A Correlation of

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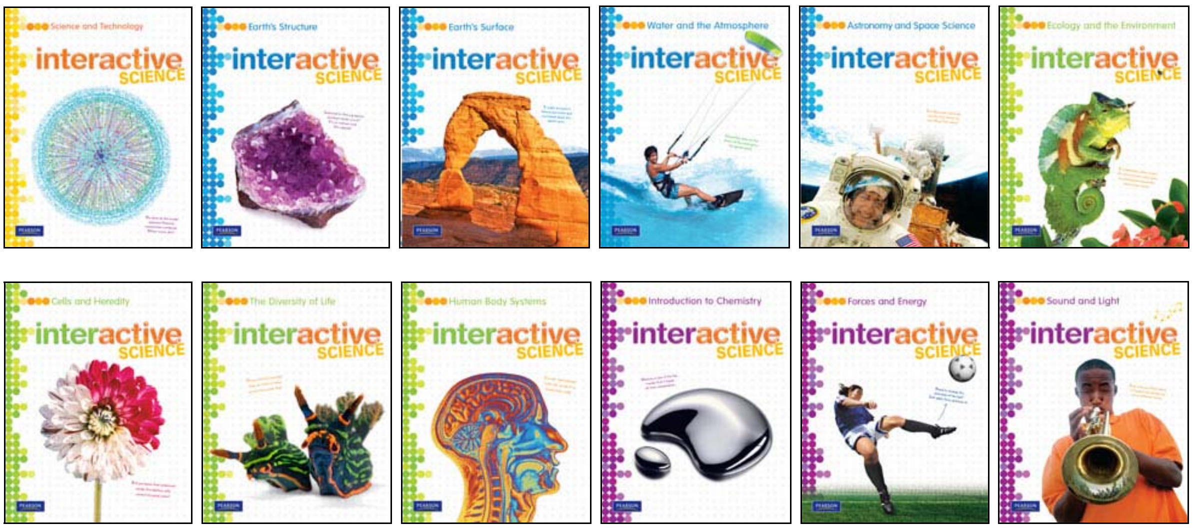

To the

Next Generation Science Standards
May, 2013

Grades 6-8

Dear Educator,

As we embark upon a new and exciting science journey, Pearson is committed to offering its complete support as classrooms transition to the new Next Generation Science Standards (NGSS). Ready-to-use solutions for today and a forward-thinking plan for tomorrow connect teacher education and development, curriculum content and instruction, assessment, and information and school design and improvement. We'll be here every step of the way to provide the easiest possible transition to the NGSS with a coherent, phased approach to implementation.

Pearson has long-standing relationships with contributors and authors who have been involved with the development and review of the Next Generation Science Frameworks and subsequent Next Generation Science Standards. As such, the spirit and pedagogical approach of the NGSS initiative is embedded in all of our programs, such as ***Interactive Science.***

The planning and development of Pearson's ***Interactive Science*** was informed by the same foundational research as the NGSS Framework. Specifically, our development teams used Project 2061, the National Science Education Standards (1996) developed by the National Research Council, as well as the Science Anchors Project 2009 developed by the National Science Teachers Association to inform the development of this program. As a result, students make connections throughout the program to concepts that cross disciplines, practice science and engineering skills, and build on their foundational knowledge of key science ideas.

Interactive Science is a middle school science program composed of twelve student modules spanning life, earth, physical, and nature topics that makes learning personal, engaging, and relevant for today's student. ***Interactive Science*** features an innovative Write-in Student Edition that enables students to become active participants in their learning and truly connect the Big Ideas of science to their world.

Interactive Science Modules

Science and Technology	Human Body Systems	Earth's Structure
Ecology and the Environment	Introduction to Chemistry	Earth's Surface
Cells and Heredity	Forces and Energy	Water and the Atmosphere
The Diversity of Life	Sound and Light	Astronomy and Space Science

The following document demonstrates how ***Interactive Science,* ©2011, Grades 6-8,** supports the Next Generation Science Standards (NGSS). Correlation references are to the Student Editions, Teacher Editions, and Teacher Lab Resources, as well as to the following ancillary books: *Chapter Activities and Projects, Scenario-Based Investigations*, and *STEM Activity Book.*

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Table of Contents

MS.Structure and Properties of Matter
MS-PS1-1

Students who demonstrate understanding can:

Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

INTERACTIVE SCIENCE: Diagrams describing the atomic composition of methane molecules, oxygen molecules, carbon dioxide molecules, and water molecules are shown in "Figure 5: Conservation of Mass" on SE/TE page 25 of the *Introduction to Chemistry* module. An overview of the concepts of atoms and molecules is included on page 10 in Chapter 1, Lesson 2, "Classifying Matter." Models showing the atomic structure of water molecules in different phases are shown in "Figure 1: Melting" on SE/TE page 49. The use of chemical symbols and chemical formulas as a way to model compounds is described in the section "How Are the Formulas and Names of Ionic Compounds Written?" on SE/TE pages 134–135. Models describing the atomic composition of water and sodium chloride are included in "Figure 6: A Sea of Bonding" on SE/TE pages 144–145.

A model describing the extended atomic structure of DNA is shown in "Figure 1: DNA" on SE/TE page 97 of the *Introduction to Chemistry* module. The structure of DNA is also described in Chapter 4, Lesson 1, "The Genetic Code" on SE/TE pages 108-113 of the *Cells and Heredity* module. Models of DNA, mRNA, and proteins are described in "Figure 2: Protein Synthesis" on SE/TE pages 116–117.

Students **interpret diagrams** showing the atomic composition of simple molecules in "Figure 1: Atoms and Molecules" on SE/TE page 10 of the *Introduction to Chemistry* module. Students **make models** to illustrate chemical reactions involving simple molecules in "Differentiated Instruction: Jellybean Reaction" on TE page 25. Students use chemical formulas to **develop models** of simple molecules in the Apply It! on SE/TE page 135. Students use stick-and-ball building kits to **develop models** of simple molecules in "Differentiated Instruction: Visualizing Molecules" on TE page 145. Students **develop models** of simple molecules when they draw nitrogen molecules and hydrogen molecules in the Apply It! on SE/TE pages 172–173. Students **use models** that describe the atomic composition of DNA in "Figure 4: DNA Replication" on SE/TE pages 112–113 of the *Cells and Heredity* module. Students **use models** describing protein synthesis on SE/TE pages 116–117. Students **use models** to describe the atomic structure of a water molecule in "Modeling Atoms and Molecules" on page 13 of the TLR *Introduction to Chemistry.* They **use models** to describe the atomic composition of DNA in "Modeling the Genetic Code" on page 102 of the TLR *Cells and Heredity.* They **model** DNA and RNA in "What Is RNA" on TLR page 103. They **develop models** of compounds in "Models of Compounds" on pages 346–350 of the *Chapter Activities and Projects* book.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Introduction to Chemistry** **SE/TE:** 10, Figure 1 – Atoms and	**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. **MODULE: Introduction to Chemistry** **SE/TE:** 8–13, Classifying Matter 80–87, Organizing the Elements	**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. **MODULE: Introduction to Chemistry** **SE/TE:** 49, Figure 1 – Melting 127, Apply It!

Molecules 135, Apply It! 173, Apply It! 176–177, Balancing Chemical Equations **TE Only:** 25, Differentiated Instruction – L1 Jellybean Reaction 145, Differentiated Instruction – L1 Visualizing Molecules 173, Differentiated Instruction – Jellybean Equation 181E, Describing Chemical Reactions 181F, Describing Chemical Reactions **TLR:** 13, Modeling Atoms and Molecules 148, Did You Lose Anything? 149, Information in a Chemical Equation 150, Is Matter Conserved? **MODULE: Cells and Heredity** **SE/TE:** 112–113, Figure 4: DNA Replication 116–117, Figure 2: Protein Synthesis **TLR:** 102, Modeling the Genetic Code 103, What Is RNA? 104, Modeling Protein Synthesis 105 Oops! **Chapter Activities and Projects:** 346–350, Models of Compounds	84–85, Figure 4: The Periodic Table 92–95, How Are Metals Classified? 99–103, What Are the Families Containing Nonmetals? 125-129, Atoms, Bonding, and the Periodic Table 130–137, Ionic Bonds 132, Figure 3 – Formation of an Ionic Bond 138–145, Covalent Bonds 140, Figure 2 – Covalent Bonds 144–145, Figure 6 – A Sea of Bonding 146–151, Bonding in Metals **TE Only:** 9, Build Inquiry – Elements Everywhere 10, 21st Century Learning 13, Differentiated Instruction – L3 All About Matter 13, Build Inquiry – Getting the Iron Out 92, Teacher Demo – Differentiate Alkali Metals 95, Differentiated Instruction – L3 Alloys 103, Differentiated Instruction – L3 Computer Chips 137, Enrich – Ionic Bonds 145, Differentiated Instruction – L3 Carbon Chains 145F, Enrich – Covalent Bonds **TLR:** 108, Element Chemistry ▪ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals) **MODULE: Introduction to Chemistry** **SE/TE:** 41–42, How Do You Describe a Solid? 42, Figure 2 – Types of Solids 136, Ionic Crystals 147, What Is the Crystal Structure of a Metal? **TE Only:** 41, Build Inquiry–Observe Crystals 42, Teacher Demo–Classify Solids **TLR:** 40, Modeling Particles	137F, Enrich – Pulling Away Electrons 139, Figure 1 – Electron Sharing 140, Figure 2 – Covalent Bonds 144 Figure 5 – Nonpolar and Polar Molecules 145–146, Figure 6 – A Sea of Bonding 147, Figure 1 – Metallic Bonding 173, Apply It! **TE Only** 53, Differentiated Instruction – Diagram Changes 127, Differentiated Instruction – L1 Electron Dot Diagrams 145F, Enrich – Oil Spills 151, Differentiated Instruction – L1 Alloys 151D, Review and Reinforce – Bonding in Metals **TLR:** 40, Modeling Particles 109, How Do Ions Form? 122, Sharing Electrons

MS.Structure and Properties of Matter
MS-PS1-3

Students who demonstrate understanding can:

Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

INTERACTIVE SCIENCE: Students **make sense of information** to describe how some detergents have a beneficial impact on society in "Enrich: Oil Spills" on TE page 145F of the *Introduction to Chemistry* module. Students **research** synthetic glassy metals and **evaluate the impact on society** of these materials in "Sci-Fi Metal" on SE/TE page 157. Students **make sense of information** about fuel cells when they answer the questions in "Figure 6: How Can Chemical Reactions Generate Speed?" on SE/TE pages 178–179. Students **learn** that many detergents use a nonrenewable natural resource (petroleum) as a basis in "Can You Be Clean and Green?" on SE/TE page 193. Students **research** surfactants to **gather and make sense of information** related to the claims of detergent manufacturers in "Think Like a Scientist" on TE page 193.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. ▪ Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. **MODULE: Introduction to Chemistry** **TE Only:** 157, Technology and Society 193, Think Like a Student	**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. *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* **MODULE: Introduction to Chemistry** **SE/TE:** 5–7, What Properties Describe Matter? 9, Elements 19, Figure 4 – Using Density 80–87, Organizing the Elements 88–95, Metals 93, Do the Math! 96–103, Nonmetals and Metalloids 118, Discovery of the Elements 124–129, Atoms, Bonding, and the Periodic Table **TE Only:** 87F, Enrich – Properites of a "Missing" Element 92, Teacher Demo – Differentiating Alkalai Metals 95E, Enrich – More Properties of Metals 137, Differentiated Instruction – L3 Melting Points **TLR:** 79–87, Copper or Carbon? That Is the Question	**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. **MODULE: Introduction to Chemistry** **SE/TE:** 146, My Planet Diary – Superconductors 148–149, Figure 2: Properties of Metals 150, Apply It! 151, Alloys 157, Sci-Fi Metal 182, My Planet Diary – Up in Flames **TE Only:** 157, Technology and Society **MODULE: Forces and Energy** **SE/TE:** 152, Aerogel Windows 153, Thermal Expansion **TE Only:** 147E, Enrich – Thermostats 152, Frontiers and Technology 153, Everyday Science

	90, Carbon—A Nonmetal 108, Element Chemistry 112–120, Shedding Light on Ions 123, Properties of Molecular Compounds 126, Metal Crystals 127, What Do Metals Do? 176, Does It Dissolve? 183, pHone Home **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. *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.)* **MODULE: Introduction to Chemistry** **SE / TE:** 165, Bonding and Chemical Change 165, Figure 3: Breaking and Making Bonds 173, Apply It! 174–177, How Is Mass Conserved During a Chemical Reaction? 180–181, What Are the Three Types of Chemical Reactions? 180, Apply It! 213–214, What Are the Properties of Acids? 215–217, What Are the Properties of Bases? 222–223, What Are the Products of Neutralization? 229, Limestone and Acid Drainage **TE Only:** 168, Teacher Demo – A Toaster Reaction 181, Build Inquiry – The Disappearing Penny 187E, Enrich – Flameless Ration Heaters **TLR:** 137, What Happens When Chemicals React? 138, Observing Change 148, Did You Lose Anything? 180, Properties of Acids 181, Properties of Bases 182, What Can Cabbage Juice Tell You?	**MODULE: Sound and Light** **SE / TE:** 16, My Planet Diary – The Fall of Galloping Gertie --- ***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. **MODULE: Introduction to Chemistry** **SE / TE:** 146, My Planet Diary – Superconductors 157, Sci-Fi Metal 178–179, Figure 6 – How Can Chemical Reactions Generate Speed? **MODULE: Forces and Energy** **TE Only:** 147E, Enrich – Thermostats **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. **MODULE: Introduction to Chemistry** **TE Only :** 145F, Enrich – Oil Spills 179, Differentiated Instruction – L3 Fuel Cells: Present and Future **MODULE: Forces and Energy** **SE / TE:** 130, Charge It! **TE Only:** 130, Museum of Science

MS.Structure and Properties of Matter
MS-PS1-4

Students who demonstrate understanding can:

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

INTERACTIVE SCIENCE: Background on the states of matter is presented in the *Introduction to Chemistry* module, Chapter 2, "Solids, Liquids, and Gases." In Lesson 1, SE/TE pages 40-47, solid, liquid, and gas are defined and discussed. The arrangement of particles in solids is discussed in "How Do You Describe a Solid" on SE/TE page 41. The arrangement of particles in liquids is discussed in "How Do you Describe a Liquid" on SE/TE page 43. The arrangement of particles in gases is discussed in "How Do you Describe a Gas?" on SE/TE page 45. On SE/TE page 47, the effect of temperature upon a gas is discussed. In Lesson 2, SE/TE pages 48-55, changes of state and the relationship to change in temperature and particle motion is presented. In Lesson 3, SE/TE pages 56-59, the effect on pressure and volume in gases as temperature changes is presented.

Students **use models** of particles in melting ice cubes in "Figure 1: Melting" on SE/TE page 49. Students **develop models** to describe changes in particle motion as particles move from one state to another in "Differentiated Instruction: Diagram Changes" on TE page 53. Students **use models** of gas particles at low and temperatures in "Figure 1: Temperatures and Gas Pressures" on SE/TE page 57 and "Figure 3: Charles's Law" on SE/TE page 58. Students **explain** how a change in thermal energy relates to the motion of particles during a change of state in "Figure 5: The Changing States of Water" on SE/TE pages 54–55. Students **form a hypothesis** about change in state in "What Happens When You Breathe on a Mirror?" on TLR page 43. In "Melting Ice" on TLR pages 44-52, students **form a hypothesis** about the source of thermal energy that causes ice to melt. In "Keeping Cool," on TLR page 53, students **observe** the effect on the temperature of a liquid as it evaporates. In "Observing Sublimation," on TLR page 54, students **observe** the effect on the temperature of the surrounding liquid as dry ice sublimates. In "How Are Pressure and Temperature Related?," TLR page 56, and in "Hot and Cold Balloons," on TLR page 57, students indirectly **observe** the relationship between temperature and the speed of molecules in a gas.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Introduction to Chemistry** **SE/TE Only:** 49, Figure 1 – Melting 57, Figure 1 – Temperature and Gas Pressure 58, Figure 3 – Charles's Law **TE Only:** 45, Differentiated Instruction – L1 Model Gases 46, Teacher to Teacher	**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. **MODULE: Introduction to Chemistry** **SE/TE:** 40-47, States of Matter 48-55, Changes of State 56-59 Gas Behavior **TE Only:** 53, Differentiated Instruction – Diagram Changes 55, Differentiated Instruction – Diagram Changes in State **TLR:** 56, How are Pressure and	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. **MODULE: Introduction to Chemistry** **SE/TE Only:** 49–50, What Happens to the Particles of a Solid as It Melts? 51–52, What Happens to the Particles of a Liquid When It Vaporizes? 53, What Happens to the Particles of a Solid as It Sublimes? 54–55, Figure 5: The Changing States of Water 56–57, How are Pressure and Temperature of a Gas Related? 58–59, How are Volume and

47, Differentiated Instruction – L1 Temperature and Movement of Particles 53, Differentiated Instruction – L1 Diagram Changes **TLR:** 43, What Happens When You Breathe on a Mirror?	Temperature Related? 57, Hot and Cold Balloons ▪ 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. **MODULE: Introduction to Chemistry** **SE/TE:** 40-47, States of Matter 41, Figure 1 – Solid 43, Figure 3 – Liquid 45, Figure 5 – Gas 48-55, Changes of State 56-59, Gas Behavior **TE Only:** 41, Build Inquiry – Observe Crystals 45, Address Misconceptions 45, Differentiated Instruction **TLR:** 39, What Are Solids, Liquids, and Gases? 56, How Are Pressure and Temperature Related? 57, Hot and Cold Balloons ▪ The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **MODULE: Introduction to Chemistry** **SE/TE:** 48-55, Changes of State 49, Figure 1 – Melting 51, Figure 2 – Types of Vaporization 56-59, Gas Behavior 57, Figure 1 – Temperature and Gas Pressure 58, Figure 3 – Charles's Law **TE Only:** 51, Build Inquiry - Evaporation **TLR:** 44-52, Melting Ice 53, Keeping Cool 54, Observing Sublimation	Temperature of a Gas Related? 66, Scuba Diving **TE Only:** 52, Differentiated Instruction – L3 Defrosters 55, Differentiated Instruction – L1 Changing the Freezing Point of Water **TLR:** 43, What Happens When You Breathe on a Mirror? 53, Keeping Cool 54, Observing Sublimation 56, How Are Temperature and Pressure Related? 57, Hot and Cold Balloons

	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 fron 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)* **MODULE: Introduction to Chemistry** **SE/TE:** 26, Temperature, Thermal Energy 27, Thermal Energy and Changes in Matter 47, Temperature 149, Thermal Conductivity **TE Only:** 27, Differentiated Instruction 47, 21st Century Learning **MODULE: Forces and Energy** **SE/TE:** 139, Heat 139, Vocabulary Skill 139, Figure 2 – Heat 140–143, The Transfer of Heat 141, Figure 1 – Heat Transfer **TE Only:** 138, Teacher to Teacher ▪ The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)* **MODULE: Introduction to Chemistry** **SE/TE:** 26, Temperature and Thermal Energy 47, Temperature 49–51, What Happens to the Particles of a Solid as It Melts? 50, Apply It! 51–52, What Happens to Particles of a Liquid as It Vaporizes?	

