Investigations of Thermal Energy Transfer copymaster” and “Rubrics for Assessing Students’ Investigations of Thermal Energy Transfer” ○ **Activity 4,** screens 1–2 of 2, Student View, Possible Responses tab, “Dumpling Dilemma: Oil or Water?” article, and Teacher Support tab (“Assessment, Assessment Opportunity: Student Understanding of How the Nature of a Material Affects Energy Transfer”)		
DCI	**PS3.B: Conservation of Energy and Energy Transfer**	***Thermal Energy*** unit*:* ● Lesson 2.3, ○ **Activity 2,** Student View, Possible Responses tab, and simulation		

	■ Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)	○ **Activity 3**, Student View and "How Air Conditioners Make Cities Hotter" article (paragraphs 6–8) ● Lesson 3.1, **Activity 2,** "Thermal Energy is NOT Temperature" article (paragraph 7)		Fly Assessment (hummingbird icon) ***Harnessing Human Energy*** unit*:* ● Lesson 2.2, **Activity 4,** Instructional Guide (steps 1–8) and Sorting Tool activity: Introducing Energy Transfer
DCI	**ETS1.A: Defining and Delimiting an Engineering Problem** ■ 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)	***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–12), Welcome to Futura video, and Teacher Support tab ("Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria") ● Ch.1, Day 2, **Activity: Modeling Thermal Energy Transfer**, Instructional Guide (step 1) and Teacher Support tab ("Background, Engineering Note: Understanding the Difference Between Constraints and Criteria" and "Instructional Suggestion, Engineering Note: Examples of Constraints") ● Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9) and Teacher Support tab ("Instructional Suggestion: Providing More Support, Examples of Constraints and Criteria") ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–14), Welcome to Futura video, and Teacher Support tab ("Rationale, Engineering Note:		

		Understanding the Difference Between Constraints and Criteria") ● Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–6) and Teacher Support tab ("Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria")		
DCI	**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. 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)	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster" ● Ch.1, Day 7, **Activity: Outlining Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab		
CCC	**Energy and Matter**	***Harnessing Human Energy*** unit*:* ● Lesson 2.2, **Activity 4,** Instructional Guide (steps 1–8) and		

	■ The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)	Sorting Tool activity: Introducing Energy Transfer ***Light Waves*** unit*:* ● Lesson 1.2, **Activity 3,** Instructional Guide (steps 1–15) and Student View ***Thermal Energy*** unit*:* ● Lesson 2.3, **Activity 4,** Instructional Guide (steps 4–12)		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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,	***Magnetic Fields*** unit*:* ● Lesson 3.1, **Activity 2,** Instructional Guide (steps 1–13) and Student View ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Rubrics for Assessing Students’ Investigations of Forces on Different Objects” ***Thermal Energy*** unit*:* ● Lesson 3.3 ○ **Lesson Brief** ■ Materials and Preparation, Preparation	**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**	[CCC] ***Thermal Energy*** unit*:* ● Lesson 3.2, **Activity 2,** Instructional Guide (steps 1–9), Student View, and “Thermal Energy Is NOT Temperature” article ***Force and Motion*** unit*:* ● Lesson 2.1, **Activity 2,** Instructional Guide (steps 1–14), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) [SEP, DCI] ***Thermal Energy*** unit*:* ● Lesson 3.3 ○ **Lesson Brief,** Digital Resources: ■ Materials and Preparation,

	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)	Before the Day of the Lesson, step 10, ▪ Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer") ○ **Activity 4,** "Dumpling Dilemma: Oil or Water?" article	**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	Preparation Before the Day of the Lesson, step 10 ▪ Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer" ○ **Activity 4,** "Dumpling Dilemma: Oil or Water?" article
SEP	***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-PS3-4)	***Force and Motion*** unit*:* ● Lesson 3.4, **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ● Lesson 4.3, **Activity 6,** Student View ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ***Thermal Energy*** unit*:* ● Lesson 3.4,		[DCI, CCC] ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Differences in Temperature Change copymaster" [DCI] ***Thermal Energy*** unit*:* ● Lesson 4.3, **Activity 4,** Student View, Possible Responses tab, and "Rubrics for Assessing Students' Final Written Arguments"