	TE Only: 47, Differentiated Instruction – L1 Temperature and Movement of Particles **TLR:** 53, Keeping Cool **MODULE: Forces and Energy** **SE/TE:** 118, Thermal Energy 136–139, Temperature, Thermal Energy, and Heat 138, Apply It! **TE Only:** 138, Teach Key Concepts **TLR:** Temperature and Thermal Energy	

MS.Chemical Reactions
MS-PS1-2

Students who demonstrate understanding can:

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 HCl.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

INTERACTIVE SCIENCE: Change in physical and chemical properties is discussed in the *Introduction to Chemistry* module in Chapter 5, Lesson 1, "Observing Chemical Change," on SE/TE pages 163-167. On page 163, students **learn** about the chemical changes to a copper penny that becomes tarnished. On page 165, students **contrast** the properties of the reactants oxygen and magnesium with the properties of the product magnesium oxide. Students **explain** why the formation of table salt from sodium and chlorine is a chemical reaction in "Differentiated Instruction: Table Salt" on TE page 165. Students **research** the chemical reaction that happens when fruits ripen in "Differentiated Instruction: Ripening" on TE page 165. Students **interpret data** on the chemical reaction that occurs when vinegar is added to baking soda in "Teacher Demo: Hopping Corn" on TE page 167. They **interpret data** on the chemical reaction that occurs when bread is toasted in "Teacher Demo: A Toaster Reaction" on TE page 168.

Students **use data** to **explain** chemical reactions and **compare** properties in "What Happens When Chemicals React?" on TLR page 137 and in "Observing Change" on TLR page 138. In "Where's the Evidence?" on TLR pages 139-147, students **observe** three different chemical reactions and **record** their observations of changes in properties from reactants to products.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Introduction to Chemistry** **SE/TE:** 184, Figure 2 – Graphs of Exothermic and Endothermic Reactions 187, Figure 5 – Catalysts **TE Only:** 187, Build Inquiry – Comparing Reaction Rates 187D, Review and Reinforce – Controlling Chemical Reactions **TLR:** 139–147, Where's the Evidence? 152, Can You Speed Up or Slow Down a Reaction? 153, Modeling Activation Energy	**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. *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* **MODULE: Introduction to Chemistry** **SE/TE:** 5–7, What Properties Describe Matter? 9, Elements 19, Figure 4 – Using Density 80–87, Organizing the Elements 88–95, Metals 93, Do the Math! 96–103, Nonmetals and Metalloids 118, Discovery of the Elements 124–129, Atoms, Bonding, and the Periodic Table **TE Only:** 87F, Enrich – Properties of a "Missing" Element 92, Teacher Demo – Differentiating Alkalai Metals	**Patterns** ▪ Macroscopic patterns are related to the nature of microscopic and atomic-level structure. **MODULE: Introduction to Chemistry** **SE/TE:** 80–87, Organizing the Elements 92–95, How Are Metals Classified? 96–105, Nonmetals and Metalloids 136–137, What Are Properties of Ionic Compounds? 141–142, What Are Properties of Molecular Compounds? 148–149, What Are Properties of Metals? 148–149, Figure 2: Properties of Metals 163-167, Observing Chemical Change **TE Only:** 87F, Enrich – Properties of a "Missing" Element 95E, Enrich – Metals

154, Effect of Temperature on Chemical Reactions ------------------------------------ ***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) **MODULE: Introduction to Chemistry** **SE/TE:** 166-169, How Do You Identify a Chemical Reaction? **TE Only:** 167, Teacher Demo—Hopping Corn 167, Differentiated Instruction – L1 Changes in Wood 167, 21st Century Learning **TLR:** 138, Observing Change 139-147, Where's the Evidence?	95E, Enrich – More Properties of Metals 137, Differentiated Instruction – L3 Melting Points **TLR:** 79–87, Copper or Carbon? That Is the Question 90, Carbon—A Nonmetal 108, Element Chemistry 112–120, Shedding Light on Ions 123, Properties of Molecular Compounds 126, Metal Crystals 127, What Do Metals Do? 176, Does It Dissolve? 183, pHone Home **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. *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* **MODULE: Introduction to Chemistry** **SE/TE:** 165, Bonding and Chemical Change 165, Figure 3: Breaking and Making Bonds 173, Apply It! 174–177, How Is Mass Conserved During a Chemical Reaction? 180–181, What Are the Three Types of Chemical Reactions? 180, Apply It! 213–214, What Are the Properties of Acids? 215–217, What Are the Properties of Bases? 222–223, What Are the Products of Neutralization? 229, Limestone and Acid Drainage **TE Only:** 168, Teacher Demo – A Toaster Reaction 181, Build Inquiry – The Disappearing Penny 187E, Enrich – Flameless Ration Heaters	137F, Enrich – Pulling Away Electrons 165, Differentiated Instruction – L1 Table Salt 167, 21st Century Learning **TLR:** 77, Expanding the Periodic Table 92, How Much Goes Away 107, What Are the Trends in the Periodic Table? 122, Sharing Electrons 123, Properties of Molecular Compounds 137, What Happens When Chemicals React? 138, Observing Change 139-147, Where's the Evidence?

	TLR: 137, What Happens When Chemicals React? 138, Observing Change 148, Did You Lose Anything? 180, Properties of Acids 181, Properties of Bases 182, What Can Cabbage Juice Tell You?	

MS.Chemical Reactions
MS-PS1-5

Students who demonstrate understanding can:

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter, and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

INTERACTIVE SCIENCE: The concept of conservation of mass is explored in the *Introduction to Chemistry* module, Chapter 1, Introduction to Matter, "Conservation of Mass," SE/TE page 25 and Chapter 5, Chemical Reactions, "How Is Mass Conserved During a Chemical Reaction?," SE/TE pages 174-177.

In "Figure 5: Conservation of Mass" on SE/TE page 25, students **use models** of molecules to show how mass is conserved when methane and oxygen react to produce carbon dioxide and water. Students **develop and use a model** in "Differentiated Instruction: Visualizing Conservation of Mass" on TE Page 25. Students **use models** to describe the conservation of mass in "Differentiated Instruction: Jellybean Reaction" on TE page 25. On SE/TE page 177, students **use models** of molecules to balance a chemical equation for hydrogen and oxygen forming and demonstrate conservation of mass. Students **model** conservation of mass using coins in "Did You Lose Anything?" on TLR page 148 and using bolts and nuts in "Is Matter Conserved?" on TLR page 150.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe unobservable mechanisms.

MODULE: Introduction to Chemistry
SE/TE:
25, Figure 5 – Conservtion of Mass
177, Balancing Chemical Equations

TE Only:
25, Differentiated Instruction – L1 Visualizing Conservation of Mass
25, Differentiated Instruction – L1 Jellybean Reaction
175, Build Inquiry – Still There
177, Build Inquiry – A Balancing Act

TLR:
148, Did You Lose Anything?
150, Is Matter Conserved?

Disciplinary Core Ideas

PS1.B: Chemical Reactions
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)*

MODULE: Introduction to Chemistry
SE/TE:
165, Bonding and Chemical Change
165, Figure 3: Breaking and Making Bonds
173, Apply It!
180–181, What Are the Three Types of Chemical Reactions?
180, Apply It!
213–214, What Are the Properties of Acids?
215–217, What Are the Properties of Bases?
222–223, What Are the Products of Neutralization?
229, Limestone and Acid Drainage

TE Only:
25, Teacher Demo – Conservation of Mass

Crosscutting Concepts

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

MODULE: Introduction to Chemistry
SE/TE:
25, Figure 5 – Conservation of Mass
174–177, How Is Mass Conserved During a Chemical Reaction?

TE Only:
25, Teacher Demo – Conservation of Mass
175, Differentiated Instruction – L3 Conservation of Matter
175, Differentiated Instruction – L3 Lavoisier's Experiment
175, Build Inquiry – Still There
177, Differentiated Instruction
177, Build Inquiry – A Balancing Act

TLR:
148, Did You Lose Anything?
150, Is Matter Conserved?
174, How is Mass Conserved During a Chemical Reaction?
176-177, Balancing Chemical Equations

_____________________________ ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ Laws are regularities or mathematical descriptions of natural phenomena. **MODULE: Introduction to Chemistry** **SE/TE:** 24, Conservation of Mass 24, Figure 5: Conservation of Mass 174–177, How Is Mass Conserved During a Chemical Reaction? 178–179, Figure 6 – How Can Chemical Reactions Generate Speed? **TE Only:** 25, Teacher Demo – Conservation of Mass 175, Differentiated instruction – L1 Conservation of Mass 175, Differentiated Instruction – L3 Lavoisier's Experiment 175, Build Inquiry – Still There **TLR:** 148, Did You Lose Anything? 150, Is Matter Conserved?	175, Differentiated instruction – L1 Conservation of Mass 175, Differentiated Instruction – L3 Lavoisier's Experiment 175, Build Inquiry – Still There **TLR:** 137, What Happens When Chemicals React? 138, Observing Change 180, Properties of Acids 181, Properties of Bases 182, What Can Cabbage Juice Tell You? ▪ The total number of each type of atom is conserved, and thus the mass does not change. **MODULE: Introduction to Chemistry** **SE/TE:** 25, Figure 5 – Conservation of Mass 174–177, How Is Mass Conserved During a Chemical Reaction? **TE Only:** 25, Teacher Demo – Conservation of Mass 175, Differentiated Instruction 175, Build Inquiry – Still There 177, Differentiated Instruction 177, Build Inquiry – A Balancing Act **TLR:** 148, Did You Lose Anything? 150, Is Matter Conserved? 174, How is Mass Conserved During a Chemical Reaction? 176-177, Balancing Chemical Equations	

MS.Chemical Reactions
MS-PS1-6

Students who demonstrate understanding can:

Undertake a design process to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

INTERACTIVE SCIENCE: Endothermic and exothermic reactions are explored in the *Introduction to Chemistry* module in Chapter 5, Lesson 1, “Observing Chemical Change,” in “Changes in Energy,’ on pages SE/TE 168-169. In the Do the Math! feature on SE/TE page 169, students **graph** and **interpret** data to determine if a reaction was exothermic or endothermic. In “Figure 6: How Can Chemical Reactions Generate Speed?”, students **explain** the chemical reactions that release energy in a fuel cell.

In the *Cells and Heredity* module, Chapter 2, “Cell Processes and Energy,” students **obtain information** about the chemical reactions for photosynthesis on SE/TE page 49, and cellular respiration on SE/TE page 52. These are described in terms of releasing energy when complex molecules are broken down and absorbing energy when simple molecules are combined.

Students **design, construct, test, and modify** a closed reaction chamber that absorbs thermal energy in “Design and Build a Closed Reaction Chamber” on pages 353–357 of the *Chapter Activities and Projects* book. Students **explore** the chemical reactions and thermal consequences when natural gas burns in “The Pipeline Is Burning” on pages 152–153 of the *Scenario-Based Investigations* book.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Science and Technology** **SE/TE:** 128, Apply It! **Chapter Activities and Projects** 353–357, Design and Build a Closed Reaction Chamber	**PS1.B: Chemical Reactions** ▪ Some chemical reactions release energy, others store energy. **MODULE: Introduction to Chemistry** **SE/TE:** 168–169, Changes in Energy 169, Do the Math! 178–179, Figure 6: How Can Chemical Reactions Generate Speed? **MODULE: Cells and Heredity** **SE/TE:** 49, The Photosyntheis Equation 52, The Cellular Respiration Equation	**Energy and Matter** ▪ The transfer of energy can be tracked as energy flows through a designed or natural system. **MODULE: Introduction to Chemistry** **SE/TE:** 169, Do the Math! 184, Graphing Changes in Energy 184, Figure 2: Graphs of Exothermic and Endothermic Reactions 187, Catalysts and Inhibitors 187, Figure 5 – Catalysts **MODULE: Cells and Heredity** **SE/TE:** 49, The Photosynthesis Equation 52, The Cellular Respiration Equation

	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)* **Chapter Activities and Projects** 353–357, Design and Build a Closed Reaction Chamber **Scenario-Based Investigations** 152–153, The Pipeline Is Burning **ETS1.C: Optimizing the Design Solution** ▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)* **Chapter Activities and Projects** 353–357, Design and Build a Closed Reaction Chamber ▪ 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)* **Chapter Activities and Projects** 353–357, Design and Build a Closed Reaction Chamber	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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to the Next Generation Science Standards – May, 2013
Grades 6-8

MS.Forces and Interactions
MS-PS2-1

Students who demonstrate understanding can:

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

INTERACTIVE SCIENCE: Newton's Third Law of Motion is introduced in the *Forces and Energy* module in SE/TE Chapter 2, Lesson 3, "What Is Newton's Third Law of Motion?*,"* on SE/TE pages 48-49.

Students apply Newton's Third law to **design a solution** for making hockey easier, safer, or more fun in "21st Century Learning" on TE page 49. On this same TE page, students **investigate** action-reaction pairs in "Teacher Demo: Action-Reaction in Action" and in "Differentiated Instruction: Make a Rocket." Students **examine** opposing forces in Quick Lab "Interpreting Illustrations" on TLR page 54. They **investigate** action-reaction pairs in Inquiry Warm-Up "How Pushy is a Straw?" on TLR page 55.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas or principles to design an object, tool, process or system.

TE Only:
49, 21st Century Learning

Disciplinary Core Ideas

PS2.A: Forces and Motion
- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).

MODULE: Forces and Energy
SE/TE:
48-49, What is Newton's Third Law of Motion?
48, Figure 3 – Action-Reaction Pairs
49, Did You Know?, Figure 4 – Action-Reaction Forces
50-51, What Makes a Bug Go Splat?

TE Only:
49, Teacher Demo – Action-Reaction in Action
49, Differentiated Instruction – L3 Make a Rocket
49, 21st Century Learning
51A, After the Inquiry Warm-Up

TLR:
54, Interpreting Illustrations
55, How Pushy Is a Straw?

Crosscutting Concepts

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

MODULE: Forces and Energy
SE/TE:
49, Figure 4 – Action-Reaction Forces
55, Inquiry Warm-Up - How Pushy Is a Straw?

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.

Scenario-Based Investigations
170–171, Please Drop In

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

MS.Forces and Interactions
MS-PS2-2

Students who demonstrate understanding can:

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 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.]

INTERACTIVE SCIENCE: Units of measurement and reference points for making observations are discussed in the *Forces and Energy* module, Chapter 1, Lesson 1, "Describing Motion." On SE/TE pages 4-6, reference points and relative motion are presented. In the Art in Motion feature on SE/TE page 5, students **write** about reference points. In the 21st Century Learning feature on TE page 5, pairs of student **simulate** the motion of Earth around the sun and **describe** the motion from the reference point of the sun and Earth. In the Apply It! feature on SE/TE page 6, students **write** about relative position. On TE page 6, students **identify** different reference points to observe Earth's motion. Different units of distance in the SI system of measurements are described on SE/TE page 7. In Figure 2, Measuring Distance, on SE/TE page 7, students **convert** units of distance among various different units. In the Build Inquiry feature on TE page 7, students **identify** appropriate units of measurement to use in measuring classroom objects. Students **describe** motion from multiple reference points in enrichment activity on TE page 7E. Students **observe** motion from multiple reference points in "What Is Motion" on TLR page 9 and "Identifying Motion" on TLR page 10.

Force and its effect on motion are explored in Chapter 2, Lesson 1, "Nature of Force" on SE/TE pages 32–35. In "Figure 2: Net Force" on SE/TE pages 34–35, illustrations are used to demonstrate that a change in motion is caused by the net force acting on an object. Students **calculate** the net force in three different situations: when forces cause motion because they are added together and they have the same direction, when forces cause motion because they have opposite direction but are unbalanced, and when forces do not cause motion because they are in opposite directions but are balanced. In the Apply it! feature on SE/TE page 35, students **draw** a diagram to illustrate two forces and the resulting net force. The effects of friction and the force of gravity are described. On TE page 35E, students **graph** the relationship between mass and force at a constant speed and **interpret** the graph. Students **observe** how equal and unequal forces affect the motion of an object in "Is the Force With You?" on TLR page 37. Students **measure** forces in "What Is Force?" on TLR page 38. They **model** unbalanced forces in a game of tug-of-war during the Quick Lab "Modeling Unbalanced Forces" on TLR page 39.

Newton's first, second, and third law of motion are detailed in Chapter 2, Lesson 3, "Newton's Laws of Motion" on SE/TE pages 44–51. Students use Newton's first law of motion to **explain** the motions of a roller coaster in "Figure 1: Inertia" on SE/TE page 45. They **illustrate** Newton's second law of motion in "Figure 2: Newton's Second Law" on SE/TE page 46. They **investigate** motion and forces in "What Changes Motion?" on TLR page 51. They **investigate** Newton's first law in "Around and Around on TLR page 52. They **investigate** mass and acceleration in "Newton's Second Law" on TLR page 53.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and	**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.	**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.

controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. **MODULE: Forces and Energy** **TLR:** 39, Modeling Unbalanced Forces 40, Observing Friction 41-49, Sticky Sneakers 51, What Changes Motion? 52, Around and Around --------------------------------------- ***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 **MODULE: Forces and Energy** **SE / TE:** 44–45, What Is Newton's First Law of Motion? **TLR:** 39, Modeling Unbalanced Forces 40, Observing Friction 41-49, Sticky Sneakers 51, What Changes Motion? 52, Around and Around	**MODULE: Forces and Energy** **SE / TE:** 32–35, The Nature of Force 34–35, Figure 2: Net Force 35, Apply It! 44–45, What Is Newton's First Law of Motion? 46–47, What Is Newton's Second Law of Motion? 46, Figure 2: Newton's Second Law **TE Only:** 35E, Enrich – Net Force, Mass, and Change in Motion **TLR:** 39, Modeling Unbalanced Forces 40, Observing Friction 41-49, Sticky Sneakers 51, What Changes Motion? 52, Around and Around 53, Newton's Second Law **PS2.A: Forces and Motion** • All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. **MODULE: Forces and Energy** **SE / TE:** 4-6, Describing Motion 7, Measuring Distance **TE Only:** 5, 21st Century Learning 6, 21st Century Learning 7, Differentiated Instruction – L3 SI Units 7, Build Inquiry – Describe Distance 7E, Enrichment – Exploring Reference Points **TLR:** 9, What is Motion? 10, Identifying Motion	**MODULE: Forces and Energy** **SE / TE:** 34–35, How Do Forces Affect Motion? 34–35, Figure 2: Net Force 44–51, Newton's Laws of Motion 56–59, Free Fall and Circular Motion 58, Figure 2 – Satellite Motion 64, Safety Restraints **TE Only:** 35E, Enrich – The Nature of Force **TLR:** 37, Is the Force With You? 38, What Is Force? 39, Modeling Unbalanced Forces 41–49, Sticky Sneakers 51, What Changes Motion? 53, Newton's Second Law 57, What Makes an Object Move in a Circle? 59, Orbiting Earth

MS.Forces and Interactions
MS-PS2-3

Students who demonstrate understanding can:

Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

INTERACTIVE SCIENCE: Electric fields are discussed in Chapter 6, Lesson 1, "Electric Charge and Static Electricity" on SE/TE pages 158–163 of the *Forces and Energy* module. The factors affecting the strength of electrical forces are explored in "How Does Charge Build Up?" on SE/TE pages 161-163. A discussion of magnetic force is included in "How Do Magnetic Poles Interact?" on SE/TE pages 198–199. Students **learn** about factors that affect magnetic force in "Enrich: William Gilbert and the Science of Magnetism" on TE page 199E. Students **obtain information** about factors that affect the strength of magnetic forces in Chapter 7, Lesson 2, "Magnetic Fields" on SE/TE pages 200–205; in Chapter 7, Lesson 3, in "What Is a Magnetic Field Produced by a Current Like?" on SE/TE page 209; and in "What Are the Characteristics of Solenoids and Electromagnets?" on SE/TE pages 210-211. In the Enrich activity "A Turn for the Better" on TE page 211F, students **learn** about the relationship between current turns of wire around a core and electromagnetic strength.