		○ **Activity 2,** screen 1 of 2, Instructional Guide (steps 1–5), Student View, and Possible Responses tab; screen 2 of 2, Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ○ **Lesson Brief,** Digital Resources, "Modeling Tool: Differences in Temperature Change copymaster" ***Phase Change*** unit*:* ● Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–3), Student View, and Possible Responses tab	energy is added.] [*Assessment Boundary: Assessment does not include calculating the total amount of* ***Thermal Energy*** *transferred.*]	[SEP] ***Force and Motion*** unit*:* ● Lesson 2.1 ○ **Activity 2,** Instructional Guide (steps 1–16), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Rubrics for Assessing Students' Investigations of Forces on Different Objects"
DCI	**PS3.A: Definitions of Energy** ■ 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)	***Thermal Energy*** unit*:* ● Lesson 2.1, **Activity 2,** screens 1–2 of 3, Student View, Instructional Guide (steps 6–9) ● Lesson 3.1 ○ **Activity 1,** Student View ○ **Activity 2**, Instructional Guide (steps 1–9), Student View, and "Thermal Energy is NOT Temperature" article ● Lesson 3.3 ○ **Lesson Brief**, Digital Resources, "Planning and Conducting Investigations of Thermal Energy Transfer copymaster" and "Rubrics for Assessing Students' Investigations of Thermal Energy Transfer" ○ **Activity 4,** screens 1–2 of 2, Student View, Possible		

		Responses tab, “Dumpling Dilemma: Oil or Water?” article, and Teacher Support tab (“Assessment, Assessment Opportunity: Student Understanding of How the Nature of a Material Affects Energy Transfer”)		
DCI	**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)	***Thermal Energy*** unit*:* • Lesson 3.3, ○ **Activity: Setting up the Thermal Energy and Size Demo**, Instructional Guide (steps 1–10) ○ **Activity 2**, Instructional Guide (steps 1–11), Student View, and simulation ○ **Lesson Brief,** ■ Materials and Preparation, Preparation Before the Day of the Lesson, step 10 ■ Digital Resources, “Planning and Conducting Investigations of Thermal Energy Transfer copymaster” and “Rubrics for Assessing Students’ Investigations of Thermal Energy Transfer” ○ **Activity 4,** “Dumpling Dilemma: Oil or Water?” article		

CCC	**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-PS3-4)	***Thermal Energy*** unit*:* ● Lesson 3.2, **Activity 2,** Instructional Guide (steps 1–9), Student View, and "Thermal Energy Is NOT Temperature" article ***Force and Motion*** unit*:* ● Lesson 1.4, **Activity 3,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") ● Lesson 2.1, **Activity 3,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") ***Magnetic Fields*** unit*:* ● Lesson 2.2, **Activity 2,** Teacher Support tab ("Instructional Suggestion, Going Further: Mathematical Thinking") ***Phase Change*** unit*:* ● Lesson 1.3, **Activity 2,** Teacher Support tab ("Background, Crosscutting Concept: Scale, Proportion, and Quantity") ● Lesson 3.3,, **Activity 3,** Student View, Possible Responses tab, and Modeling Tool activity: Methane Lake 2002–2007		

Science and Engineering Practices **Disciplinary Core Ideas** **Crosscutting Concepts**	**Publisher Citations**	**Performance Expectation**	**Publisher Citations**

SEP	**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)	***Force and Motion*** unit*:* ● Chapter 4, Chapter Overview ● Lesson 4.2, **Activity 3,** Instructional Guide (steps 1–11) and Student View ● Lesson 4.3, **Activity 4,** Instructional Guide (steps 1–5) and Student View ***Light Waves*** unit*:* ● Chapter 4, Chapter Overview ● Lesson 4.2, **Activity 3,** Instructional Guide (steps 1–12) and Student View ● Lesson 4.3, **Activity 4,** Instructional Guide (steps 1–3), Student View, and Possible Responses tab ***Thermal Energy*** unit*:* ● Chapter 4, Chapter Overview ● Lesson 4.2, **Activity 3,** Instructional Guide (steps 1–13) and Student View ● Ch. 4 Lesson 4.3, **Activity 4,** Instructional Guide (steps 1–4), Student View, and Possible Responses tab ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 7, **Activity: Introducing the Proposal,** Instructional Guide (steps 1–4) ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Instructional Guide (steps 1–2) and Possible Responses tab	**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:*	[DCI, SEP, CCC] ***Thermal Energy*** unit*:* ● Lesson 4.3, **Activity 4,** Student View, Possible Responses tab, and "Rubrics for Assessing Students' Final Written Arguments" ***Harnessing Human Energy*** unit*:* ● Lesson 2.1, **Activity 3,** Instructional Guide (steps 1–16), Student View, Possible Responses tab, and simulation [DCI] ***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 4,** screen 2 of 2, Student View, "Wrecking Ball" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of Mass and Speed in Relation to Kinetic Energy") ***Magnetic Fields*** unit*:* ● Lesson 2.4, ○ **Activity 4,** Instructional Guide (steps 1–8), Student View, Possible Responses tab, and On-the-Fly (hummingbird icon) Assessment ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Spacecraft Launch Energy copymaster" ***Thermal Energy*** unit*:* ● Lesson 2.4, **Activity 5,** Student View, Possible Responses tab,
SEP	***Connections to Nature of Science***	***Force and Motion*** unit*:* ● Lesson 3.4, **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale,		

	Scientific Knowledge is Based on Empirical Evidence ■ Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3–5)	Pedagogical Goals: Understanding the Nature of Science") ● Lesson 4.3, **Activity 6,** Student View ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and Teacher Support tab ("Rationale, Pedagogical Goals: Understanding the Nature of Science") ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Differences in Temperature Change copymaster" ***Phase Change*** unit*:* ● Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–3), Student View, Possible Responses tab, and Teacher Support tab ("Instructional Suggestion, Going Further: Correlation and Causation")	*Assessment does not include calculations of energy*.]	"Molecule Collisions and Newton's Cradle" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of the Transfer of Motion Energy")
DCI	**PS3.B: Conservation of Energy and Energy Transfer** ■ When the motion energy of an	***Thermal Energy*** unit*:* ● Lesson 2.3, ○ **Activity 2,** Student View and simulation ○ **Activity 3**, Student View and "How Air Conditioners		

	object changes, there is inevitably some other change in energy at the same time. (MS-PS3–5)	Make Cities Hotter" article, paragraphs 3–8 ○ **Activity 4**, screens 1–3 of 3, Instructional Guide (steps 1–11) ● Lesson 2.4, **Activity 5,** Student View, Possible Responses tab, "Molecule Collisions and Newton's Cradle" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of the Transfer of Motion Energy") ***Magnetic Fields*** unit*:* ● Lesson 2.2, **Activity 3,** Instructional Guide (steps 1–10) and Student View ● Lesson 2.4 ○ **Activity 4,** Instructional Guide (steps 1–8), Student View and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Spacecraft Launch Energy copymaster" ***Force and Motion*** unit*:* ● Lesson 3.3, **Activity 4,** screen 2 of 2, Student View and "Wrecking Ball" article		
CCC	**Energy and Matter** ■ Energy may take different forms (e.g., energy in fields, Thermal Energy unit: energy of motion). (MS-PS3–5)	***Harnessing Human Energy*** unit*:* ● **Unit Guide**, Unit Overview ● Lesson 1.3 ○ **Activity 2,** Instructional Guide (steps 1–7), Student View, and Sorting Tool activity: Types of Energy ○ **Activity 3,** Instructional Guide (steps 1–6) and Student View		

		○ **Activity 4,** Instructional Guide (steps 1–3) and Student View ● Lesson 2.1, **Activity 3,** screen 2 of 3, Instructional Guide (steps 1–17), Student View, Possible Responses tab, and simulation ***Magnetic Fields*** unit*:* ● Lesson 2.2 ○ **Activity 2,** Instructional Guide (steps 1–12), Student View, and "The Potential for Speed" article ○ **Activity 3,** Instructional Guide (steps 1–10) and Student View ***Light Waves*** unit*:* ● Lesson 1.2, **Activity 3,** Instructional Guide (steps 1–4) and Student View ***Thermal Energy*** unit*:* ● Lesson 2.3 ○ **Activity 1,** Student View and simulation ○ **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and simulation ○ **Activity 3,** Instructional Guide (steps 1–7), Student View, Possible Responses tab, and "How Air Conditioners Make Cities Hotter" article		

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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)	***Light Waves*** unit*:* ● Lesson 2.2, **Activity 4,** Student View, Possible Responses tab, and simulation ● Lesson 2.3 ○ **Activity 3,** Instructional Guide (steps 1–9), Student View, Possible Responses tab, and simulation ○ **Activity: Video: The Shape of Waves**, The Shape of Waves video ○ **Activity 4,** Instructional Guide (steps 1–7), Student View, and Teacher Support tab ("Background, Pedagogical Goals: Reflecting on How Light Waves are Different") ***Force and Motion*** unit*:* ● Lesson 4.3, **Activity 5,** Instructional Guide (steps 1–9) and Student View ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 7, **Activity: Outlining Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab ***Thermal Energy*** unit*:* ● Lesson 2.4, **Activity 3,** Instructional Guide (steps 1–10) and Student View ● Lesson 3.4	**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*	[DCI] ***Light Waves*** unit*:* ● Lesson 2.4 ○ **Activity 2,** Instructional Guide (steps 1–10), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Light's Effect on Genetic Material copymaster" and simulation [SEP] ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9 ○ **Activity: Finalizing the Proposal,** Possible Responses tab ○ **Lesson Brief**, Digital Resources, "Printable Proposal Rubric copymaster" ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, "Modeling Tool:

		○ **Activity 2,** Instructional Guide (steps 1–5), Student View, and Possible Responses tab ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Differences in Temperature Change copymaster”	*standard repeating waves.*]	Differences in Temperature Change copymaster” [CCC] ***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 4,** Instructional Guide (steps 1–7), Student View, Possible Responses tab, Sorting Tool: Evaluating Evidence, and On-the-Fly Assessment (hummingbird icon) ***Thermal Energy*** unit*:* ● Lesson 2.4 ○ **Activity 1,** Student View ○ **Activity 2,** screen 1 of 2, Instructional Guide (steps 1–8), Student View, Possible Responses tab, and simulation
SEP	***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-PS4-1)	***Force and Motion*** unit*:* ● Lesson 3.4, **Activity 2,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ● Lesson 4.3, **Activity 6,** Student View ***Light Waves*** unit*:* ● Lesson 3.6, **Activity 3,** Instructional Guide (steps 1–6), Student View, Possible Responses tab, and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ***Thermal Energy*** unit*:* ● Lesson 3.4 ○ **Activity 2,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”) ○ **Lesson Brief**, Digital Resources, “Modeling Tool: Differences in Temperature Change copymaster” ***Phase Change*** unit*:*		

		• Lesson 2.3, **Activity 3,** Instructional Guide (steps 1–3), Student View, Possible Responses tab, and Teacher Support tab (“Instructional Suggestion, Going Further: Correlation and Causation”)		

DCI	**PS4.A: Wave Properties**
	▪ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
		Light Waves unit*:*
		• Lesson 2.3
		  ○ **Activity: The Shape of Waves**, The Shape of Waves video
		  ○ **Activity 4,** screen 1 of 2, Instructional Guide (steps 1–5) and Student View
		  ○ **Activity 3,** screens 1–2 of 3, Instructional Guide (steps 1–8) and Student View
		• Lesson 2.4, **Activity 2**, screen 2 of 2, Instructional Guide (step 15)
		• Lesson 3.1, **Activity 3**, screens 1–2 of 2, Instructional Guide (steps 1–7), and simulation		

CCC	**Patterns**
	▪ Graphs and charts can be used to identify patterns in data. (MS-PS4-1)
		Light Waves unit*:*
		• Lesson 1.2, **Activity 2,** Instructional Guide (steps 1–5) and Student View
		• Lesson 2.5, **Activity 3,** Instructional Guide (steps 1–10) and Student View
		
		Magnetic Fields unit*:*
		• Lesson 1.5
		  ○ **Activity 2,** Instructional Guide (steps 1–9), Student View, and “Earth’s Geomagnetism” article
		  ○ **Activity 3,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and simulation
		
		Thermal Energy unit*:*
		• Lesson 2.4		

		○ **Activity 1,** Student View ○ **Activity 2,** screen 1 of 2, Instructional Guide (steps 1–8), Student View, Possible Responses tab, and simulation ***Chemical Reactions*** unit*:* ● Lesson 1.3, **Activity 4,** Instructional Guide (steps 1–7), Student View, Possible Responses tab, and Sorting Tool: Evaluating Evidence		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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)	***Phase Change*** unit*:* ● Lesson 1.3 ○ **Lesson Brief**, Digital Resources, “Modeling Molecules and Phases copymaster” ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 11–13) ○ **Activity 5**, Student View ***Force and Motion*** unit*:* ● Lesson 1.2, **Activity 5,** Student View ● Lesson 3.2 ○ **Activity 1,** Student View, Teacher Support tab (“Instructional Suggestion, Pedagogical Goals: Discussing Prior Knowledge About Collision Forces”) ○ **Activity 5**, Student View	**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	[DCI] ***Light Waves*** unit*:* ● Lesson 2.3, **Activity 5,** Student View, “Why No One in Space Can Hear You Scream” article, and Teacher Support tab (“ Assessment, Assessment Opportunity: Student Understanding of How Sound Waves Travel”) ● Lesson 2.4, **Activity 2,** Instructional Guide (steps 6–10), Student View, Possible Responses tab, simulation, and On-the-Fly Assessment (hummingbird icon) ● Lesson 4.3, **Activity 4,** Student View, Possible Responses tab, and “Rubrics for Final Written Argument” [SEP] ***Magnetic Fields*** unit*:* ● Lesson 3.3