Students **observe** the effects of increased electric charge in "Drawing Conclusions: Electricity" on TLR page 149. In this lab, they **observe** the effect of electric charge before and after causing a charge in a comb. Students **investigate** the relationship between an electric current and the magnetic field it creates in "Can a Magnet Move a Wire?" on TLR page 201. Students use magnets of various sizes and strengths to **build** a piece of artwork in "Magnetic Art" on pages 402–406 of the *Chapter Activities and Projects* book.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. **MODULE: Forces and Energy** **SE/TE:** 203, Apply It! **TLR:** 193, Predict the Field	**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. **MODULE: Forces and Energy** **SE/TE:** 158–163, Electric Charge and Static Electricity 160, Figure 2: Electric Fields 198–199, How Do Magnetic Poles Interact? 198, Figure 2: Attraction and Repulsion 200–205, Magnetic Fields 209, What Is a Magnetic Field Produced by a Current Like? 210-211, What Are the Characteristics of Solenoids and Electromagnets? **TE Only:** 160, Teacher Demo: Electric Field Exerts a Force	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **MODULE: Forces and Energy** **SE/TE:** 161-163, How Does Charge Build Up? 207, Targeted Reading Skill – Relate Cause and Effect 209, What Is a Magnetic Field Produced by a Current Like? 210-211, What Are the Characteristics of Solenoids and Electromagnets? 211, Apply It! **TLR:** 182, Natural Magnets 193, Predict the Field 199, Electromagnet

	161, Differentiated Instruction – Model How Objects Are Charged 163, 21st Century Learning – Differentiated Instruction 165E, Enrich – St. Elmos' Fire 199E, Enrich – William Gilbert and the Science of Magnetism 211E, Review and Reinforce – Electromagnetic Force 211F, Enrich – A turn for the Better **TLR:** 148, Can You Move a Can Without Touching It? 149, Drawing Conclusions: Electricity 183–191, Detecting Fake Coins 193, Predict the Field 198, Magnetic Fields From Electric Current 201, Can a Magnet Move a Wire? **Chapter Activities and Projects** 402–406, Magnetic Art	

MS.Forces and Interactions
MS-PS2-4

Students who demonstrate understanding can:

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

INTERACTIVE SCIENCE: Gravitational force is introduced in the *Forces and* Energy module in Chapter 2, Lesson 2, "What Factors Affect Gravity?" on SE/TE pages 41-43. Students **use** a model of a hypothetical planetary system to **describe** the relationship among gravity, mass, and distance in "Figure 3 - Gravitational Attraction," on page SE/TE page 42.

The relationship between gravity, mass, and weight is also discussed in Chapter 1, Lesson 3, "Gravity and Motion," on SE/TE pages 18–21 of the *Astronomy and Space Science* module. Students interpret a graph to **draw conclusions** about how distance affects the force of gravity in "Do the Math!" on SE/TE page 21. Students use magnets to **model** the force of gravity and then **use evidence** obtained from their models in "What's Doing the Pulling?" on TLR page 28.

The affect of the sun and the moon's force of gravity on tides is discussed in Chapter 1, Lesson 5, "Tides," on pages 28–31 of the *Astronomy and Space Science* module. Students **use evidence** to support the claim that gravitational interactions are attractive in "Differentiated Instruction: Track the Tides" on TE page 31.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

MODULE: Astronomy and Space Science
TE Only:
31, Differentiated Instruction – L3 Track the Tides

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.

MODULE: Astronomy and Space Science
SE/TE:
29, Figure 1: Tides
30, The Sun's Role

Disciplinary Core Ideas

PS2.B: Types of Interactions

- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.

MODULE: Forces and Energy
SE/TE:
41–43, What Factors Affect Gravity?
42, Figure 3: Gravitational Attraction

TE Only:
43, Plant Response to Gravity

MODULE: Astronomy and Space Science
SE/TE:
18–21, Gravity and Motion
28–31, Tides

TE Only:
21E, Enrich – Your Weight in the Solar System
31, Differentiated Instruction – L3 Track the Tides

Crosscutting Concepts

Systems and System Models

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

MODULE: Forces and Energy
SE/TE:
42, Figure 3 – Gravitational Attraction

MODULE: Astronomy and Space Science
SE/TE:
19, Figure 1 – Gravity, Mass, and Distance
20, Figure 2 – Orbital Motion
29, Figure 1: Tides
30, The Sun's Role

TLR:
34, Modeling the Moon's Pull of Gravity

TE Only: 31, Differentiated Instruction – Le Track the Tides 31E, Enrich – What Affects the Heights of Tides?	31E, Enrich – What Affects the Heights of Tides? **TLR:** 28, What's Doing the Pulling?	

MS.Forces and Interactions
MS-PS2-5

Students who demonstrate understanding can:

Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields. Assessment is limited to qualitative evidence for the existence of fields.]

INTERACTIVE SCIENCE: Gravitational fields are introduced in the *Forces and* Energy module in Chapter 2, Lesson 2, "What Factors Affect Gravity?" SE/TE pages 41-43. Students obtain information about electric fields in Chapter 6, Lesson 1, "How Do Charges Interact?," on SE/TE pages 159-160. Magnetic fields are introduced in Chapter 7, Lesson 2, "What Is a Magnetic Field's Shape?" on SE/TE pages 201-203. The magnetic field of Earth is illustrated in "Figure 3: Earth's Magnetic Field" on SE/TE page 204. Students learn about electromagnetic fields in Chapter 7, Lesson 3, "Electromagnetic Force," on SE/TE pages 209-211.

Students **observe** how the electric force of a charged balloon affects a stream of water in "Teacher Demo: Electric Field Exerts a Force" on TE page 160. Students **demonstrate** the forces acting at a distance from magnetic fields in the Apply it! feature on SE/TE page 203. They **demonstrate** that an electrical field can act at a distance to move an aluminum can in "Can You Move a Can Without Touching It?" on TLR page 148. Students **conduct an investigation** and **evaluate the experimental design** to show a magnetic field acts at a distance when they use a magnet to detect fake coins in "Detecting Fake Coins" on TLR pages 188–191. Students **conduct an investigation** to show how iron filings in a Petri dish align if a magnet is placed beneath the Petri dish in "Predict the Field" on TLR page 193. Students **conduct an investigation** using iron filings and a magnet to model the effect of Earth's magnetic field in "Earth's Magnetic Field" on TLR page 195. Students **conduct an investigation** to show the effect of electric fields acting at a distance on a compass in "Magnetic Fields From Electric Current" on TLR page 198. Students **conduct an investigation** to show how an electromagnetic field can produce mechanical motion in "Can a Magnet Move a Wire?" on TLR page 201.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Forces and Energy** **SE/TE:** 203, Apply It! **TLR:** 182–190, Detecting Fake Coins 193, Predict the Field 198, Magnetic Fields From Electric Currents 201, Can a Magnet Move a Wire?	**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). **MODULE: Forces and Energy** **SE/TE:** 41–43, What Factors Affect Gravity? 159–160, How Do Charges Interact? 159, Figure 1 – Repel or Attract 160, Figure 2 – Electric Fields 161, Figure 3 – Charge Buildup 201–203, What Is a Magnetic Field's Shape? 201, Figure 1 – Magnetic Field Lines 202, Figure 2 – Magnetic Fields	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. **MODULE: Forces and Energy** **SE/TE:** 159, Figure 1 – Repel or Attract? 161, Figure 3 – Charge Buildup 203, Apply It! 211, Apply It! **TE Only:** 200A – Content Refresher 165E, Enrich – St. Elmo's Fire 204, Teacher Demo – Earth's Magnetic Field 205, Differentiated Instruction – Multimedia Presentation

	204, Figure 3 – Earth's Magnetic Field 209–211, Electromagnetic Force 209, Figure 2 – Change Magnetic Field Characteristics 210, Figure 3 – A Solenoid and an Electromagnet **TE Only:** 43, Teacher Demo 160, Teacher Demo – Electric Field Exerts a Force 202, Address Misconceptions – Contact Forces and Field Forces 210, Build Inquiry – Modeling a Solenoid's Magnetic Field **TLR:** 148, Can You Move a Can Without Touching It? 149, Drawing Conclusions 182–190, Detecting Fake Coins 193, Predict the Field 194, Spinning in Circles 195, Earth's Magentic Field 196, Electromagnetism 197, Magnetic Fields From Electric Current 201, Can a Magnet Move a Wire? **MODULE: Astronomy and Space Science** **SE/TE:** 18-21, Gravity and Motion 21, Do the Math! 29, Figure 1 – Tides 30, The Sun's Role **TE Only:** 18A, Content Refresher 21E, Enrich – Your Weight in the Solar System 31E, Enrich – What Affects the Heights of Tides? **TLR:** 27, What Factors Affect Gravity?	**TLR:** 148, Can You Move a Can Without Touching It? 149, Drawing Conclusions 182–190, Detecting Fake Coins 193, Predict the Field 201, Can a Magnet Move a Wire?

MS.Energy
MS-PS3-1

Students who demonstrate understanding can:

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

INTERACTIVE SCIENCE: The relationship between the kinetic energy of an object and the mass and speed of that object is discussed in the *Forces and* Energy module, Chapter 4, Lesson 1, "Kinetic Energy," on SE/TE pages 108–113. In "Figure 2: Kinetic Energy" on SE/TE page 110, students **rank** objects by amount of kinetic energy. In the Do the Math! feature on SE/TE page 111, students **draw conclusions** about the relative amount of kinetic energy of a running person and a running dog. Students **investigate** the relationship between kinetic energy and speed by dropping a tennis ball and measuring the height of the bounce in "How High Does a Ball Bounce?" on TLR page 99. Students **investigate** the effects of increasing the mass of a moving skateboard and kinetic energy's relationship with mass and speed in "Mass, Velocity, and Kinetic Energy" on TLR page 109. Students **construct graphical displays** showing the relative amounts of kinetic and potential energy of a roller coaster as it progresses up and down ramps in "Figure 4: Conserving Energy While You Ride" on SE/TE page 124–125.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Forces and Energy** **SE/TE:** 124–125, Figure 4: Conserving Energy While You Ride 127, Review and Assessment	**PS3.A: Definitions of Energy** • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. **MODULE: Forces and Energy** **SE/TE:** 110-111, Kinetic Energy 110, Figure 2 – Kinetic Energy 111, Relate Cause and Effect 111, Do the Math! **TLR:** 99, How High Does a Ball Bounce? 109, Mass, Velocity, and Kinetic Energy	**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. **MODULE: Forces and Energy** **SE/TE:** 111, Calculating Kinetic Energy 111, Do the Math! 124–125, Figure 4 – Conserving Energy While You Ride

MS.Energy
MS-PS3-2

Students who demonstrate understanding can:

Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

INTERACTIVE SCIENCE: Students **obtain** information about potential energy in a gravitational field in the *Forces and* Energy module in Chapter 4, Lesson 1, "Potential Energy," on SE/TE page 112. Students **calculate** the gravitational potential energy of three rock climbers and rank the climbers according to the amount of potential energy. Students **use models** of arrangements of objects when they interpret diagrams of a person jumping on a trampoline in "Figure 4: Elastic Potential Energy" on SE/TE page 113. Students **use models** of a roller coaster to construct bar graphs showing the relative amounts of potential and kinetic energy as the roller coaster moves up and down the tracks in "Figure 4: Conseving Energy While You Ride" on SE/TE pages 124–125. In Lesson 2, SE/TE page 115, students **draw conclusions** about the change in the potential energy of a basketball as its position changes. In "Determining Mechanical Energy" on TLR page 111, students drop a ball from four different heights onto clay to **observe** the difference in the effect and **explain** these differences in terms of increased potential energy due to position. In "Design and Build a Roller Coaster" on Chapter Activities and Projects pages 386–392, students build a roller coaster and **change variables** to determine how potential energy is stored in the system.

Students **obtain** information about the interaction of electrical charges and the force between charged objects in Chapter 6, Lesson 1, "Electric Charge and Static Electricity," on SE/TE pages 158–161 of the *Forces and Energy* module. Students **label** drawings to **develop models** that describe how the position of charged spheres relative to each other changes when the charges on the spheres change (thus changing the amount of potential energy) in "Figure 1: Repel or Attract?" on SE/TE page 159. Students **label** photographs to **develop models** describing that as the distance between a charged balloon and a student's hair decreases, the student's hair becomes attracted to the balloon (thus changing the amount of potential energy stored in the student–balloon "system") in "Figure 3: Charge Buildup" on SE/TE page 161. Students **investigate** how the interaction of a charged balloon and an aluminum can changes as the balloon is brought closer to the can in "Can You Move a Can Without Touching It?" on TLR page 148.

Students **obtain** information about magnets and the interaction of magnetic poles in "How Do Magnetic Poles Interact?" on SE/TE page 198–199 of the *Forces and Energy* module. Students label drawings to **develop models** describing that when the distance between magnetic poles decreases, the arrangment of the poles relative to each other changes (thus changing the amount of potential energy stored in the magnet–magnet system) in "Figure 2: Attraction and Repulsion" on SE/TE page 198. Students **investigate** how the interaction of two toy cars changes when a bar magnet is attached to each car and the distance between the cars decreases in "Magnetic Poles" on TLR page 192.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Forces and Energy** **SE/TE:** 112, Figure 3 – Gravitational Potential Energy	**PS3.A: Definitions of Energy** • A system of objects may also contain stored (potential) energy, depending on their relative positions. **MODULE: Forces and Energy** **SE/TE:** 112, Potential Energy 112, Figure 3 – Gravitational Potential Energy 115, Figure 1, Mechanical Energy 124–125, Figure 4 – Conserving Energy While You Ride 158–161, Electric Charge and Static Electricity 159, Figure 1 – Repel or Attract? 161, Figure 3 – Charge Buildup 198–199 How Do Magnetic Poles Interact? 198, Figure 2 – Attraction and Repulsion **TLR:** 111, Determining Mechanical Energy 148, Can You Move a Can Without Touching It? 192, Magnetic Poles **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. **MODULE: Forces and Energy** **SE/TE:** 116, Mechanical Energy and Work 158–161, Electric Charge and Static Electricity 159, Figure 1 – Repel or Attract? 161, Figure 3 – Charge Buildup 198–199 How Do Magnetic Poles Interact? 198, Figure 2 – Attraction and Repulsion **TLR:** 111, Determining Mechanical Energy 148, Can You Move a Can Without Touching It? 192, Magnetic Poles	**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. **MODULE: Forces and Energy** **SE/TE:** 124–125, Figure 4 – Conserving Energy While You Ride 161, Figure 3 – Charge Buildup 198, Figure 2 – Attraction and Repulsion **TLR:** 111, Determining Mechanical Energy **Chapter Activities and Projects** 386–392, Design and Build a Roller Coaster

MS.Energy
MS-PS3-3

Students who demonstrate understanding can:

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, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

INTERACTIVE SCIENCE: Temperature and thermal energy are discussed in Chapter 5, Lesson 1 "Temperature, Thermal Energy, and Heat," on SE/TE pages 136–139 of the *Forces and Energy* module. Students **obtain information** about heat transfer in Chapter 5, Lesson 2, "The Transfer of Heat," on SE/TE pages 140–143. The citations below indicate additional areas in ***Interactive Science*** where these and related ideas are presented.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. **MODULE: Forces and Energy** **SE/TE:** 153, Science Matters, Make Way for Heat **TE Only:** 142, 21st Century Learning – Creativity **TLR:** 125-133, Lab Investigation, Build Your Own Thermometer **Chapter Activities and Projects:** 414-420, In Hot Water **MODULE: Ecology and the Environment** **TLR:** 144-152, Design and Build a Solar Cooker	**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. **MODULE: Forces and Energy** **SE/TE:** 136-137, What Determines the Temperature of an Object? 138-139, What Is Thermal Energy? **TE Only:** 139A, After the Inquiry Warm-Up – How Cold Is the Water? **TLR:** 124, How Cold Is the Water? 125-133, Build Your Own Thermometer 134, Temperature and Thermal Energy **PS3.B: Conservation of Energy and Energy Transfer** • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **MODULE: Forces and Energy** **SE/TE:** 139, Heat 140-143, The Transfer of Heat **TE Only:** 139, Support the Big Q – Where Does Heat Go?	**Energy and Matter** • The transfer of energy can be tracked as energy flows through a designed or natural system. **MODULE: Forces and Energy** **SE/TE:** 120-125, Energy Transformations and Conservation 140-143, The Transfer of Heat **TE Only:** 125A, After the Inquiry Warm-Up – What Would Make a Card Jump? **TLR:** 113, What Would Make a Card Jump? 136, Visualizing Convection Currents

	142, Build Inquiry – Heat Flow From Lamps 143, Differentiated Instruction – Observing Conduction 143A, After the Inquiry Warm-Up - What Does It Mean to Heat Up? 143E, Enrich – Radiating Heat **TLR:** 135, What Does It Mean to Heat Up? 136, Visualizing Convection Currents **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)* **Chapter Activities and Projects:** 414-420, In Hot Water **MODULE: Ecology and the Environment** **TLR:** 144-152, Design and Build a Solar Cooker **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)* **Chapter Activities and Projects:** 414-420, In Hot Water **MODULE: Ecology and the Environment** **TLR:** 144-152, Design and Build a Solar Cooker	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

MS.Energy
MS-PS3-4

Students who demonstrate understanding can:

Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

INTERACTIVE SCIENCE: Temperature and thermal energy are discussed in Chapter 5, Lesson 1 "Temperature, Thermal Energy, and Heat," on SE/TE pages 136–139 of the *Forces and Energy* module. The citations below indicate additional areas in ***Interactive Science*** where these and related ideas are presented.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Chapter Activities and Projects
414-420, In Hot Water

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

MODULE: Forces and Energy
TLR
124, How Cold Is the Water?
125-133, Build Your Own Thermometer
134, Temperature and Thermal Energy

Disciplinary Core Ideas

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.

MODULE: Forces and Energy
SE/TE:
136-137, What Determines the Temperature of an Object?
138-139, What Is Thermal Energy?

TE Only:
139A, After the Inquiry Warm-Up – How Cold Is the Water?

TLR:
124, How Cold Is the Water?
125-133, Build Your Own Thermometer
134, Temperature and Thermal Energy

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.

MODULE: Forces and Energy
SE/TE:
138-139, What Is Thermal Energy?

Crosscutting Concepts

Scale, Proportion, and Quantity
• Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

MODULE: Forces and Energy
TLR:
134, Temperature and Thermal Energy
137, Thermal Properties
138, Frosty Balloons

	138, Apply It! 138, Identify Supporting Evidence **TE Only:** 138, Make Analogies 138, Apply It! **TLR:** 134, Temperature and Thermal Energy	

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Grades 6-8

MS.Energy
MS-PS3-5

Students who demonstrate understanding can:

Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

INTERACTIVE SCIENCE: Energy transformations are discussed in Chapter 4, Lesson 3, "Energy Transformations and Conservation," on SE/TE pages 120–125 of the *Forces and Energy* module. The citations below indicate additional areas in ***Interactive Science*** where this idea is presented.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Forces and Energy** **TE Only:** 125, Differentiated Instruction – Oral Presentation **Chapter Activities and Projects:** 386-392, Design and Build a Roller Coaster **Scenario-Based Investigations:** 166-168, Stuck at the Top -- ***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 **MODULE: Forces and Energy** **TLR:** 112, Forms of Energy 113, What Would Make a Card Jump? 114, Soaring Straws	**PS3.B: Conservation of Energy and Energy Transfer** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. **MODULE: Forces and Energy** **SE/TE:** 120-123, How Are Different Forms of Energy Related? 124-125, What Is the Law of Conservation of Energy? **TE Only:** 122, 21st Century Learning – Critical Thinking 123, Differentiated Instruction – Pole Vault Energy 123, Build Inquiry – Model Pole Vaulting 125, Differentiated Instruction – Oral Presentation **TLR:** 113, What Would Make a Card Jump? 114, Soaring Straws **Chapter Activities and Projects:** 386-392, Design and Build a Roller Coaster	**Energy and Matter** • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). **MODULE: Forces and Energy** **SE/TE:** 108-109, How Are Energy, Work, and Power Related? 110-113, What Are Two Types of Energy? 114-116, How Can You Find an Object's Mechanical Energy? 117-119, What Are Other Forms of Energy? **TLR:** 110, What Makes a Flashlight Shine? 112, Forms of Energy **Chapter Activities and Projects:** 386-392, Design and Build a Roller Coaster **Scenario-Based Investigations:** 166-168, Stuck at the Top

MS.Waves and Electromagnetic Radiation
MS-PS4-1

Students who demonstrate understanding can:

Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

INTERACTIVE SCIENCE: The definition, characteristics, and types of mechanical waves are discussed on SE/TE pages 4–9 of Chapter 1, Lesson 1, "What Are Waves?" in the *Sound and Light* module. The relationsip between wave amplitude and the energy in waves is described in "Amplitude" on SE/TE page 11.

Students **use models** of waves to identify areas of compression and areas of rarefaction in "Figure 3: Motion in a Longitudinal Wave" on SE/TE page 8 and in the "Apply It!" on this same page. Students **use models** of a transverse wave to measure its amplitude in "Figure 1: Amplitude" on SE/TE page 11. Students **use models** of a transverse wave to identify wavelength and frequency in "Figure 2: Properties of Waves" on SE/TE pages 12–13. Students **use mathematical representations** to describe a simple model for waves when they construct a table by using mathematical formulas to show the relationship between wavelength, frequency, and speed in "Do the Math!" on SE/TE page 14. Students **predict** how the amplitude of the waves in the wave pool at an amusement park will change if the timing and strength (i.e., energy) of the waves changed in "Figure 3: Ride the Waves" on SE/TE page 15. Students **use mathematical representations** when they use a graph to answer questions related to patterns in the orbit of one of Jupiter's moons in "Enrich: Moon Waves" on TE page 15E. Students **investigate** how amplitude and energy are related in "What Do Waves Look Like?" on TLR page 12.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Sound and Light** **SE/TE:** 14, Do the Math! **TE Only:** 15E, Enrich – Moon Waves --- ***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. **MODULE: Sound and Light** **SE/TE:** 6, Waves and Energy	**PS4.A: Wave Properties** ▪ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. **MODULE: Sound and Light** **SE/TE:** 4–9, What Are Waves? 9, Figure 4 – Waves Transfer Energy 10–15, Properties of Waves 11, Figure 1: Amplitude 12–13, Figure 2: Properties of Waves 14, Do the Math! 15, Figure 3 – Ride the Waves 28, Wall of Water 29, The Operatic Superpower **TE Only:** 7, Teacher Demo – Diagram Transverse Waves 9, Differentiated Instruction – L3 Torsional Waves 9E, Enrich – Waves in the World Around You	**Patterns** ▪ Graphs and charts can be used to identify patterns in data. **MODULE: Sound and Light** **SE/TE:** 14, Do the Math! 37, Figure 3: Speed of Sound in Air 38, Do the Math! 43, Apply It! 74, Figure 2: The Electromagnetic Spectrum **TE Only:** 15E, Enrich – Moon Waves 37, Differentiated Instruction – L3 Properties of Sound Waves 43, Differentiated Instruction – L3 Research Decibel Levels 57E, Enrich – Range of Hearing

6, Figure 1: Forming a Mechanical Wave **TLR:** 10, What Causes Mechanical Waves? 12, What Do Waves Look Like? 11, Three Types of Waves	13, Teacher Demo – Speed of a Wave 13, Differentiated Instruction – Make a Presentation 15, Differentiated Instruction – Solve Problems 15, Differentiated Instruction – Wave Pool 15E, Enrich – Mon Waves **TLR:** 9, What Are Waves? 10, What Causes Mechanical Waves? 11, Three Types of Waves 12, What Do Waves Look Like? 13, Properties of Waves 14, What Affects the Speed of a Wave?	

MS.Waves and Electromagnetic Radiation
MS-PS4-2

Students who demonstrate understanding can:

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

INTERACTIVE SCIENCE: The materials that sound waves travel through are explored in Chapter 2, Lesson 1, "The Nature of Sound," on SE/TE pages 34–39 of the *Sound and Light* module. Students **use a model** of sound waves to identify areas of rarefaction and compression in "Figure 1: Sound Waves" on SE/TE apge 35. They **use a model** of a bird's anatomy to show how birds produce sound in "Enrich: The Sound of Nature" on SE/TE page 39F. A discussion of pitch, loudness, and the Doppler affect is provided in "Properties of Sound" on SE/TE pages 40– 45. Students **make models** representing different sound frequencies (pitch) in "Figure 1: Pitch" on SE/TE page 41. Students can **develop and use a model** to represent loudness in "Build Inquiry: Model Sound Intensity" on TE page 42. Students **use a model** to show how headphones transmit sound waves through air in "Figure 4: How Your Headphones Work" on SE/TE page 45. Echolocation, sonar and ultrasound imaging, which make use of reflected sound waves, are discussed in Lesson 5 on SE/TE pages 55–56. Students **use models** to describe how echolocation and sonar work in "Figure 1: Echolocation" on SE/TE page 55 and "Apply It!" on SE/TE page 56, respectively. Students **investigate** reflected sound waves and **explain** how these waves moved in "Designing Experiments" on TLR page 55.

The properties of electromagnetic waves, which include light waves, are described in Chapter 3, Lesson 1, "The Nature of Electromagnetic Waves," on SE/TE pages 68–71 of the *Sound and Light* module. Students **use a model** of light in "Figure 2: Light as a Wave" on SE/TE page 70. They write labels to **develop and use a model** of light waves emitted by a flashlight in "Apply It!" on SE/TE page 71. They **develop a model** of the electromagnetic spectrum in "Differentiated Instruction: Make a Drawing" on TE page 75. They **develop and use a model** of the electromagnetic spectrum in "Figure 6: Surfing the Spectrum" on SE/TE page 79.

Light waves are discussed in the *Sound and Light* module in Chapter 4. Absorption of light waves is presented in Lesson 1, "Light and Color," on SE/TE pages 98-103. Students **use a model** to show which colors are produced by absorption, transmital, and reflection of light waves in "Figure 2: Color of an Opaque Object" on SE/TE page 100. They **develop and use models** to indicate how the colors we see are affected by red, green, and blue filters in "Apply It!" on SE/TE page 101. Students **learn** about the reflection of light waves in Lesson 2, "Reflection and Mirrors," on SE/TE pages 104-109. They **develop models** by adding labels to illustrations showing how light reflects off different materials in "Figure 1: Diffuse and Regular Reflection" on SE/TE page 105. They **use models** showing how light reflects off of mirrors in "Figure 3: Concave Mirror" on SE/TE page 107, "Figure 4: Convex Mirror" on SE/TE page 108, and "Apply It!" on SE/TE page 109. They **use a model** showing how light is reflected and refracted by water droplets in "Figure 3: Water + Light = A Rainbow" on SE/TE page 113. They **develop a model** of reflected light waves in "Differentiated Instruction: Diagramming a Mirage" on TE page 115. They draw and add labels to **develop and use models** illustrating how light is transmitted and reflected in cameras and telescopes in (respectively) "Apply It!" on SE/TE page 123 and "Figure 1: Reflecting and Refracting Telescopes" on SE/TE page 124. They **develop a model** of a reflecting telescope in "Seeing Double" on SE/TE page 130. They **develop and use a model** to show how light reflects off of (and is absorbed and scattered by) a chameleon's skin in "Hiding in Plain Sight" on SE/TE page 131.

Seismic waves, which are mechanical waves, are explored in the *Earth's Structure* module, Chapter 4, Lesson 2, "What Are Seismic Waves?" on SE/TE pages 111-113. Students **use models** of three types of seismic waves in "Figure 2: P, S, and Surface Waves" on SE/TE page 113. Students **model** seismic waves in "Properties of Seismic Waves" on TLR page 102.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena.

MODULE: Sound and Light
SE/TE:
35, Figure 1 – Sound Waves
41, Figure 1 – Pitch
71, Apply It!
73, Figure 1 – Comparing Electromagnetic Waves
74, Figure 2 – The Electromagnetic Spectrum
79, Figure 6 – Surfing the Spectrum
99, Figure 1 – Types of Materials
100, Figure 2 – Color of an Opaque Object
101, Apply It!
105, Figure 1 – Diffuse and Regular Reflection
108, Figure 4 – Convex Mirror
115, Figure 5 – Concave Lens
116, Figure 7 – How a Convex Lens Works
123, Apply It!
124, Figure 1 – Reflecting and Refracting Telescopes
130, Seeing Double
131, Hiding in Plain Sight

TE Only:
42, Build Inquiry – Model Sound Intensity
43, Differentiated Instruction – L1 Make a Drawing
75, Differentiated Instruction – L1 Make a Drawing
107, Differentiated Instruction – L3 Diagram Reflected Rays
115, Differentiated Instruction – L1 Diagramming a Mirage

TLR:
52, Hearing Sound

Disciplinary Core Ideas

PS4.A: Wave Properties

- A sound wave needs a medium through which it is transmitted.

MODULE: Sound and Light
SE/TE:
34-39, The Nature of Sound
35, Figure 1: Sound Waves Properties of Sound
38, Did You Know?
40–45, Properties of Sound

TE Only:
37, Differentiated Instruction – L1 Feel Sound Waves
38, Teacher Demo – Stiffness and Speed of Sound
39, Differentiated Instruction – L3 Write a Story
39F, The Sound of Nature
44, Teacher Demo – Model the Doppler Effect
49E, Enrich – Musical Wood

TLR:
35, What Is Sound?
36, Understandings Sound
37, Ear to the Sound
48, Listen to This
51, How Can You Change Pitch?

PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.

MODULE: Sound and Light
SE/TE:
98–101 What Determines Color?
100, Figure 2 – Color of an Opaque Object
101, Apply It!
104–109, Reflection and Mirrors
105, Figure 1 – Diffuse and Regular Reflection
107, Figure 3 – Concave Mirror
108, Figure 4 – Convex Mirror
109, Apply It!

TE Only:
100, Teacher Demo – Light Reflected by Opaque Materials

Crosscutting Concepts

Structure and Function

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

MODULE: Sound and Light
SE/TE:
109, Apply It!
122–125, Using Light
123, Apply It!
124, Figure 1 – Reflecting and Refracting Telescopes
125, Figure 2 – Microscope
130, Seeing Double

TE Only:
125, Differentiated Instruction – L3 Scanning Electron Microscope (SEM)

TLR:
110, How Does a Pinhole Camera Work?
111, What a View!

	103E, Enrich – Colors: Reflected, Absorbed, Passed Through 107, Teacher Demo – Model Reflection From a Concave Mirror 107, Differentiated Instruction – L3 Diagram Reflected Rays **TLR:** 92, Developing Hypotheses 93–101, Changing Colors 103, Observing ▪ 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) **MODULE: Sound and Light** **SE/TE:** 104–109, Reflection and Mirrors 106, Figure 2 – Image in a Plane Mirror 110–117, Refraction and Lenses 113, Figure 3 – Water + Light = A Rainbow 116, Figure 7 – How a Convex Lens Works 117, Apply It! 122–125, Using Light 123, Apply It! 124, Figure 1: Reflecting and Refracting Telescopes **TE Only:** 71E, Enrich – Measuring the Speed of Light 107, Teacher Demo – Model Reflection From a Concave Mirror 113, Build Inquiry – Observing Refraction of Light 116, Teacher Demo – Focal Point 117E, Enrich – Light Benders 121E, Enrich – A Better View **TLR:** 102, How Does Your Reflection Wink? 104, Mirror Images 106, Bent Pencil ▪ A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. **MODULE: Sound and Light** **SE/TE** 68–69, What Makes Up Electromagnetic Waves?	

	71, Wave Model of Light 71, Figure 2: Light as a Wave 71, Apply It! **TE Only:** 70, Build Inquiry – Observe How Filters Polarize Light 71, Differentiated Instruction – L1 Polarized Sunglasses ▪ However, because light can travel through space, it cannot be a matter wave, like sound or water waves. **MODULE: Sound and Light** **SE/TE** 71, Particle Model of Light 71, Figure 3 – The Photoelectric Effect	

MS.Waves and Electromagnetic Radiation
MS-PS4-3

Students who demonstrate understanding can:

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 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.]

INTERACTIVE SCIENCE: Students **list** the advantages and disadvantages of using voice recognition software to create a word-processing document in “Relate Text and Visuals” on SE/TE page 120 of the *Science and Technology* module. Students can **integrate qualitative scientific and technical information** by reading the discussion regarding designing a computer mouse on SE/TE pages 124–131 and then answering the questions in “Enrich – A Redesigned Mouse” on TE page 131E.

A discussion of the use of computers in mapmaking is provided in Chapter 1, Lesson 3, “Mapping Technology,” on SE/TE pages 18–23 in the *Earth’s Surface* module. Students can **integrate technical information** from their textbooks to answer questions regarding the advantages of using computers for mapmaking in “Teach Key Concepts” on TE page 19. A discussion of the use of digitized satellite images to make maps is included in “Maps From Satellite Images” on SE/TE page 20.

A discussion of the technologies involved with cell phones, satellite communications, and the global positioning system is included on pages 84–86 of the *Sound and Light* module.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Science and Technology** **SE/TE:** 120, Relate Text and Visuals	**PS4.C: Information Technologies and Instrumentation** ▪ Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. **MODULE: Science and Technology** **SE/TE:** 120, Relate Text and Visuals 122, Apply It! **TE Only:** 131E, Enrich – A Redesigned Mouse **MODULE: Earth’s Surface** **SE/TE:** 20, Maps From Satellite Images **TE Only:** 19, Teach Key Concepts **MODULE: Forces and Energy** **SE/TE:** 230, Magnetic Pictures	**Structure and Function** ▪ Structures can be designed to serve particular functions. **MODULE: Science and Technology** **SE/TE:** 122, Apply It! **TE Only:** 131E, Enrich – A Redesigned Mouse **MODULE: Sound and Light** **SE/TE:** 84–85, How Does a Cell Phone Work? 86–87, How Does Satellite Communications Work? 123, Apply It!

	MODULE: Sound and Light **SE / TE:** 84–85, How Does a Cell Phone Work? 86–87, How Does Satellite Communications Work? 92, Channel Surfin' on an Infrared Wave 123, Cameras **TE Only:** 92, Museum of Science	--- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. **MODULE: Science and Technology** **TLR:** 17, Reading Satellite Images **MODULE: Forces and Energy** **SE / TE:** 230, Magnetic Pictures --- ***Connections to Nature of Science*** ***Science is a Human End*eavor** ▪ Advances in technology influence the progress of science and science has influenced advances in technology. **MODULE: Science and TEchnology** **SE / TE:** 120, Relate Text and Visuals **MODULE: Sound and Light** **SE / TE** 84–85, How Does a Cell Phone Work? 86–87, How Does Satellite Communication Work?

MS.Structure, Function, and Information Processing
MS-LS1-1

Students who demonstrate understanding can:

Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

Students **obtain information** about what cells are, how they are seen, and the difference between unicellular and multicellular in the *Cells and Heredity* module in Chapter 1, Lesson 1, on SE/TE pages 4-11, and in Lesson 2, SE/TE pages 20-21 "How Do Cells Work Together in an Organism?" Similar information is found in *The Diversity of Life* module in Chapter 1, Lesson 1, on SE/TE pages 5-6.

In the *Cells and Heredity* TLR, students **conduct an investigation** where they observe and compare plant and animal cells in "Comparing Cells" on TLR page 10. Students **use a microscope** to make observations and inferences in "Observing Cells" on TLR page 11. Students **investigate** and **model** the organization of a multicellular organism in "Tissues, Organs, Systems" on TLR page 23. In *The Diversity of Life* TLR, students **investigate** the characteristics of living things in "Is It Living or Non-Living?" on TLR page 9.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use <u>multiple variables</u> and provide evidence to support explanations or solutions. ▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **MODULE: Cells and Heredity** **TLR:** 10, Comparing Cells 11, Observing Cells 23, Tissues, Organs, Systems **MODULE: The Diversity of Life** **TLR:** 9, Is It Living or Non-Living?	**LS1.A: Structure and Function** ▪ All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). **MODULE: Cells and Heredity** **SE/TE:** 4-11, Discovering Cells 20-21, How Do Cells Work Together in an Organism? **TLR:** 10, Comparing Cells 11, Observing Cells 23, Tissues, Organs, Systems **MODULE: The Diversity of Life** **SE/TE:** 5-6, What Are the Characteristics of All Living Things? **TLR:** 9, Is It Living or Non-Living?	**Scale, Proportion, and Quantity** ▪ Phenomena that can be observed at one scale may not be observable at another scale. **MODULE: Cells and Heredity** **SE/TE:** 8-11, How Do Microscopes Work? 38, Science Matters, Electron Eyes --- ***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. **MODULE: Cells and Heredity** **SE/TE:** 8-11, How Do Microscopes Work? 38, Science Matters, Electron Eyes

MS.Structure, Function, and Information Processing
MS-LS1-2

Students who demonstrate understanding can:

Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

Information about how cells function is presented in the *Cells and Heredity* module in Chapter 1, Lesson 2, "Looking Inside Cells," on SE/TE pages 12-21. Students **identify** and **describe** the functions of cell structures in Figure 3, Interactive Art, Cells in Living Things on SE/TE pages 16-17. Students **model** cell structures that are most like parts of a store in the Apply It on SE/TE page 18. Students **model** a cell and **describe** the functions of cell structures in "Gelatin Cell Model" on TLR page 22.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. **MODULE: Cells and Heredity** **SE/TE:** 18, Apply It **TE Only:** 19, Differentiated Instruction, Making Models 21F, Enrich—Looking Inside Cells **TLR:** 22, Gelatin Cell Model	**LS1.A: Structure and Function** ▪ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. **MODULE: Cells and Heredity** **SE/TE:** 12-21, Looking Inside Cells 16-17, Figure 3, Interactive Art, Cells in Living Things 18, Apply It **TE Only:** 19, Differentiated Instruction, Making Models 21F, Enrich—Looking Inside Cells **TLR:** 22, Gelatin Cell Model	**Structure and Function** ▪ Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. **MODULE: Cells and Heredity** **SE/TE:** 12-21, Looking Inside Cells 16-17, Figure 3, Interactive Art, Cells in Living Things

MS.Structure, Function, and Information Processing
MS-LS1-3

Students who demonstrate understanding can:

Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

Information pertaining to levels of organization in living things is presented in the *Cells and Heredity* module in Chapter 1, Lesson 2, "How Do Cells Work Together in an Organism?" on SE/TE pages 20-21. In "Tissues, Organs, Systems" on TLR page 23, students **model** the organization of a multicellular organism and use that model as evidence to answer questions. Information regarding body organization can also be found in the *Human Body Systems* module in Chapter 1, Lesson 1, SE/TE pages 4-9. In "How Is Your Body Organized?" on TLR page 9, students **examine** a model and use their observations as evidence to answer questions.