		Harnessing Human Energy unit*:* ● Lesson 3.2, **Activity 2,** Instructional Guide and Student View ***Chemical Reactions*** unit*:* ● Lesson 2.3 ○ **Activity 3,** Instructional Guide (steps 1–7) and Student View ○ **Lesson Brief**, Digital Resources, "Modeling Tool: How the Rust Formed copymaster" ● Lesson 3.4, ○ **Activity 3,** Instructional Guide (steps 1–5) and Student View ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Products of the Reaction copymaster" ***Force and Motion*** unit*:* ● Lesson 2.3, **Activity 3,** screen 1–2 of 2, Student View, Modeling Tool activity: Claim 1, Ch. 2 and Modeling Tool activity: Claim 2, Ch. 2	include drawings, simulations, and written descriptions.] [*Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves*.]	○ **Activity 3,** Instructional Guide (steps 1–5), Student View, Possible Responses tab, and On-the-Fly Assessment (hummingbird icon) ○ **Lesson Brief**, Digital Resources, "Modeling Tool: Spacecraft Launches copymaster" ***Force and Motion*** unit*:* ● Lesson 2.3 ○ **Activity 3,** Instructional Guide (steps 1–13), Student View, Possible Responses tab, On-the-Fly Assessment (hummingbird icon), Modeling Tool activity: Claim 1, Ch. 2, and Modeling Tool activity: Claim 2, Ch. 2 ***Phase Change*** unit*:* ● Lesson 1.3 ○ **Lesson Brief**, Digital Resources, "Modeling Molecules and Phases copymaster" ○ **Activity 2,** screen 2 of 2, Instructional Guide (steps 11–13) ○ **Activity 5**, Student View [CCC] ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9 ○ **Activity: Finalizing the Proposal,** Possible Responses tab
DCI	**PS4.A: Wave Properties** ■ A sound wave needs a medium through which it is transmitted. (MS-PS4-2)	***Light Waves*** unit*:* ● Lesson 2.3, **Activity 5,** Student View, "Why No One in Space Can Hear You Scream" article ● Lesson 3.2, **Activity 4**, "Making Waves at Swim Practice" article (paragraphs 1 and 2)		
DCI	**PS4.B: Electromagnetic Radiation** ■ When light shines on an	[Light absorption, reflection, and transmission] ***Light Waves*** unit*:* ● Lesson 3.1, **Activity 3**, screens 1–2 of 2, Instructional Guide (steps 1–7), Student View, and simulation		

	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) ■ 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) ■ A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light	[The path that light travels …] ***Light Waves*** unit*:* ● Lesson 3.1, **Activity 2**, screens 1–3 of 3, Instructional Guide (steps 5–20) and Student View [Wave model of light] ***Light Waves*** unit*:* ● Lesson 2.3 ○ **Activity 3**, screen 1 of 3, Instructional Guide (steps 1–7), Student View, and simulation ○ **Activity: Video: The Shape of Waves**, The Shape of Waves video ○ **Activity 4**, screen 1 of 2, Instructional Guide (steps 1–5) ○ Lesson 3.2, **Activity 4**, screen 2 of 2, Student View, and "Making Waves at Swim Practice" article [Light can travel through space] ***Light Waves*** unit*:* ● Lesson 2.3, **Activity 5**, Student View and "Why No One in Space Can Hear You Scream" article ● Lesson 3.2, **Activity 4**, screen 2 of 2, "Making Waves at Swim Practice" article (paragraph 4)		○ **Lesson Brief**, Digital Resources, "Printable Proposal Rubric" ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7**, Lesson Brief**, Digital Resources, "Printable Proposal Rubric"

	at a surface between media. (MS-PS4-2) ■ However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)			
CCC	**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-PS4-2)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 3, **Activity: Revising the Egg Drop Model Designs,** Instructional Guide (steps 6–9) and Teacher Support tab (“Background, Crosscutting Concepts: Structure and Function”) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 2, **Activity 2,** and *Futura Chemical Engineer’s Dossier*, “Phase Change Materials” article ● Ch.1, Day 4, **Activity: Analyzing Incubator Material,** Instructional Guide (steps 1–11) and BabyWarmer Design Tool ***Chemical Reactions*** unit*:* ● Lesson 2.1, **Activity 5,** Student View and “Synthetic Materials: Making Substances in the Lab” article		