Information pertaining to how body systems interact is presented in the *Human Body Systems* module in Chapter 1, Lesson 2, SE/TE pages 10-17. In "How Does Your Body Respond?" on TLR page 11, students **identify** parts of the body that work together to perform life functions and and use their observations as evidence to answer questions. In "Working Together, Act I" on TLR page 21, students **model** the interaction among different body systems involved in delivering oxygen and removing carbon dioxide and other wastes. Students **use their observations** as evidence to answer questions. In "Working Together, Act II" on TLR page 22, students **model** the interaction of the nervous system with other body systems and use their observations as evidence to answer questions.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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(s). ▪ Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. **MODULE: Cells and Heredity** **TE Only:** 21, Differentiated Instruction, Cells in Tissues **TLR**: 23, Quick Lab, Tissues, Organs, Systems **MODULE: Human Body Systems TE Only:** 9A, After the Inquiry Warm-Up, Body Organization	**LS1.A: Structure and Function** ▪ In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. **MODULE: Cells and Heredity** **SE/TE:** 20-21, How Do Cells Work Together in an Organism? **TE Only:** 21, Differentiated Instruction, Cells in Tissues **TLR**: 23, Quick Lab, Tissues, Organs, Systems **MODULE: Human Body Systems SE/TE:** 4-9, How Is Your Body Organized?	**Systems and System Models** ▪ Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. **MODULE: Cells and Heredity** **SE/TE:** 20-21, How Do Cells Work Together in an Organism? **TLR**: 23, Quick Lab, Tissues, Organs, Systems **MODULE: Human Body Systems SE/TE:** 4-9, How Is Your Body Organized? 11-12, How Do You Move? 13-15, Which Systems Move Materials in Your Body? 16-17, Which Systems Control Body Functions?

15, Differentiated Instruction, All Systems Go 17A, After the Inquiry Warm-Up, System Interactions 17F, Enrich, System Interactions **TLR**: 9, Inquiry Warm-Up, How Is Your Body Organized? 11, Inquiry Warm-Up, How Does Your Body Respond? 21, Quick Lab, Working Together, Act I 22, Quick Lab, Working Together, Act II	11-12, How Do You Move? 13-15, Which Systems Move Materials in Your Body? 16-17, Which Systems Control Body Functions? **TE Only:** 9A, After the Inquiry Warm-Up, Body Organization 15, Differentiated Instruction, All Systems Go 17A, After the Inquiry Warm-Up, System Interactions 17F, Enrich, System Interactions **TLR**: 9, Inquiry Warm-Up, How Is Your Body Organized? 11, Inquiry Warm-Up, How Does Your Body Respond? 21, Quick Lab, Working Together, Act I 22, Quick Lab, Working Together, Act II	**TE Only:** 9A, After the Inquiry Warm-Up, Body Organization 15, Differentiated Instruction, All Systems Go 17A, After the Inquiry Warm-Up, System Interactions 17F, Enrich, System Interactions **TLR**: 9, Inquiry Warm-Up, How Is Your Body Organized? 11, Inquiry Warm-Up, How Does Your Body Respond? 21, Quick Lab, Working Together, Act I 22, Quick Lab, Working Together, Act II --- ***Connections to Nature of Science*** **Science is a Human Endeavor** ▪ Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. **MODULE: Cells and Heredity** **TE Only:** 9E, Enrich, Body Organization

MS.Structure, Function, and Information Processing
MS-LS1-8

Students who demonstrate understanding can:

Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

INTERACTIVE SCIENCE: Information pertaining to the nervous systems, stimuli, and and response is introduced in the *Human Body Systems* module in Chapter 1, Lesson 2, pages 16-17. In Figure 4 on SE/TE page 16, students synthesize information regarding stimuli and response.

The nervous system is explored in the *Human Body Systems* module in Chapter 7, Lessons 1 and 2. Students **obtain information** about the nervous system's response to stimuli and its role in maintaining homeostasis on SE/TE page 216. In the Apply It on SE/TE page 216, students **synthesize information** to determine how a body responds to stimuli. The central nervous is explored in "What Is the Role of the Central Nervous System?" on SE/TE pages 221-223. Sense receptors are discussed in Lessons 3, "Sight and Hearing," and 4, "Smell, Taste, and Touch. Students learn about sight receptors on SE/TE page 321. Sound receptors are discussed in "The Inner Ear" on SE/TE page 234. Students **obtain information** about smell and taste receptors in "How Do Smell and Taste Work Together?" on SE/TE page 237. They l**earn** about touch receptors in "How Do You Sense Touch?" on SE/TE page 238.

Students **identify** the parts of the central nervous system, including the spinal cord and the brain on SE/TE pages 221-224. They **write** about how sight receptors work on SE/TE page 231. Students **write** about the functions of the outer, middle, and inner ear in Figure 5, The Ear, on SE/TE page 234. Students **sequence** the steps involved in sensing taste in Figure 1, Taste Buds on SE/TE page 237. They **write** about different types of touch sensing in the Apply it! feature on SE/TE page 238.

In "Ready or Not!" on TLR pages 187-195, students **gather and synthesize information** by conducting an experiment to determine if a person's reaction time varies depending on the time of day. In "Modeling a Neuron" on TLR page 196, students **model** the three different types of neurons to determine the role of each in responding to stimuli. They also **model** responses passing through neurons in "What Are the Parts of the Nervous System" in TLR page 198. Students **model** the brain and explain the function of the parts in "Making a Model of the Brain" in TLR page 199. Students **gather information** on how useful eyes and ears are in interpreting stimuli in "Eyes and Ears" in TLR page 202. Students **gather and sythesize information** on how touch sensors respond to different stimuli in "What's in the Bag?" on TLR page 207.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. ▪ Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)	**LS1.D: Information Processing** ▪ Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. **MODULE: Human Body Systems** **SE/TE:** 16-17 Which Systems Control Body Functions?	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural systems. **MODULE: Human Body Systems** **SE/TE:** 16-17 Which Systems Control Body Functions? 230, Apply It 234, Relate Cause and Effect

MODULE: Human Body Systems **TLR:** 196, Modeling a Neuron 198, What Are the Parts of the Nervous System? 199, Making a Model of the Brain 202, Eyes and Ears 207, What's in the Bag?	16, Figure 4, Stimulus and Response 214-219, How the Nervous System Works 220-227, Divisions of the Nervous System 228-235, Sight and Hearing 236-239, Smell, Taste, and Touch **TE Only:** 17F, Enrich, System Interactions 217, Differentiated Instruction 219, Differentiated Instruction 219F, Enrich, How the Nervous System Works **TLR:** 187-195, Ready or Not! 196, Modeling a Neuron 198, What Are the Parts of the Nervous System? 199, Making a Model of the Brain 202, Eyes and Ears 207, What's in the Bag?	**TE Only:** 15, Differentiated Instruction **TLR:** 187-195, Ready or Not! 207, What's in the Bag?

MS.Matter and Energy in Organisms and Ecosystems
MS-LS1-6

Students who demonstrate understanding can:

Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

INTERACTIVE SCIENCE: Information on how living things get their energy is presented in the *Cells and Heredity* module in Chapter 2, Lesson 1 in "How do Living Things Get Energy From the Sun?," SE/TE pages 45-46. In the Apply It! feature on SE/TE page 46, students sequence the flow of energy from the sun to a spider. Students **explain** how energy from the sun gets into their cells in "Assess Your Understanding" feature, #1c, on SE/TE page 46. In "Figure 2 – First Stage of Photosynthesis" on page SE/TE page 47, students **explain** that photosynthesis starts the chain of energy.

Additional information on the role of photosynthesis in the flow of energy can be found in the Ecology and the Environment module in Chaper 2, Lesson 1 in "What Are the Energy Roles in an Ecosystem?," SE/TE pages 43-45. The role of photosynthesis in the cycling of matter is discussed in Chapter 2, Lesson 2 "Cycles of Matter."

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **MODULE: Cells and Heredity** **TLR:** 38, Quick Lab, Energy From the Sun **MODULE: Ecology and the Environment** **TLR:** 54, Quick Lab, Carbon and Oxygen Blues --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical connections between evidence and explanations.	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. **MODULE: Cells and Heredity** **SE/TE:** 45, How Do Living Things Get Energy From the Sun? 46, The Sun as an Energy Source 46, Apply it! 47, Figure 2 – First Stage of Photosynthesis 49, Figure 4 – From the Sun to You **TLR:** 38, Quick Lab, Energy From the Sun **MODULE: Ecology and the Environment** **SE/TE:** 43-45, What Are the Energy Roles in an Ecosystem? 50-51, What Processes Are Involved in the Water Cycle?	**Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter. **MODULE: Ecology and the Environment** **SE/TE:** 43-45, What Are the Energy Roles in an Ecosystem? 50-51, What Processes Are Involved in the Water Cycle? 52-53, How Are the Carbon and Oxygen Cycles Related? 54-55, How Does Nitrogen Cycle Through Ecosystems?

MODULE: Ecology and the Environment **SE / TE:** 43-45, What Are the Energy Roles in an Ecosystem? 50-51, What Processes Are Involved in the Water Cycle? 52-53, How Are the Carbon and Oxygen Cycles Related? 54-55, How Does Nitrogen Cycle Through Ecosystems?	52-53, How Are the Carbon and Oxygen Cycles Related? 54-55, How Does Nitrogen Cycle Through Ecosystems? 52, Apply It! **TE Only:** 53, Differentiated Instruction 53, Build Inquiry **TLR:** 54, Quick Lab, Carbon and Oxygen Blues **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)* **MODULE: Cells and Heredity** **SE / TE:** 47-49, What Happens During Photosynthesis? 47, Figure 2 – First Stage of Photosynthesis 48, Sequence 48, Figure 3 – Producing Food	

MS.Matter and Energy in Organisms and Ecosystems
MS-LS1-7

Students who demonstrate understanding can:

Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 describe unobservable mechanisms. **MODULE: Diversity of Life** **TE Only:** 213, Differentiated Instruction, Draw a Diagram	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. **MODULE: Cells and Heredity** **SE/TE:** 44-49, Photosynthesis 50-55, Cellular Respiration 52, Figure 2 – Releasing Energy 53, Comparing Two Energy Processes 53. Figure 3 – Opposite Processes 54, What Happens During Fermenttion? 55, Energy for Life **TE Only:** 53, Differentiated Instruction – All About Glucose **TLR**: 40, Cellular Respiration 41-49, Exhaling Carbon Dioxide **MODULE: Diversity of Life** **SE/TE:** 213, Digestion Inside Cells 214-215 Digestion Outside Cells 215, Specialized Digestive Systems **TE Only:** 215E, Enrich – Rushing to Eat **TLR**: 165, How Do Snakes Feed? 166, Planarian Feeding Behavior 167-175, Looking at an Owl's Leftovers	**Energy and Matter** ▪ Matter is conserved because atoms are conserved in physical and chemical processes. **MODULE: Cells and Heredity** **SE/TE:** 53, Figure 3 – Opposite Processes 54, What Happens During Fermentation? **TLR**: 41-49, Exhaling Carbon Dioxide

	MODULE: Human Body Systems **SE/TE:** 66-73, Food and Energy 80-85, The Digestive Process Begins 86-91, Final Digestion and Absorption **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary to MS-LS1-7)* **MODULE: Cells and Heredity** **SE/TE:** 44-49, Photosynthesis 50-55, Cellular Respiration	

MS.Matter and Energy in Organisms and Ecosystems
MS-LS2-1

Students who demonstrate understanding can:

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

INTERACTIVE SCIENCE: The concept of populations is explored in the *Ecology and the Environment* module in Chapter 1, Lesson 2, "Populations." The limiting factors on population growth are defined in "What Factors Limit Population Growth?" on SE/TE pages 15-16.

Students **graph** the factors that could affect a population's size "Growing and Shrinking" on TLR page 24. They **make models** about the limiting resources and the growth, and decrease of a population in "Elbow Room" on TLR page 25.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 provide evidence for phenomena. **MODULE: Ecology and the Environment** **TLR:** 13-21, Lab Investigation, World in a Bottle 24, Growing and Shrinking **Chapter Activities and Projects:** 50-56, What's a Crowd?	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **MODULE: Ecology and the Environment** **SE/TE:** 4-9, Living Things and the Environment **TE Only:** 9, Differentiated Instruction, Compare Habitats 9A, After the Inquiry Warm-Up, What's in the Scene? 9F, Enrich **TLR:** 11, Inquiry Warm-Up, What's in the Scene? 13-21, Lab Investigation, World in a Bottle ▪ In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. **MODULE: Ecology and the Environment** **SE/TE:** 15-17, What Factors Limit Population Growth?	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. **MODULE: Ecology and the Environment** **SE/TE:** 7, Apply It! 15, Relate Cause and Effect **TE Only:** 17, Differentiated Instruction, Classroom Density

	TE Only: 17, Differentiated Instruction, Classroom Density **TLR:** 25, Quick Lab, Elbow Room **Chapter Activities and Projects:** 50-56, What's a Crowd? ▪ Growth of organisms and population increases are limited by access to resources. **MODULE: Ecology and the Environment** **SE/TE:** 15-17, What Factors Limit Population Growth? **TE Only:** 17, Differentiated Instruction, Classroom Density **TLR:** 25, Quick Lab, Elbow Room **Chapter Activities and Projects:** 50-56, What's a Crowd?	

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to the Next Generation Science Standards – May, 2013
Grades 6-8

MS.Matter and Energy in Organisms and Ecosystems
MS-LS2-3

Students who demonstrate understanding can:

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

INTERACTIVE SCIENCE: Cycles of Matter are explored in the *Ecology and the Environment* module in Chapter 2, Lesson 2, "Cycles of Matter" on SE/TE pages 50-57. Students **obtain information** about the water cycle on SE/TE pages 50-51. They **learn** about the carbon cycle on SE/TE/ pages 52-53, and the nitrogen cycle on SE/TE pages 54-55. In the Enrich activity on TE page 57F, students **model** the carbon and oxygen cycle. Students **investigate** carbon and oxygen cycling in "Build Inquiry – Predict Carbon and Oxygen Cycling" on TE page 53.

Students **demonstrate** the water cycle in "Are You Part of the Water Cycle" on TLR page 52. Students **model** the water cycle in "Following the Water" on TLR page 53. Students **investigate** the carbon and oxygen cycles in "Carbon and Oxygen Blues" on TLR page 54. Students **model** the nitrogen cycle in "Playing Nitrogen Cycle Roles" on TLR page 55.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 describe phenomena. **MODULE: Ecology and the Environment** **TE Only:** 57F, Enrich – Testing for Oxygen and Carbon Dioxide **TLR:** 43-51, Laboratory Investigation, Ecosystem Food Chains 53, Quick Lab, Following Water 55, Quick Lab, Playing Nitrogen Cycle Roles	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** ▪ Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. **MODULE: Ecology and the Environment** **SE/TE:** 42-49, Energy Flow in Ecosystems 50-55, Cycles of Matter **TE Only:** 53, Differentiated Instruction 53, Build Inquiry – Predict Carbon and Oxygen Cycling 55, Differentiated Instruction, Nitrogen in the Soil 57F, Enrich – Testing for Oxygen and Carbon Dioxide	**Energy and Matter** ▪ The transfer of energy can be tracked as energy flows through a natural system. **MODULE: Ecology and the Environment** **SE/TE:** 42-49, Energy Flow in Ecosystems --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **MODULE: Ecology and the Environment** **TLR:** 43-51, Laboratory Investigation, Ecosystem Food Chains 52, Inquiry Warm-Up, Are You Part of a Cycle? 53, Quick Lab, Following Water 54, Quick Lab, Carbon and Oxygen Blues 55, Quick Lab, Playing Nitrogen Cycle Roles

	TLR: 43-51, Laboratory Investigation, Ecosystem Food Chains 52, Inquiry Warm-Up, Are You Part of a Cycle? 53, Quick Lab, Following Water 54, Quick Lab, Carbon and Oxygen Blues 55, Quick Lab, Playing Nitrogen Cycle Roles	

MS.Matter and Energy in Organisms and Ecosystems
MS-LS2-4

Students who demonstrate understanding can:

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

INTERACTIVE SCIENCE: The effect of a biological or physical component upon populations of species is presented in the *Ecology and the Environment* module in Chapter 3, Lesson 5, "Biodiversity." On SE/TE pages 108-110, the importance of keystone species is highlighted with the example of effects of sea otter decline and recovery. Students **learn** about the changes to populations caused by human activity, which change both physical and biological components of an ecosystem, in "How Do Humans Affect Biodiversity?" on SE/TE page 114. Students **model** the concept of keystone in "Modeling Keystones Species" on TLR page 93.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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(s). ▪ Construct an oral and written argument 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. **MODULE: Ecology and the Environment** **TLR**: 93, Modeling Keystones Species 95, Humans and Biodiversity --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science disciplines share common rules of obtaining and evaluating empirical evidence. **MODULE: Ecology and the Environment** **TLR**: 93, Modeling Keystones Species 95, Humans and Biodiversity	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ▪ Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **MODULE: Ecology and the Environment** **SE/TE:** 109, Ecological Value 110, Figure 2, Keystone Otters 114, Damaging Biodiversity **TE Only:** 113, Differentiated Instruction 114, Make Analogies – Habitat Destruction 115, Differentiated Instruction **TLR**: 93, Modeling Keystones Species 95, Humans and Biodiversity	**Stability and Change** ▪ Small changes in one part of a system might cause large changes in another part. **MODULE: Ecology and the Environment** **SE/TE:** 108, Ecological Value 109, Figure 2, Keystone Otters **TLR**: 93, Modeling Keystones Species 95, Humans and Biodiversity

MS.Interdependent Relationships in Ecosystems
MS-LS2-2

Students who demonstrate understanding can:

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

INTERACTIVE SCIENCE: Competition, predation, mutualism, and commensalism are introduced in the *Ecology and the Environment* module in Chapter 1, Lesson 3, "Interactions Among Living Things." Students **obtain information** about competition and predation in "What Are Competition and Predation?" on SE/TE pages 21-24. Students **learn** about symbiotic relationships in "What Are the Three Types of Symbiosis?" on SE/TE pages 25-27. Mutualism is explored on SE/TE page 25. Students **learn** about commensalism and parasitism on SE/TE page 26.

Students **write** about competition in an ecosystem in Figure 2 – Niche and Competition on SE/TE page 21. They **explain** the predator-prey relationship between wolf and moose on Isle Royale in "Do the Math! – Predator-Prey Interactions" on SE/TE page 24. Students **analyze** data relating to predator prey relationships in "Understanding Main Ideas" on TE page 27E and in "Analyzing Interactions Among Organisms" on TE page 27F. Students **model and explain the relationship between** competition and predation in the Quick Lab "Competition and Predation" on TLR page 28. They **classify** different types of symbiosis in "Type of Symbiosis" on TLR page 29.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. **MODULE: Ecology and the Environment** **SE/TE:** 24, Do the Math! **TE Only:** 27E, Understanding Main Ideas 27F, Enrich - Analyzing Interactions Among Organisms **TLR**: 28, Completion and Predation 29, Type of Symbiosis	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. **MODULE: Ecology and the Environment** **SE/TE:** 21-23, What are Competition and Predation? 24, Do the Math! 25, Mutualism 26, Commensalism 34, Review and Assessment Q#15 **TE Only:** 23, Differentiated Instruction 25, Differentiated Instruction 27E, Understanding Main Ideas 27F, Enrich - Analyzing Interactions Among Organisms **TLR**: 28, Completion and Predation 29, Type of Symbiosis	**Patterns** ▪ Patterns can be used to identify cause and effect relationships. **MODULE: Ecology and the Environment** **SE/TE:** 24, Do the Math! **TE Only:** 27E, Understanding Main Ideas 27F, Enrich - Analyzing Interactions Among Organisms

MS.Interdependent Relationships in Ecosystems
MS-LS2-5

Students who demonstrate understanding can:

Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

MODULE: Ecology and the Environment

STEM Activity Book
17-20, It's All Water Under the Dam

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

MODULE: Ecology and the Environment
SE/TE:
108-117, Biodiversity
116-117, Figure 6

LS4.D: Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.

MODULE: Ecology and the Environment
SE/TE:
92-97, Introduction to Natural Resources
108-117, Biodiversity
128-133, Conserving Land and Soil
142-151, Air Pollution and Solutions
152-159, Water Pollution and Solutions

TE Only:
133E, Enrich, The Copper Basin

TLR:
95, Quick Lab, Humans and Biodiversity

Crosscutting Concepts

Stability and Change
- Small changes in one part of a system might cause large changes in another part.

MODULE: Ecology and the Environment
SE/TE
89, Relate Cause and Effect
93, Relate Text and Visuals
115, Compare and Contrast

TE Only
115, Differentiated Instruction, Compare and Contrast

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- The use 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.

MODULE: Ecology and the Environment
SE/TE
86-91, Introduction to Environmental Issues
156-157, How Can Water Pollution Be Reduced?
157, Apply It!

TLR
74, Quick Lab, Comparing Costs and Benefits

	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. **MODULE: Ecology and the Environment** **SE/TE** 86-91, Introduction to Environmental Issues 157, Apply It!	-- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** ▪ Scientific knowledge can describes consequence of actions but does not make the decisions that society takes. **MODULE: Ecology and the Environment** **SE/TE** 86-91, Introduction to Environmental Issues 108-117, Biodiversity **TE Only:** 91E, Enrich, Congestion Pricing **TLR** 74, Quick Lab, Comparing Costs and Benefits

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

MS.Growth, Development, and Reproduction of Organisms
MS-LS1-4

Students who demonstrate understanding can:

Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced in the *Diversity of Life* Module.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
- Use an oral and written argument 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.

MODULE: The Diversity of Life
TE Only:
107, Elaborate: Lab Zone – Modeling Seed Dispersal
117, 21st Century Learning, Critical Thinking
251E, Enrich- Animal Reproduction and Fertilization
279, Differentiated Instruction – Make Analogies

TLR:
200, To Care or Not To Care

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms
- Animals engage in characteristic behaviors that increase the odds of reproduction.

MODULE: The Diversity of Life
SE/TE:
245-251, How Do Animals Reproduce?
259-261, How Do Animals Care for Their Young?
261, Do the Math!
262-269, What Is Behavior?
270-279, Patterns of Behavior
278-279, Birds of a Feather…

TE Only:
251E, Enrich- Animal Reproduction and Fertilization
259, Differentiated Instruction – Crocodile Mothers
260, Support the Big Q
266, Support the Big Q
273, Teacher Demo, Competition and Aggression
274, Build Inquiry – Group Safety
275, Differentiated Insruction – Drones
279, Differentiated Instruction – Make Analogies

TLR:
194, Making More
200, To Care or Not To Care
201, What Behaviors Can You Observe?
202, Animal Behavior

Crosscutting Concepts

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

MODULE: The Diversity of Life
SE/TE:
107, Target Skill: Related Cause and Effect
274-275, Cooperative Behavior
278-279, Birds of a Feather…

TE Only:
117, 21st Century Learning, Critical Thinking
274, Build Inquiry – Group Safety

	204, Communicating Without Words ▪ Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. **MODULE: The Diversity of Life** **SE/TE:** 100-109, Plant Structures 106, Figure 6: Story of a Seed 107, Target Skill: Related Cause and Effect 108, Figure 7: Pollinator Matchup 110-117, Plant Reproduction 117, Figure 5, Flower to Fruit **TE Only:** 105, Differentiated Instruction, Specialized Leaves 106, Lead a Discussion, Seed Dispersal and Germination 107, Elaborate: Lab Zone – Modeling Seed Dispersal 108, Explain: Teach With Visuals 109, Elaborate: Lab Zone – Observing the Structure of a Flower 115, Differentiated Instruction, Fire Pines 117, 21st Century Learning, Critical Thinking **TLR:** 92, Quick Lab, The In-Seed Story 93, Quick Lab: Modeling Flowers Inquiry Warm-Up 94, Inquiry Warm-Up, Make the Pollen Stick 96, Where Are the Seeds?	

MS.Growth, Development, and Reproduction of Organisms
MS-LS1-5

Students who demonstrate understanding can:

Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **MODULE: Cells and Heredity** **TE Only:** 91, Differentiated Instruction, Sex Determination in Reptiles **TLR:** 81, Is It All in the Genes?	**LS1.B: Growth and Development of Organisms** ▪ Genetic factors as well as local conditions affect the growth of the adult plant. **MODULE: Cells and Heredity** **SE/TE:** 86-91, Patterns of Inheritance 86, My Planet Diary 87, Figure 1- Other Patterns of Inheritance 91, Assess Your Understanding **TE Only:** 90, Lead a Discussion 91, Differentiated Instruction, Sex Determination in Reptiles 91A, Lab zone- After the Inquiry Warm-Up 91B, Assess Your Understanding **TLR:** 81, Is It All in the Genes?	**Cause and Effect** ▪ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **MODULE: Cells and Heredity** **SE/TE:** 86, Unlock the Big Question- How Do Genes and the Environment Interact? 88, Apply it! 90, Explore the Big Question- Patterns of Inheritance **TE Only:** 91D, Review and Reinforce 91E, Enrich **TLR:** 81, Is It All in the Genes?

MS.Growth, Development, and Reproduction of Organisms
MS-LS3-1

Students who demonstrate understanding can:

Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

INTERACTIVE SCIENCE: Harmful, beneficial, and neutral mutations are addressed in the *Cells and Heredity* module, Chapter 4, Lesson 3, SE/TE pages 118-123. In the Assess Your Knowledge feature on SE/TE page 120, students **explain** why mutations are harmful or beneficial. Students **model** what happens when errors occur in DNA sequences in "Oops!" on TLR page 105. Students **model** the effects of a mutation and **explain** why a mutation is beneficial or harmful in "Effects of Mutations" on TLR page 106.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. **TE Only:** 119, ELL Support 119, Support the Big Q **TLR:** 105, Inquiry Warm-Up, Oops! 106, Quick Lab, Effects of Mutations	**LS3.A: Inheritance of Traits** ▪ Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. **MODULE: The Cells and Heredity** **SE/TE:** 93-95, How Are Chromosomes, Genes, and Inheritance Related? 109-111, What Forms the Genetic Code? 118-123, Mutations **LS3.B: Variation of Traits** ▪ In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. **MODULE: The Cells and Heredity** **SE/TE:** 118-123, Mutations **TE Only:** 119, ELL Support 119, Support the Big Q	**Structure and Function** ▪ Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. **MODULE: Cells and Heredity** **TLR:** 105, Inquiry Warm-Up, Oops! 106, Quick Lab, Effects of Mutations

	TLR: 105, Inquiry Warm-Up, Oops! 106, Quick Lab, Effects of Mutations	

MS.Growth, Development, and Reproduction of Organisms
MS-LS3-2

Students who demonstrate understanding can:

Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

INTERACTIVE SCIENCE: The citations below indicate areas in ***Interactive Science*** where this idea is introduced.

Students **obtain information** about sexual and asexual reproduction in the *Diversity of Life* module in Chapter 7, Lesson 1, "How Do Animals Reproduce?" on SE/TE page 245-247.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena.

MODULE: The Diversity of Life
TLR:
194, Inquiry Warm-Up, Making More

MODULE: The Cells and Heredity
71-78, Lab Investigation, Make the Right Call!

Chapter Activities and Projects:
99-105, All in the Family

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms
- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

MODULE: The Diversity of Life
SE/TE:
245, Asexual Reproduction
246, Sexual Reproduction
247, Comparing Asexual and Sexual Reproduction
247, Figure 3, Asexual and Sexual Reproduction

TLR:
194, Inquiry Warm-Up, Making More

LS3.A: Inheritance of Traits
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

MODULE: The Cells and Heredity
SE/TE:
74-79, What Is Heredity?
80-85, Probability and Heredity
86-91, Patterns of Inheritance
92-97 Chromosomes and Inheritance

TLR:
67, Quick Lab, Inferring the Parent Generation

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural systems.

MODULE: The Diversity of Life
SE/TE:
247, Comparing Asexual and Sexual Reproduction

MODULE: The Cells and Heredity
TLR:
67, Quick Lab, Inferring the Parent Generation
71-78, Lab Investigation, Make the Right Call!

	LS3.B: Variation of Traits ▪ In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. **MODULE: The Cells and Heredity** **SE/TE:** 86-91, Patterns of Inheritance 92-97 Chromosomes and Inheritance **TLR:** 67, Quick Lab, Inferring the Parent Generation 71-78, Lab Investigation, Make the Right Call! **Chapter Activities and Projects:** 99-105, All in the Family	

MS.Growth, Development, and Reproduction of Organisms
MS-LS4-5

Students who demonstrate understanding can:

Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

INTERACTIVE SCIENCE: Analysis of the production of desired traits is presented in the *Cells and Heredity* module in Chapter 5, Lesson 3, "How Can Organisms Be Produced With Desired Traits?" on SE/TE pages 146-151.

Students **model** selective breeding in "Selective Breeding" on TLR page 132 in Lesson 3. They **create an outline** to organize information about methods of developing organisms with desirable traits in the Ask Questions feature on SE/TE page 147. Students **graph and analyze data** about production of rice influenced by genetic factors in the Do the Math! feature on SE/TE page 149.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. ▪ Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. **MODULE: Cells and Heredity** **SE/TE:** 160, Science Matters, Mini But Mighty **TE Only:** 150, 21st Century Learning, Information Literacy 151, Differentiated Instruction, Genetically Engineered Medicine	**LS4.B: Natural Selection** ▪ In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. **MODULE: Cells and Heredity** **SE/TE:** 146-151, How Can Organisms Be Produced With Desired Traits? **TE Only:** 147, Lead a Discussion – Breeding Pets 149, Differentiated Instruction 149, Make Analogies - Cloning 150, 21st Century Learning 151E, Enrich, A Closer Look at Gene Therapy for Cystic Fibrosis **TLR:** 132, Quick Lab, Selective Breeding	**Cause and Effect** ▪ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **MODULE: Cells and Heredity** **SE/TE:** 148, Apply It! --- ***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. **MODULE: Cells and Heredity** **SE/TE:** 146-151, How Can Organisms Be Produced With Desired Traits? 160, Science Matters, Mini But Mighty **TE Only:** 150, 21st Century Learning, Information Literacy 151, Differentiated Instruction, Genetically Engineered Medicine

		-- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** ▪ Science knowledge can describe consequences of actions but does not make the decisions that society takes. **MODULE: Cells and Heredity** **SE / TE:** 160, Science Matters, Mini But Mighty **TE Only:** 149, Differentiated Instruction 150, 21st Century Learning, Information Literacy

MS.Natural Selection and Adaptations
MS-LS4-1

Students who demonstrate understanding can:

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]

INTERACTIVE SCIENCE: Patterns of change in fossils are explored in the *Earth's Surface* module in Chapter 4, Lesson 1, "What Do Fossils Show?" on SE/TE pages 108-109. Students **analyze** information about the relationship of an extinct horse-like species to modern horses in the Challenge question on SE/TE page 108. In Assess Your Understanding on SE/TE page 109, students **write to explain** what the fossil record shows. In Review and Assessment, question 23 on SE/TE page 142, students **analyze** an image of a fossil, **make inferences** about the organism and its environment, and **provide evidence** for their inferences. On TE page 109D, Key Concept Summaries, students **explain** how fossils help scientists make discoveries about lives of organisms. On TLR page 102, students will **infer** what trace fossils tell you about an organism in "Modeling Trace Fossils." Students **infer and model** what fossils can tell you about Earth's past in "Modeling the Fossil Record" on TLR page 103.

Patterns of change in fossils content is also presented in the *Cells and Heredity* module in Chapter 6, Lesson 2. The relationship between homologous structures in modern and extinct animals is presented on SE/TE page 178. In Chapter 6, Lesson 3, information on how the fossil record provides evidence for the rate of evolution can be found on SE/TE pages 182-183. Students **analyze** and **interpret** fossils relating to horse evolution in Figure 2 on SE/TE page 182. Students **analyze** and **interpret** a hypothetical case of punctuated equilibrium in "Rate of Change" on TE page 183E. In "Walking Whales," SE/TE page 189, students **trace** the fossil history of the ancestor species to whales.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Cells and Heredity** **TE Only:** 178, Build Inquiry, Observe Similar Species **MODULE: Earth's Surface** **TLR:** 102, Modeling Trace Fossils 103, Modeling the Fossil Record	**LS4.A: Evidence of Common Ancestry and Diversity** ▪ The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. **MODULE: Earth's Surface** **SE/TE:** 108-109, What Do Fossils Show? 142, Review and Assessment, Q# 23 **TE Only:** 109D, Key Concept Summaries **TLR:** 102, Modeling Trace Fossils 103, Modeling the Fossil Record	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. **MODULE: Cells and Heredity** **SE/TE:** 178, Similarities in Body Structure 183, Apply It --------------------------- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **MODULE: Cells and Heredity** **SE/TE:** 178, Similarities in Body Structure

-- ***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. **MODULE: Cells and Heredity** **SE / TE:** 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution? 189, Walking Whales **TE Only:** 183E, Rate of Change	**MODULE: Cells and Heredity** **SE / TE:** 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution? 189, Walking Whales **TE Only:** 183E, Rate of Change	182-183, What Patterns Describe the Rate of Evolution? 183, Apply It 189, Walking Whales

MS.Natural Selection and Adaptations
MS-LS4-2

Students who demonstrate understanding can:

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

INTERACTIVE SCIENCE: Information on patterns of change in fossils is explored in the *Earth's Surface* module in Chapter 4, Lesson 1, "What Do Fossils Show?" on SE/TE pages 108-109. Students **analyze information** about the Hyracotherium to explain its relationship to modern horses in the Challenge question on SE/TE page 108.

Information is also found in the *Cells and Heredity* module in Chapter 6, Lesson 2. Similarities in early development anatomical structures of modern organisms are discussed on SE/TE page 177. How fossils allow scientists to infer the structures of ancient organisms is described on SE/TE page 177. The relationship between homologous structures in modern and extinct animals is discussed on SE/TE page 178. Students **examine** horse evolution and **explain** how the evolution of the shape of the leg and number of toes would have benefited *Equus* on SE/TE page 182. Students **analyze and interpret** a hypothetical case of punctuated equilibrium in "Rate of Change" on TE only page 183E. In "Walking Whales," SE/TE page 189, students **research** the evolutionary history of the ancestor species to whales.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 to construct an explanation for real-world phenomena, examples, or events. **MODULE: Earth's Surface** **SE/TE:** 108-109, What Do Fossils Show? **MODULE: Cells and Heredity** **SE/TE:** 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution? 189, Walking Whales	**LS4.A: Evidence of Common Ancestry and Diversity** ▪ Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. **MODULE: Earth's Surface** **SE/TE:** 108-109, What Do Fossils Show? **TE Only:** 109D, Key Concept Summaries **MODULE: Cells and Heredity** **SE/TE:** 108-109, What Do Fossils Show? 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution? 185, Review and Assessment, Q#9 189, Walking Whales **TE Only:** 183E, Rate of Change	**Patterns** ▪Patterns can be used to identify cause and effect relationships. **MODULE: Cells and Heredity** **SE/TE:** 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution? -- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **MODULE: Cells and Heredity** **SE/TE:** 108-109, What Do Fossils Show? 178, Similarities in Body Structure 182-183, What Patterns Describe the Rate of Evolution?

MS.Natural Selection and Adaptations
MS-LS4-3

Students who demonstrate understanding can:

Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]

INTERACTIVE SCIENCE: The similarities in early development of different organisms are discussed in the *Cells and Heredity* module in Chapter 6, Lesson 2, "What Evidence Supports Evolution?" on SE/TE page 177. Students **analyze** visual representations to **compare** the anatomical differences between four organisms in Figure 1, "Similarities in Development" on page 177. In the TE, Teach with Visuals supports students in this effort.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 displays of data to identify linear and nonlinear relationships. **MODULE: Cells and Heredity** **SE/TE:** 177, What Evidence Supports Evolution? 177, Figure 1, Similarities in Devleopment **TE Only:** 177, Teach with Visuals	**LS4.A: Evidence of Common Ancestry and Diversity** ▪ Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. **MODULE: Cells and Heredity** **SE/TE:** 177, What Evidence Supports Evolution? 177, Figure 1, Similarities in Devleopment **TE Only:** 177, Teach with Visuals	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. **MODULE: Cells and Heredity** **SE/TE:** 177, What Evidence Supports Evolution? 177, Figure 1, Similarities in Devleopment **TE Only:** 177, Teach with Visuals

MS.Natural Selection and Adaptations
MS-LS4-4

Students who demonstrate understanding can:

Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations

INTERACTIVE SCIENCE: Natural selection is explained in the *Cells and Heredity* module in Chapter 6, Lesson 1, "What Is Natural Selection?" on SE/TE pages 172-176. Students **write** about the factors that affect natural selection in Figure 5 – Factors That Affect Natural Selection" on SE/TE pages 172-173. In Do the Math!, SE page 174, students **speculate** on loggerhead turtle nesting sites in the Challenge question. Students **draw a conclusion** about genetic variation and natural selection in "Figure 6 – Environmental Change' on SE/TE page 175. In Assess Your Understanding, students **answer** the big question, #2b, and **relate** cause and effect, #2c. In Enrich, Darwin's Theory, TE page 175F, students **communicate** evolution theories of long-necked giraffes to Darwin's theory of evolution. Students **model** natural selection in "Nature at Work" on TLR pages 148-156. In Review and Assessment, p. 186, #15, students **predict** what changes would be observed as a result of environmental change. In Standardized Test Prep, #6, students **describe** a situation in which natural selection would favor flies with small wings.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. **MODULE: Cells and Heredity** **SE/TE:** 175, Assess Your Understanding, #2b, 2c, Got it? 186, Review and Assessment, Apply the Big Q, #15. 187, Standardized Test Prep, Constructed Response, #6 **TE Only:** 175F, Enrich, Darwin's Theory **TLR:** 148-156, Nature at Work	**LS4.B: Natural Selection** ▪ Natural selection leads to the predominance of certain traits in a population, and the suppression of others. **MODULE: Cells and Heredity** **SE/TE:** 172, Factors That Affect Natural Selection, Figure 5- Factors That Affect Natural Selection 175, Figure 6- Environmental Change, Assess Your Understanding, #2b, 2c, Got it? 186, Review and Assessment, Apply the Big Q, #15. 187, Standardized Test Prep, Constructed Response, #6 **TE Only:** 175F, Enrich, Darwin's Theory **TLR**: 148-156, Nature at Work	**Cause and Effect** ▪Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **MODULE: Cells and Heredity** **SE/TE:** 173, Relate Cause and Effect 174, Do the Math! 175, Figure 6- Environmental Change 175, Assess Your Understanding, #2c

MS.Natural Selection and Adaptations
MS-LS4-6

Students who demonstrate understanding can:

Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

INTERACTIVE SCIENCE: Natural selection is explained in the *Cells and Heredity* module in Chapter 6, Lesson 1, "What Is Natural Selection?" on SE/TE pages 172-176. Students **use** a mathematical model of natural selection in "Nature at Work" on TLR pages 148-156.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. ▪ Use mathematical representations to support scientific conclusions and design solutions. **MODULE: Cells and Heredity** **SE/TE:** 174, Do the Math! **TLR**: 148-156, Nature at Work	**LS4.C: Adaptation** ▪ Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. **MODULE: Cells and Heredity** **SE/TE:** 172-176, What Is Natural Selection? 172, Factors That Affect Natural Selection 174, Do the Math! **TLR**: 148-156, Nature at Work	**Cause and Effect** ▪ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **MODULE: Cells and Heredity** **SE/TE:** 174, Do the Math! **TLR**: 148-156, Nature at Work

MS.Space Systems
MS-ESS1-1

Students who demonstrate understanding can:

Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

INTERACTIVE SCIENCE: The concept of patterns of motion of celestial bodies, including the motions of Earth, the moon, and the sun, is introduced at the start of the *Astronomy and Space Science* module with the photograph on SE/TE page 1. From that point on, every section relates occurrences such as the occurrence of day and night, eclipses, and lunar phases to the patterns of the observed motions of celestial bodies. Rotation and day/night cycles are shown on SE/TE page 11, and seasons are shown on pages 14-15. Students **learn** about lunar phases on SE/TE pages 22-24 and eclipses on pages 25-26.