	Publisher Citations		**Publisher Citations**

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts			Performance Expectation	
SEP	**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)	***Chemical Reactions*** unit*:* ● Lesson 3.1 ○ **Activity: Playing Burning Paper**, Instructional Guide (steps 1–3) and Burning Paper video ○ **Activity 2,** Instructional Guide (steps 1–2) and "What Happens When Fuels Burn?" article ● Lesson 3.2 ○ **Activity 2,** Instructional Guide (steps 1–6) and simulation ○ **Activity 3,** Instructional Guide (steps 1–8) and "What Happens When Fuels Burn?" article ○ **Activity 4,** Instructional Guide (steps 1–6) and Student View	**MS-PS4-3. Integrate qualitative scientific and technical information to 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	[DCI] ***Light Waves*** unit*:* ● Lesson 3.1, **Activity 4,** Student View, "How Fiber-optic Communication Works" article, and Teacher Support tab ("Assessment, Assessment Opportunity: Student Understanding of the Reliability of Digitized Signals") [SEP] ***Chemical Reactions*** unit*:* ● Lesson 3.1 ○ **Activity: Playing Burning Paper**, Instructional Guide (steps 1–3) and Burning Paper video ○ **Activity 2,** Instructional Guide (steps 1–2) and "What Happens When Fuels Burn?" article ● Lesson 3.2, **Activity 4,** Instructional Guide (steps 1–4), Student View, and On-the-Fly Assessment (hummingbird icon) [CCC] ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric"
DCI	**PS4.C: Information Technologies and Instrumentation** ▪ Digitized signals (sent as wave pulses)	***Light Waves*** unit*:* ● Lesson 3.1, **Activity 4,** Student View, and "How Fiber-optic Communication Works" article		

	are a more reliable way to encode and transmit information. (MS-PS4-3)		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*.]	***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 9 **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, "Printable Proposal Rubric"
CCC	**Structure and Function** ■ Structures can be designed to serve particular functions. (MS-PS4-3)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 3, **Activity: Revising the Egg Drop Model Designs,** Instructional Guide (steps 6–9) and Teacher Support tab ("Background, Crosscutting Concepts: Structure and Function") ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 2, **Activity 2,** *Futura Chemical Engineer's Dossier*, "Phase Change Materials" article ● Ch.1, Day 4, **Activity: Analyzing Incubator Material,** Instructional Guide (steps 1–11) and Teacher Support tab ("Rationale, Connection to Crosscutting Concept of Structure and Function") ***Chemical Reactions*** unit*:* ● Lesson 2.1, **Activity 5,** Student View, and "Synthetic Materials: Making Substances in the Lab" article		
CCC	***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and**	***Phase Change*** unit*:* ● Lesson 1.2, **Activity: Investigating Methane on Titan,** Instructional Guide (steps 1–6) and Studying a Distant Moon video ***Light Waves*** unit*:* ● Lesson 1.2, **Activity: Interview with a Spectroscopist,** Interview with a Spectroscopist video		

	Technology on Society and the Natural World ■ Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)			
CCC	***Connections to Nature of Science*** **Science is a Human Endeavor** ■ Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–3) ***Chemical Reactions*** unit*:* ● Lesson 2.3, **Activity 5,** Student View, Teacher Support tab (“Rationale, Pedagogical Goals: Understanding the Nature of Science”), and “Meet a Scientist Who Preserves Artwork” article ***Phase Change*** unit*:* ● Lesson 1.2, **Activity: Investigating Methane on Titan,** Instructional Guide (steps 1–6) and Studying a Distant Moon video ***Light Waves*** unit: ● Lesson 1.2, **Activity: Interview with a Spectroscopist**, Interview with a Spectroscopist video		

MS-ETS1 Engineering Design

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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, and 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,	***Phase Change Engineering Internship*** unit*:* • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–12), Welcome to Futura video, and Teacher Support tab (“Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria”) • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9) and Teacher Support tab (“Instructional Suggestion: Providing More Support: Examples of Constraints and Criteria”) ***Force and Motion Engineering Internship*** unit*:* • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, and 11–14), Welcome to Futura video, and Teacher Support tab (“Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria”) • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–6) and Teacher Support tab (“Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria”)	**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.**	[DCI, SEP] ***Phase Change Engineering Internship***: • Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab • Ch.1, Day 7**, Lesson Brief**, Digital Resources, “Printable Proposal Rubric” ***Force and Motion Engineering Internship*** unit*:* • Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab • Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric copymaster”

	including scientific knowledge that may limit possible solutions. (MS-ETS1-1)			
DCI	**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)	***Phase Change Engineering Internship*** unit*:* • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–12), Welcome to Futura video, and Teacher Support tab ("Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria") • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9) and Teacher Support tab ("Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria") ***Force and Motion Engineering Internship*** unit*:* • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, and 11–14), Welcome to Futura video, and Teacher Support tab ("Rationale, Engineering Note: Understanding the Difference Between Constraints and Criteria" and "Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria," and "Instructional Suggestion, Engineering Note: Examples of Constraints") • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–6) and Teacher Support tab ("Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria")		