Students **analyze** various figures, **mark** the pictures, and **complete** illustrations that reinforce the concept of how objects change position in the sky on SE/TE pages 8-12. Students **calculate** hours of sunlight on SE/TE page 17. On SE/TE page 20, students **interpret data** from a graph about the moon's orbit. Students **make a model** of the Earth-sun-moon system to describe lunar phases in the Apply It! on SE/TE page 24. They **use a model** of the Earth-sun-moon system to describe lunar phases in Figure 2 on page SE/TE page 24. They **use a model** of the Earth-sun-moon system to describe eclipses in Figure 3 on SE/TE page 25 and Figure 4 on SE/TE page 26. They **use a model** of the Earth-sun-moon system to represent eclipses in the Teacher to Teacher activity on TE page 26. They also **use a model** of the Earth-sun-moon system to describe seasons, lunar phases, and eclipses in Figure 5 on SE/TE page 27. They **develop and use a model** of the Earth-sun-moon system to represent eclipses in the Differentiated Instruction on TE page 27. They **use a model** of the Earth-sun-moon system to describe tides on SE/TE page 30. Students **demonstrate** their content knowledge in Assess Your Understanding, SE/TE: 27, 1a, 1b and Got it? On TE page 27C, students **construct explanations** of how the interaction of the moon, Earth, and sun cause phases of the moon and eclipses.

Students **make models** of how Earth's rotation causes day and night on TLR page 16. They **model** how tilting of Earth's axis causes the seasons, on TLR page 19. Students **model** the Earth-sun-moon system to describe lunar phases on TLR page 31. They **model** the Earth-sun-moon system to describe eclipses on TLR page 32.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. **MODULE: Astronomy and Space Science** **SE/TE:** 15, Figure 4: Seasons 23, Figure 1: The Moon's Motion 24, Apply It! 25, Figure 3: Solar Eclipse 26, Figure 4: Lunar Eclipse 27, Figure 5 Seasons and Shadows	**ESS1.A: The Universe and Its Stars** ▪ Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. **MODULE: Astronomy and Space Science** **SE/TE:** 11, How Does Earth Move? 15, What Causes Seasons? 24, Phases of the Moon 25, What Are Eclipses? 29, What Are Tides? **TE Only:** 27C, Key Concept Summaries	**Patterns** ▪ Patterns can be used to identify cause and effect relationships. **MODULE: Astronomy and Space Science** **SE/TE:** 11, How Does Earth Move? 14, What Causes Seasons 15, Figure 4: Seasons 22, What Causes the Moon's Phases? 23, Figure 1: The Moon's Motions 24, Figure 2: Moon Phases

TE Only: 15, Build Inquiry: Compare and Contrast Angles of Sunlight 15: Differentiated Instruction: Model 27, Differentiated Instruction: Model Eclipses **TLR:** 16, What Causes Day and Night? 17, Sun Shadows 18-26, Reasons for the Seasons 31, Moon Phases 32, Eclipses	**TLR:** 15, Watching the Skies 16, What Causes Day and Night? 17, Sun Shadows 18-26, Reasons for the Seasons 29, Around and Around We Go 30, How Does the Moon Move? 31, Moon Phases 32, Eclipses **ESS1.B: Earth and the Solar System** ▪ This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. **MODULE: Astronomy and Space Science** **SE / TE:** 11-12, How Does Earth Move? 14-17 What Causes Seasons? 22-24, What Causes the Moon's Phases? 23, Figure 1: The Moon's Motions 24, Figure 2: Moon Phases 25-26, What Are Eclipses? 25, Figure 3: Solar Eclipse 26, Figure 4: Lunar Eclipse **TE Only:** 17D, Understanding Main Ideas 27C, Key Concept Summaries 27D, Understanding Main Ideas **TLR:** 18-26, Reasons for the Seasons 30, How Does the Moon Move? 31, Moon Phases 32, Eclipses	**TE Only:** 17E, Enrich – Build a Simple Sundial 27C, Key Concept Summaries ------------------------------------ ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **MODULE: Astronomy and Space Science** **SE / TE:** 8-9, How Do Objects in the Sky Appear to Move? 10-17, Earth in Space 22-27, Phases and Eclipses 28-31, Tides 79-81, What Was the Geocentric Model? **TE Only:** 9E, Enrich – The Phases of Venus 17E, Enrich – Build a Simple Sundial 31E, Enrich – What Affects the Heights of Tides? 81E, Enrich – The Phases of Venus **TLR:** 16, What Causes Day and Night? 17, Sun Shadows 18-26, Reasons for the Seasons 31, Moon Phases 32, Eclipses 83-91, Speeding Around the Sun

MS.Space Systems
MS-ESS1-2

Students who demonstrate understanding can:

Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
[Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

INTERACTIVE SCIENCE: Students **learn** about gravity and the factors that determine the strength of the force of gravity between two objects in Chapter 1, Lesson 3, "Gravity and Motion" on SE/TE pages 18-21 of the *Astronomy and Space Science* module. Students **obtain information** about the role gravity plays in orbital motions in "What Keeps Objects in Orbit?" on page 20. Students **use a model** to predict how the motion of Earth's moon would change if the force of Earth's gravity increased in "Figure 2 – Orbital Motion" on SE/TE page 20. Students **learn** about the role gravity played in the formation of the solar system and gravity's role in holding the solar system together in "How Did the Solar System Form?" on SE/TE page 86. Students **learn** about the role gravity plays in the motion of stars within star systems in "What Is a Star System?" on SE/TE page 148. They **obtain knowledge** about the role gravity plays in pulling together gases to form stars in "Make Analogies" on TE page 152. Students **learn** how the force of gravity might reverse the current expansion of the universe and begin to pull all the galaxies of the universe together on SE/TE page 156 "The Big Bang and the Future of the Universe." They **use a model** to show how gravity might pull all the galaxies of the universe together in "Figure 2 – The Big Crunch" on SE/TE page 156.

On TE page 83, ELL Support, students **complete** a flowchart to show the formation of the solar system as a result of gravity pulling materials together to form a cloud. On TE page 162, Hot Science, students **obtain information** about how the gravity of a black hole pulls everything within its gravitational field into it. Students **use a model** to represent how gravity helps to determine the orbit of objects in the solar system in "Around and Around We Go" on TLR page 29. Students **use a model** to show the formation of the solar system as a result of gravity pulling together rock, gas, ice and other material in "Clumping Planets" on TLR page 92. Students **use a model** to show the effect of planetary gravity on the orbits of comets and asteroids in "Changing Orbits" on TLR page 103. Students **use a model** to describe the movement of galaxies in the universe in "How Does the Universe Expand?" on TLR page 138. Students **develop and use a model** to describe motions within the solar system in "Speeding Around the Sun" on TLR pages 88-91; in this lab students **describe** the role gravity plays in the motion of planets in the solar system in "Communicate" on page 91. Students **use a model** to explore how gravity could pull all the galaxies of the universe together in a "big crunch" in "The Future of the Universe" on TLR page 139.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. **MODULE: Astronomy and Space Science** **SE/TE:** 20, Figure 2: Orbital Motion 86, Figure 2: Formation of the Solar System 149, Figure 1: Invisible Partner	**ESS1.A: The Universe and Its Stars** ▪ Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **MODULE: Astronomy and Space Science** **SE/TE:** 152-153, What Are the Major Types of Galaxies? 154-155, What Does the Big Bang Theory Say About the Universe?	**Systems and System Models** ▪ Models can be used to represent systems and their interactions. **MODULE: Astronomy and Space Science** **SE/TE:** 20, Figure 2: Orbital Motion 149, Figure 1: Invisible Partner 155, Apply It! 156, Figure 2: The Big Crunch

156, Figure 2: The Big Crunch **TLR:** 29, Around and Around We Go 92, Clumping Planets 83-91, Speeding Around the Sun 103, Changing Orbits 138, How Does the Universe Expand 139, The Future of the Universe	**TE Only:** 153, Differentiated Instruction – L1 Where in the Milky Way Are We? 153E, Enrich – Star Systems and Galaxies **TLR:** 135, Why Does the Milky Way Look Hazy? 138, How Does the Universe Expand? 139, The Future of the Universe **ESS1.B: Earth and the Solar System** ▪ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. **MODULE: Astronomy and Space Science** **SE/TE:** 82-87, Introducing the Solar System 88-93, The Sun 94-101, The Inner Planets 102-109, The Outer Planets 110-115, Smal Solar System Objects **TE Only:** 83, Teach Key Concepts, Lead a Discussion 84, Teacher to Teacher 85, Differentiated Instruction – L1 Make Flashcards 91, Differentiated Instruction – L1 Interpret Diagrams 101, Differentiated Instruction – L1 Oral Review 101D, Review and Reinforce 105, 21st Century Learning 107, Teacher Demo – Compare and Contrast Planets 113, Differentiated Instruction – L1 Make Flashcards 115, Differentiated Instruction – L3 Multimedia Presentation **TLR:** 83-91, Speeding Around the Planets 97, Characteristics of the Inner Planets 99, How Big Are the Planets? 100, Density Mystery 102, Collecting Micrometeorites **ESS1.B: Earth and the Solar System**	**TLR:** 29, Around and Around We Go 83-91, Speeding Around the Sun 92, Clumping Planets 103, Changing Orbits 138, How Does the Universe Expand? 139, The Future of the Universe --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **MODULE: Astronomy and Space Science** **SE/TE:** 18, What Determines Gravity? 20, What Keeps Objects in Orbit? 148, What Is a Star System? **TLR:** 83-91, Speeding Around the Sun 103, Changing Orbits 138, How Does the Universe Expand? 139, The Future of the Universe

	▪ The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. **MODULE: Astronomy and Space Science** **SE/TE:** 86-87, How Did the Solar System Form? **TE Only:** 83, ELL Support **TLR:** 92, Clumping Planets	

MS.Space Systems
MS-ESS1-3

Students who demonstrate understanding can:

Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

INTERACTIVE SCIENCE: Data and other information about properties of objects in the solar system, including planets, dwarf planets, comets, asteroids, and meteors, are detailed in the *Astronomy and Space Science* module, Chapter 3, Lessons 1-6. The concept of scale and distance in the solar system is discussed in Lesson 2, "Introducing the Solar System," page 83. The relative sizes of the planets and data related to their orbital radii and orbital periods are presented in "Figure 1 - The Solar System" on pages 84-85. The use of the telescopes to obtain data related to objects in in the solar system and in the universe is discussed in "My Planet Diary: Galileo Galiliei" on SE/TE page 32, "Galileo's Evidence" on SE/TE page 81, "My Planet Diary: Predicting a Planet" on SE/TE page 102, "Figure 3: The Hubble Space Telescope" on SE/TE page 129, and "Black Holes" on SE/TE page 162. The use of spacecraft, including rockets, lunar landers, probes, and space stations, to obtain data is discussed in "After Apollo: Exploring the Moon" on SE/TE page 41, "Figure 2: Major Events in Moon Exploration" on SE/TE pages 54–55, "The History of Space Exploration" on SE/TE pages, "Space Stations" on SE/TE page 58, and the Apply It! activity on SE/TE pages 60–61. Individual spacecraft used to explore specific planets in the solar system is detailed in "What Are the Characteristics of the Inner Planets?" on pages 96–101 and "What Are the Characteristics of the Outer Planets?" on SE/TE pages 104–109.

Students **interpret data** and **draw** the scale distance of each planet from the sun in "Figure 1 – The Solar System" on SE/TE pages 84-85 in the *Astronomy and Space Science* module. Students **learn** about scale properties of the inner planets in Chapter 3, Lesson 4, pages 94-101. Students **analyze and interpret data** related to scale properties of objects in the universe in "Figure 1 – The Inner Planets," page 95. Students **compare** the size and mass of Earth with the size and mass of Venus in the Teacher Demo activity on TE page 97. Students **interpret data** related to the atmospheres of Earth and Venus in "Enrich: Atmosphere of Earth and Venus" on TE page 101E. Students **analyze and interpret data** related to scale properties of objects in the universe in "Figure 1 – The Outer Planets," page 103. Students **calculate** the size of Jupiter's Great Red Spot relative to the size of storms on Earth in "Figure 2 – The Great Red Spot," page 104. Students **test** each other's knowledge of properties of the planets, including relative size, in Differentiated Instruction" on TE page 85. Students **interpret photographs** to compare sizes of Jupiter's moons in "Differentiated Instruction: Photo Research" on TE page 105. Students **compare** the orbital radii of Neptune and Pluto in "The Outer Planets" on TE pgae 109E. Students **make a model** of the solar system to show relative distances from the sun to each planet in "Alternate Assessment" on TE page 117. Students **compare** the size of Earth to the size of the sun in "How Big Is Earth?" on TLR page 82. Students **investigate** the relationship between a planet's period of rotation and its distance from the sun in "Speeding Around the Sun" on TLR pages 83-91. Students **make a model** of the sun's layers in "Layers of the Sun" on TLR page 94. Students **compare** the sizes of the planets in "How Big Are the Planets?" on TLR page 99.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Astronomy and Space Science** **SE/TE:** 79, Apply It! 80-81, Figure 1: Changing Models 102, My Planet Diary: Predicting a Planet **TLR:** 79, What Is at the Center?	**ESS1.B: Earth and the Solar System** ▪ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. **MODULE: Astronomy and Space Science** **SE/TE:** 18-21, Gravity and Motion 82-87, Introducing the Solar System 88-93, The Sun 94-101, The Inner Planets 102-109, The Outer Planets 110-115, Small Solar System Objects **TE Only:** 21E, Enrich – Your Weight in the Solar System 83, ELL Support 87E, Enrich – Planets for Human Settlement 91, Differentiated Instruction 93E, Enrich – Sunspot Clues 97, Differentiated Instruction – L1 Compare and Contrast Inner Planets 97, Teacher Demo – Venus's Rotation 99, Build Inquiry – Interpret the Greenhouse Effect 101E, Enrich – Atmospheres of Earth and Venus 105, 21st Century Learning 105 – Differentiated Instruction – L3 Photo Research 107, Teacher Demo – Compare and Contrast Planets 109E, Enrich – The Orbits of Neptune and Pluto 115E, Enrich – Evidence of a Large Meteorite **TLR:** 27, What Factors Affect Gravity? 29, Around and Around We Go 36, Moonwatching 83, Speeding Around the Sun 93, How Can You Safely Observe the Sun? 95, Viewing Sunspots 99, How Big Are the Planets? 101, Make a Model of Saturn 102, Collecting Micrometeorites	**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. **MODULE: Astronomy and Space Science** **SE/TE:** 24, Apply It! 27, Figure 5, Seasons and Shadows 78-81, Models of the Solar System 80-81, Figure 1: Changing Models 84-85, Figure 1: The Solar System **TE Only:** 27, Differentiated Instruction 81, Build Inquiry – Model the Movements of the Inner Planets 84, Teacher to Teacher 104, Teacher Demo – Model the Great Red Spot **TLR:** 16, What Causes Day and Night? 16-26, Reasons for the Seasons 28, What's Doing the Pulling? 32, Eclipses 34, Modeling the Moon's Pull of Gravity 79, What Is at the Center? 80, Going Around in Circles 82, How Big Is Earth? 83-91, Speeding Around the Sun 92, Clumping Planets 96, Ring Around the Sun 98, Greenhouse Effect 99, How Big Are the Planets? 101, Make a Model of Saturn 103, Changing Orbits --------------------------------------- ***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. **MODULE: Astronomy and Space Science** **SE/TE:** 46-51, The Science of Rockets

		52-61, The History of Space Exploration 62-67, Using Space Science on Earth 72, One Ticket to Space, Please 73, Living in Space: The Expedition 18 Crew 82, Planet Diary – Extreme Conditions 128-131, What Are Telescopes and How Do They Work? **TE Only:** 46A, Content Refresher – *Atlas* Rockets 48, Build Inquiry – Draw Conclusions About Rocket Propulsion Technologies 50, 21st Century Learning 51 Differentiated Instruction 51F, Enrich – The Science of Rockets 52A, Content Refresher – History of NASA 55, Build Inquiry – Apply the Concept of Moon Exploration 64, 21st Century Learning 67, Differentiated Instruction – L1 Make a Concept Map 67F, Enrich – Geostationary Orbits and Polar Orbits 129, Differentiated Instruction – L3 History of the Telescope 131, Teacher Demo – Locating Radio Waves **TLR:** 49, Modeling Multistage Rockets 51, Humans in Space 54, Using Space Science 56-64, Space Spinoffs 65, Useful Satellites 11-125, Design and Build a Telescope

MS.History of Earth
MS-ESS1-4

Students who demonstrate understanding can:

Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

INTERACTIVE SCIENCE: The concept that fossils preserved in rock are a source of evidence about past life and environments on Earth is presented in the *Earth's Surface* module in Chapter 4, Lesson 1, on SE/TE pages 104-109. How scientists use rock strata and fossil records to determine the relative ages of rocks is explored in "The Relative Age of Rocks" on SE/TE pages 110-115. How scientists use rock strata and the fossil record to develop the geologic time scale is described in Chapter 4, Lesson 4, on SE/TE pages 120-123. How scientists use radioactive dating of rocks to determine major events in Earth's past, such as the formation of Earth and the formation of the continents, is discussed in "Early Earth" on SE/TE pages 124-127. The organization of the geologic time scale and the evolution of living organisms (including humans) is described in "Eras of Earth's History" on SE/TE pages 128-139.

Students **obtain information** about the concepts of relative and absolute age of rock, along with the law of superposition for sedimentary layering, on SE/TE page 111. Students **learn** how igneous intrusion and faulting in rock strata can be used to determine the relative age of rock on SE/TE page 112. Gaps in the geologic record caused by erosion, deposition, and folding of rock strata are covered on SE/TE page 114-115. Students **interpret diagrams** of index fossils in rock stata in SE/TE "Figure 4 – Index Fossils" on SE/TE page 113. Students **identify** which organisms lived during specific geologic eras and geologic periods in "Figure 2 – The Geologic Time Scale" on SE/TE page 122 and in "Figure 6 – Geologic Periods" on SE/TE pages 136-139. Students **interpret a diagram** of rock layers in the Grand Canyon in "Enrich – A Young Canyon Made of Old Layers" on TE page 123E. Students **describe** the extinction of the dinosaurs in "Figure 4 – The End of the Dinosaurs" on SE/TE page 134. Students **sequence** events related to the formation of Earth's oceans on SE/TE page 126. Students **model** layering and deformed rock sequences in "Which Layer Is the Oldest" on TLR page 104 and "How Did It Form?" on TLR page 114. Students **model** core samples of rock as evidence used to organize geologic time in "Exploring Geologic Time Through Core Samples" on TLR page 105-113.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 suppoted by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **MODULE: Earth's Surface** **SE/TE** 110, How Old Are Rock Layers? 112, Apply It!	**ESS1.C: The History of Planet Earth** • The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. **MODULE: Earth's Surface** **SE/TE:** 108, What Do Fossils Show? 110, How Old Are Rock Layers? 111, Figure 1: Rock Layers in the Grand Canyon 112, Figures 2 & 3: Intrusion, Fault 112, Apply It! 113, Index Fossils	**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. **MODULE: Earth's Surface** **SE/TE:** 111, Figure 1: Rock Layers in the Grand Canyon 113, Figure 4: Index Fossils 114, Figure 5: Unconformities and Folding 120, My Planet Diary – Earth's History in a Day 136, How Do Scientists Study Earth's past?