CCC	**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) ■ 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,	***Chemical Reactions*** unit*:* • Lesson 2.1, **Activity 5,** Student View, and "Synthetic Materials: Making Substances in the Lab" article ***Light Waves*** unit*:* • Lesson 3.6, **Activity 2,** Instructional Guide (steps 1–12) ***Phase Change Engineering Internship*** : • Ch.1, Day 1, **Activity: Introducing Futura,** Instructional Guide (steps 2–7, 11–12), Welcome to Futura video, and Teacher Support tab ("Instructional Suggestion, Pedagogical Goals: Pre-thinking about Criteria") • Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9) and Teacher Support tab ("Instructional Suggestion, Providing More Support: Examples of Constraints and Criteria")		

	natural Resources, “and economic conditions. (MS-ETS1-1)			

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		Publisher Citations	Performance Expectation	Publisher Citations
SEP	**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	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster” ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–7) and Possible Responses tab ● Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–6) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 5, **Activity: Analyzing Designs,** Instructional Guide (steps 1–3) ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and BabyWarmer Design Tool ● Ch.1, Day 7	**MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**	[DCI, SEP] ***Phase Change Engineering Internship***: ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7**, Lesson Brief**, Digital Resources, “Printable Proposal Rubric” ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric copymaster”

	developed and agreed-upon design criteria. (MS-ETS1-2)	○ **Activity: Outlining Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster" ● Lesson 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9)		
DCI	**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)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Lesson Brief**, Digital Resources, "Video: Engineering Tip: Analyzing Data" ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–7) and Possible Responses tab ● Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–6) ***Phase Change Engineering Internship***: ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 7, **Activity: Outlining Design Decisions,** Instructional Guide		

		(steps 1–6) and Possible Responses tab ● Ch.1, Day 10, **Activity: Applying Engineering Skills,** Instructional Guide (steps 1–9)		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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)	***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 5, **Activity: Analyzing Results,** Instructional Guide (steps 1–4) and Engineering Tip: Analyzing Data video ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster” ***Magnetic Fields*** unit*:* ● Lesson 3.3 ○ **Activity 2,** screen 1 of 2, Instructional Guide (steps 1–7) and Student View ○ **Lesson Brief**, Digital Resources, “USA Evidence Cards copymaster” ***Light Waves*** unit*:* ● Lesson 2.5, **Activity 3,** screens 1–3 of 3, Instructional Guide and Student View ***Chemical Reactions*** unit*:*	**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.**	[DCI, SEP] ***Phase Change Engineering Internship***: ● Ch.1, Day 9 **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric” ● Ch.1, Day 8, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric” ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric copymaster”

		● Lesson 1.3, **Activity 3,** Instructional Guide (steps 6–11) ***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 6, **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and BabyWarmer Design Tool		
DCI	**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) ■ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)	***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster” ● Ch.1, Day 5, **Activity: Analyzing Results,** Instructional Guide (steps 1–4) and Engineering Tip: Analyzing Data video ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab ***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 5: ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ○ **Activity: Analyzing Designs,** Instructional Guide (steps 1–7) ● Ch.1, Day 6 ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5)		

		○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ● Ch.1, Day 7, **Activity: Outlining Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab		
DCI	**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)	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 1, **Lesson Brief**, Digital Resources, “Video: Engineering Tip: Optimal Designs” ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ○ **Activity: Analyzing Designs,** Instructional Guide (steps 1–6) ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 4, ○ **Activity: Investigating SupplyDrop,** Instructional Guide (steps 1–8) and SupplyDrop Design Tool ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster” ● Ch.1, Day 5 ○ **Activity: Analyzing Results**,		

		Instructional Guide (step 1–4) and Engineering Tip: Analyzing Data video ○ **Lesson Brief**, Digital Resources, “Results Analysis copymaster” ● Ch.1, Day 6, ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool ● **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster”		

Science and Engineering Practices Disciplinary Core Ideas Crosscutting Concepts		**Publisher Citations**	**Performance Expectation**	**Publisher Citations**
SEP	**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	***Phase Change Engineering Internship*** unit*:* ● Ch.1, Day 5 ○ **Activity: Analyzing Designs,** Teacher Support tab (“Instructional Suggestion, Going Further: Developing Models”) ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster” ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 1, **Lesson Brief,** Digital Resources, “Video: Engineering Tip: Using Models”	**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.**	[DCI, SEP] ***Phase Change Engineering Internship***: ● Ch.1, Day 9, **Activity: Finalizing the Proposal**, Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric” ***Force and Motion Engineering Internship*** unit*:* ● Ch.1, Day 9, **Activity: Finalizing the Proposal,** Possible Responses tab ● Ch.1, Day 7, **Lesson Brief**, Digital Resources, “Printable Proposal Rubric copymaster”

	designed systems, including those representing inputs and outputs (MS-ETS1-4)	• Ch.1, Day 2, **Activity: Egg Drop Challenge,** Instructional Guide (steps 1–7) • Ch.1, Day 3, **Activity: Revising the Egg Drop Model Designs,** Instructional Guide (steps 1–9)		

DCI	**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)
	▪ Models of all kinds are important for testing solutions. (MS-ETS1-4)
		Phase Change Engineering Internship unit*:*
		• **Unit Guide,** Unit Overview
		• Ch.1, Day 1
		  ○ **Activity: Exploring BabyWarmer**, Instructional Guide (steps 1–5) and BabyWarmer Design Tool
		• Ch.1, Day 4, **Activity: Using Models**, Instructional Guide (steps 1–3) and Engineering Tip: Using Models video
		• Ch.1, Day 5
		  ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool
		  ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster”
		  ○ **Activity: Analyzing Designs,** Instructional Guide (steps 1–7) and Teacher Support tab (“Instructional Suggestion, Going Further: Developing Models”)
		• Ch.1, Day 6
		  ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and BabyWarmer Design Tool
		  ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster”
		• Ch.1, Day 7, **Activity: Outlining Design Decisions,** Instructional Guide		

		(steps 1–6) and Possible Responses tab ***Force and Motion Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 1, **Activity: Exploring SupplyDrop**, Instructional Guide (steps 1–4) and SupplyDrop Design Tool ● Ch.1, Day 2, **Activity: Egg Drop Challenge**, Instructional Guide (steps 1–8) ● Ch.1, Day 4 ○ **Activity: Investigating SupplyDrop,** Instructional Guide (steps 1–8) ○ **Lesson Brief**, Digital Resources, "SupplyDrop Data copymaster" ● Ch.1, Day 5, **Activity: Analyzing Results,** Instructional Guide (steps 1–4) and Engineering Tip: Analyzing Data video ● Ch.1, Day 8, **Activity: Revising Design Decisions,** Instructional Guide (steps 1–6) and Possible Responses tab		
DCI	**ETS1.C: Optimizing the Design Solution** ■ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of	***Phase Change Engineering Internship*** unit*:* ● **Unit Guide**, Unit Overview ● Ch.1, Day 1, **Lesson Brief**, Digital Resources, "Video: Engineering Tips: Optimal Designs" ● Ch.1, Day 5 ○ **Activity: Testing Incubator Designs,** Instructional Guide (steps 1–3) and BabyWarmer Design Tool ○ **Lesson Brief**, Digital Resources, "BabyWarmer Data copymaster" ○ **Activity: Analyzing Designs,** Instructional Guide (steps 1–6)		

	the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	• Ch.1, Day 6
		  ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5)
		  ○ **Lesson Brief**, Digital Resources, “BabyWarmer Data copymaster**”**
		
		Force and Motion Engineering Internship unit*:*
		• **Unit Guide**, Unit Overview
		• Ch.1, Day 4,
		  ○ **Activity: Investigating SupplyDrop,** Instructional Guide (steps 1–8) and SupplyDrop Design Tool
		  ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster”
		• Ch.1, Day 5
		  ○ **Activity: Analyzing Results**, Instructional Guide (step 1–4) and Engineering Tip: Analyzing Data video
		  ○ **Lesson Brief**, Digital Resources, “Results Analysis copymaster”
		• Ch.1, Day 6
		  ○ **Activity: Testing Final Designs,** Instructional Guide (steps 1–5) and SupplyDrop Design Tool
		  ○ **Lesson Brief**, Digital Resources, “SupplyDrop Data copymaster”		