113, Figure 4: Index Fossils 114, How Can Rock Layers Change? 115, Apply It! 125, How Did Earth Form? 126, Sequence and Applyt It! 134, Figure 4: The End of the Dinosaurs **TE Only:** 115E, Enrich – The Grandest Canyon of All 127E, Enrich – Life and Earth's Atmosphere 129, 21st Century Learning 139F, Enrich – The End of an Era **TLR** 100, What's In a Rock? 105-113, Exploring Geologic Time Through Core Samples 114, How Did It Form? 120, How Could Planet Earth Form in Space? 124, Modeling an Asteroid Impact	114, How Can Rock Layers Change? 114, Figure 5: Unconformities and Folding 114, Target Skill: Relate Text and Visuals 115, Apply It! 116, What is Radioactive Dating? 117, Half-Life 118, What Is Radioactive Dating? 118, Do the Math 119, Using Carbon-14 Dating 120, My Planet Diary 121, The Geologic Time Scale 145, Frozen Evidence **TE Only:** 113, Build Inquiry, Compare Rock Samples 115, Differentiated Instruction 115, Make Analogies – Folding Layers Under 115E, Enrich – The Grandest Canyon of All 119, Build Inquiry – Model Radioactive Dating 119E, Enrich – Radioactive Dating 123, Differentiated Instruction 123, Build Inquiry – Compare and Contrast Visuals 123E, Enrich – The Geologic Time Scale 127E, Enrich – Life and Earth's Atmosphere 129, 21st Century Learning 139F, Enrich – The End of an Era **TLR:** 100, What's In a Rock? 104, Which Layer Is the Oldest? 105–113, Exploring Geologic Time Through Core Samples 114, How Did It Form? 116, The Dating Game 117, How Old Is It? 123, Graphing the Fossil Record	139, Answer the Big Question **TE only:** 119, Build Inquiry – Model Radioactive Dating **TLR:** 101, Fossils 102, Modeling Trace Fossils 103, Modeling the Fossil Record 105, Exploring Geologic Time Through Core Samples 115, How Long Till It's Gone?

MS.History of Earth
MS-ESS2-2

Students who demonstrate understanding can:

Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Carification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

INTERACTIVE SCIENCE: The processes of weathering, erosion, and deposition, and how these processes change Earth's surface, are explored in Chapter 2, Lesson 1 and Chapter 3, Lesson 1-5 of the *Earth's Surface* module. Students learn about erosion and deposition by water, ice, and wind in the Chapter 3 lessons on Water Erosion, Glacial Erosion, Wave Erosion, and Wind Erosion. Landslides and other forms of mass movement that change Earth's surface are discussed in the Chapter 3 lesson on Mass Movement.

How forces deep inside Earth and at Earth's surface build, destroy, and change rock on Earth's surface (and in Earth's crust) is discussed in Chapter 2, Lesson 6 "The Rock Cycle" on pages 62-65 of the module *Earth's Structure*,. The ways in which Earth's tectonic plates move to change Earth's surface both slowly and quickly are discussed in Chapter 3, "Plate Tectonics", Chapter 4, "Earthquakes," and Chapter 5, "Volcanoes."

Changes to Earth's surface on a much smaller scale, including the formation of minerals as the result of lava that cools quickly, are discussed in "How Do Minerals Form?" on pages 40-43 in the module *Earth's Structure.* Changes due to the impact of meteorites are discussed in "Meteorids" on page 115 of the *Astronomy and Space Science* module.

In the module *Earth's Surface,* students **construct an explanation** for how creep affects Earth's surface in Apply It! on SE/TE page 69. Students **interpret photos** to **construct an explanation** of how erosion by a river can change with the seasons in "Figure 3 – River Erosion" on SE/TE page 73. They **explain** how erosion and deposition can shape limestone caves in "Figure 8 – Groundwater Erosion and Deposition" on SE/TE page 78. They **explain** how waves erode by abrasion on page SE/TE pages 87. They **explain** to a classmate how a sea cave can become a sea arch in Apply It! on SE/TE page 89.

In the module *Earth's Structure,* students **construct an explanation** for how plate motions acting over millions of years created the Himalayas in "Enrich – Sea-Floor Spreading" on TE page 85F. Students can **construct an explanation** for how the Appalachian Mountains formed in Differentiated Instruction on TE page 107. They **explain** the formation of fault-block mountains in "Figure 5 – Tension and Normal Faults" on SE/TE page 108 and the formation of plateaus in "Figure 6 – The Kaibab Plateaus" on SE/TE page 109. They **explain** how movement along faults can cause sudden changes in Earth's crust in "Enrich – Evidence of Movement Along Faults" on TE page 109F. Students **construct an explanation based on evidence** to explain where volcanoes form on Earth when they revise their hypotheses in "Figure 1 – The Ring of Fire" on SE/TE page 135. Students **explain** how different types of volcanoes form in "Figure 2 – Volcanic Mountains" on SE/TE page 148.

On page 40 of the TLR *Earth's Surface,* students **construct an explanation based on evidence** of chemical weathering in "Rusting Away." Students **use evidence** from their own observations to **explain** the force involved in landslides and erosion in the Open Inquiry version of the lab "Sand Hills" on pages 72-75. Students **use evidence** from their own observations to **construct an explanation** for the effect glaciers can have on Earth's surface in "How Do Glaciers Change the Land?" on TLR page 79. Students **explain** how a model of erosion by wind can be used to infer how wind affects sediments on Earth's surface in "How Does Moving Air Affect Sediment?" on TLR page 84.

In the TLR *Earth's Structure,* students **use evidence** from their own observations to **construct an explanation** for how Earth's surface changes when tectonic plates collide in "Plate Interactions" on TLR page 85. Students use their own observations to **construct an explanation** for how lava changes Earth's surface in "How Do Volcanoes Change Land?" on TLR page 137. Students **model** how the cooling and hardening of magma beneath Earth's surface can eventually change Earth's surface in "How Can Volcanic Activity Change Earth's Surface?" on TLR page 139.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **MODULE: Earth's Surface** **SE/TE** 38-39, What Breaks Down Rock? 69, Apply It! **TLR:** 40, Rusting Away 67-75, Sand Hills 79, How Do Glaciers Change the Land? 84, How Does Moving Air Affect Sediment **MODULE: Earth's Structure** **SE/TE** 8, Figure 3: From Sea to Mountain 65, Apply It! 94, Apply the Big Question 105, Apply It! 108, Figure 5: Tension and Normal Faults 109, Figure 6: The Kaibab Plateau 135, Figure 1: The Ring of Fire **TE Only:** 109F, Enrich – Evidence of Movement Along Faults 137D, Review and Reinforce – Understanding Main Ideas **TLR:** 40, How Does the Rate of Cooling Affect Crystals? 85, Plate Interactions 137, How Do Volcanoes Change Land? **Chapter Activites and Projects** 234–237, Plates Move!	**ESS2.A: Earth's Materials and Systems** • The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **MODULE: Earth's Surface** **SE/TE:** 38–45, Rocks and Weathering 49, The Process of Soil Formation 51, Figure 4– From Rock to Soil 66-69, Mass Movement 71-79, Water Erosion 80-85, Glacial Erosion 86-89, Wave Erosion 90-93, Wind Erosion 114–115, How Can Rock Layers Change? 124-127, Early Earth **TE Only:** 43, Teacher Demo – Chemical Weathering 69E, Enrich – It's Creepy! 77, Build Inquiry – Illustrate River Environments 89D, Review and Reinforce – Understanding Main Ideas 89E, Enrich – My Beach Is Shrinking! 93E, Enrich – Kinds of Sand Dunes **TLR:** 39, Freezing and Thawing 40, Rusting Away 52, The Contents of Soil 66, Weathering and Erosion 76, How Does Moving Water Wear Away Rock? 77, Raindrops Falling 79, How Do Glaciers Change the Land? 81, Modeling Valleys 83, Shaping a Coastline 84, How Does Moving Air Affect Sediment? 100, What's In a Rock? 120, How Could Planet Earth Form in Space? **MODULE: Earth's Structure** **SE/TE:** 4-9, The Earth System 18-21, Convection and the Mantle 40-43, How Do Minerals Form?	**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. **MODULE: Earth's Surface** **SE/TE:** 75, Figure 5: Oxbow Lakes **TE Only:** 45, Differentiated Instruction – L3 Use Maps 69, Teacher Demo – Modeling Mass Movement 69, Differentiated Instruction – Make Dioramas 89, Teacher Demo – Model Wave Refraction **TLR:** 55, Soil Conservation 67-75, Sand Hills 76, How Does Moving Water Wear Away Rock? 79, How Do Glaciers Change the Land? 81, Modeling Valleys 83, Shaping a Coastline 84, How Does Moving Air Affect Sediment? **MODULE: Earth's Structure** **SE/TE:** 106, Figure 1: Folded Rock **TE Only:** 89, Teacher Demo – Make a Model of Plates 107, Teacher Demo – Modeling Synclines and Anticlines 149, Build Inquiry – Make Models of Composite Volcanoes **TLR:** 11, What Forces Shape Earth? 63, Recylcing Rocks 72, Moving the Continents 76-84, Modeling Sea-Floor Spreading 85, Plate Interactions 100, Modeling Faults 101, Modeling Stress 124, Moving Volcanoes 137, How Do Volcanoes Change Land?

	47, Origin 47, Figure 2: Rock Origins 62-65, The Rock Cycle 76-79, Drifting Continents 80-85, Sea-Floor Spreading 86-91, The Theory of Plate Tectonics 97, An Ocean Is Born 134-137, Volcanoes and Plate Tectonics **TE Only:** 7, Elaborate – Modeling the Earth System 93, Enrich – Yellowstone's 1988 Forest Fire 21E, Enrich – What's Happening During Convection? 57F, Enrich – The Formation of Coal 61E, Enrich – The Metamorphic Rocks 63, 21st Century Learning 65E, Enrich – Alternate Pathways 77, 21st Century Learning 79, Differentiated Instruction – L1 Continental Drift Flip Book 85, Differentiated Instruction – L1 Ocean Floor Drawing 85F, Enrich – The Birth of the Himalayas **TLR:** 9, What Is a System? 10, Parts of Earth's System 17-25, Modeling Mantle Convections Currents 51, What Causes Layers? 64, Which Rock Came First? 76-84, Modeling Sea-Floor Spreading 85, Plate Interactions 124, Moving Volcanoes 137, How Do Volcanoes Change Land? **MODULE: Water and the Atmosphere** **SE/TE:** 52-53, How Do Waves Affect the Shore? **TE Only:** 9F, Enrich – Evaporation, Precipitation, and Runoff 53, Build Inquiry 53E, Enrich – How Far From	139, How Can Volcanic Activity Change Earth's Surface?

	Shore Do Waves Break? 59E, Enrich – The Sargasso Sea 187, Differentiated Instruction – L1 Pangaea **TLR:** 122, Floods and Droughts **ESS2.C: The Roles of Water in Earth's Surface Processes** • Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. **MODULE: Earth's Surface** **SE/TE:** 40-43, What Causes Weathering? 44-45, How Fast Does Weathering Occur? 52-55, Soil Conservation 66-67, What Processes Wear Down and Build Up Earth's Surface? 70-79, Water Erosion 80-85, Glacial Erosion 86-89, Wave Erosion 98, Floodwater Fallout **TE Only:** 42, 21st Century Learning 43, Teacher Demo – Chemical Weathering 55, 21st Century Learning 69E, Enrich – It's Creepy! 71, Lead a Discussion 74, 21st Century Learning 75, Differentiated Instruction – L3 Locate River Features 76, Build Inquiry – Compare and Contrast Deltas 77, Differentiated Instruction – L1 Describe River Features 79, Address Misconceptions 89, Differentiated Instruction – L3 Investigate Beach Erosion 89E, Enrich – My Beach is Shrinking! **TLR:** 39, Freezing and Thawing 53, How Can You Keep Soil From Washing Away? 55, Soil Conservation 66, Weathering and Erosion 76, How Does Moving Water Wear	

	Away Rocks? 77, Raindrops Falling 78, Erosion Cube 79, How Do Glaciers Change the Land? 81, Modeling Valleys 83, Shaping a Coastline **MODULE: Water and the Atmosphere** **SE/TE:** 8-9. What Is the Water Cycle? 18-23, Water Underground 52-53, How Do Waves Affect the Shore? **TE Only:** 23E, Enrich – Evaporation, Precipitation, and Runoff 53, Build Inquiry – Model Barrier Beaches 53E, Enrich – How Far From Shore Do Waves Break? **MODULE: Earth's Structure** **SE/TE:** 52-53, How Do Sedimentary Rocks Form? **TLR:** 51, What Causes Layers	

MS.History of Earth
MS-ESS2-3

Students who demonstrate understanding can:

Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

INTERACTIVE SCIENCE: The theory of plate tectonics is explored in Chapter 3, Lesson 1 of the *Earth's Structure* module. The chapter opens with Alfred Wegener's ideas on continental drift and presents the evidence for his hypothesis based on fossils, land features, and climate on SE/TE pages 77-79. Students **obtain information** about seafloor structures that evidence plate motions on SE/TE 81-85. Plate motions are presented in Lesson 3 on SE/TE pages 86-91.

Students **interpret maps** to indicate how the shapes of continents fit together in "Figure 1: Pieicing It All Together" on SE/TE page 77. Students **analyze and interpret data** for continental drift, including distribution of fossils and rocks, on SE/TE pages 78 and 79. On TE page 79, students **use knowledge** available in the 1900s to **debate** the theory of continental drift. In Elaborate, TE page 78, students **make models** of continents and **recreate** the drift. On SE/TE page 79, Differentiated Instruction, students **create** models of the continents motion through a flip book. On TE page 79, students **interpret** locations where fossils of *Mesosaurus* have been found to support the theory of continental drift. Students **research** a major change in Earth's surface caused by plate movement in "An Ocean Is Born" on SE/TE page 97.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena.

MODULE: Earth's Structure
SE/TE:
78, Figure 2: Pangaea and Continental Drift
79, Apply It!
122–123, Figure 3: Earthquakes Around the World
135, Figure 1: THe Ring of Fire

TE Only:
79, Differentiated Instruction – Debate Continental Drift
83, Differentiated Instruction – Cause and Effect Table
91E, Enrich – Magnetic Reversals Through the Ages
123E, Enrich – Earthquake Probability

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth
- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. *(secondary to MS-ESS2-3)*

MODULE: Earth's Structure
SE/TE:
80-85, Sea-Floor Spreading
82-83, Figure 2: Sea-Floor Spreading
84, Figure 3: Subduction
86-91 What is the Theory of Plate Tectonics?
87, Figure 1: Earth's Plates
88, Figure 2: Plate Motion
89, Figure 3: Breaking Up Is Hard to Do
90, Figure 4: The Andes
90-91, Figure 6: Earth's Changing Crust
91, Figure 5: Fault Line
97, An Ocean Is Born
134-137, Where Are Volcanoes Found on Earth's Surface?
135, Figure 1: The Ring of Fire
136, Figure 2: Volcanoes and Converging Boundaries

Crosscutting Concepts

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

MODULE: Earth's Structure
SE/TE:
88, Plate Motions Over Time
88, Figure 2: Plate Motion
89, Do the Math!
121, Apply It!
122-123, Figure 3: Earthquakes and Plate Tectonics
144, Figure 5: Cascade Volcanoes

TE Only:
83, Build Inquiry – Infer
85F, Enrich – The Birth of the Himalayas
91E, Enrich – Magnetic Reversals Through the Ages
123E, Enrich – Earthquake Probability

-- ***Connections to Nature of Science*** **Scientific Knowledge is Open to Revision in Light of New Evidence** • Science findings are frequently revised and/or reinterpreted based on new evidence. **MODULE: Earth's Structure** **SE / TE:** 79, Wegener's Hypothesis Rejected 135, Figure 2: The Ring of Fire 157, An Explosive Secret **TE Only:** 76A, Content Refresher 77, Support the Big Question 77, 21st Century Learning **TLR:** 72, Moving the Continents	**TE Only:** 84, Make Analogies – Ocean Conveyor Belt 85, Differentiated Instruction – Ocean Floor Drawing 85E, Understanding Main Ideas 89, Differentiated Instruction – L3 Rift Valleys **TLR:** 74, Mid-Ocean Ridges 76-84, Modeling Sea-Floor Spreading 85, Plate Interactions 125, Where Are Volcanoes Found on Earth's Surface? **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. **MODULE: Earth's Structure** **SE / TE:** 78, Figure 2: Pangaea and Continental Drift 88, Figure 2: Plate Motion **TE Only:** 77, ELL Support: Comprehensible Input 85F, Enrich – The Birth of the Himalayas 91, Differentiated Instruction – L3 Create a Timeline	

MS.Earth's Systems
MS-ESS2-1

Students who demonstrate understanding can:

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

INTERACTIVE SCIENCE: An overview of how Earth's materials cycle through the Earth system is given in the *Earth's Structure* module, Chapter 1, Lesson 1, SE/TEpage 5. The role constructive and destructive forces play in cycling Earth's materials by creating and destroying Earth's surface is presented on SE/TE pages 8-9. Information on the chemical and physical processes (including crystallization) that form minerals is given in the section "How Do Minerals Form?" in Chapter 2, Lesson 1 on SE/TE pages 40-42. An overview of how igneous, sedimentary, and metamorphic rocks form is given in the "Origin" section of Chapter 2, Lesson 2 on SE/TE page 47. Students **learn** further information about igneous rocks, on SE/TE pages 48-50. Sedimentary rocks, including the roles weathering and sedimentation play in their formation, are discussed on SE/TE pages 52-56. Metamorphic rocks and their formation via deformation are presented on SE/TE pages 58-60. A discussion of the processes of the rock cycle, including melting, weathering, erosion, deposition, and metamorphism, is included in Chapter 2, Lesson 6 "The Rock Cycle" on SE/TE pages 62-65

A discussion of the cycling of materials as the result of weathering of rocks is included in Chapter 2, Lesson 1 "Rocks and Weathering" of the *Earth's Surface* module, on SE/TE pages 38-45. Erosion and deposition are further discussed in Chapter 3, Lesson 1 (Mass Movement), Lesson 2 (Water Erosion), Lesson 3 (Glacial Erosion), Lesson 4, (Wave Erosion), and Lesson 5 (Wind Erosion), on SE/TE pages 62-93.

The flow of heat energy inside Earth is discussed in the *Earth's Structure* module, Lesson 3, "Convection and the Mantle." On SE/TE pages 20-21, students **learn** how heating and cooling of a fluid, changes in the fluid's density, and the force of gravity combine to set convection currents in motion, driving the movement of Earth's plates. This concept is further explained in "Support the Big Question" on TE page 20. Students **interpret diagrams** to explain how convection in Earth's mantle might drive motion in Earth's crust in "Enrich – What's Happening During Convection?" on TE page 21E. Structures and processes driven by this flow of energy, including the formation of mid-ocean ridges, sea-floor spreading, subduction, and the formation of deep-ocean trenches, are explored in Chapter 3, Lesson 2 "Sea-Floor Spreading" on SE/TE pages 80-85. Students **make** and **develop a model** of the flow of heat energy within Earth's mantle in "Modeling Mantle Convection Currents" on TLR pages 17-24. Students **make a model** showing how the rock cycle can break rock into sediment that later can cycle back to form new rock in "Recycling Rocks" on page 63 of the *Earth's Structure* TLR. Students **make** and **develop a model** describing sea-floor spreading and **explore** how sea-floor spreading and subduction work together in a cycle that creates and destroys rock in "Modeling Sea-Floor Spreading" on TLR pages 76-84.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. **MODULE: Earth's Structure** **SE/TE:** 20, Convection Currents 212, Figure 3 – Mantle Convection 64, Figure 2 – The Rock Cycle 65, Apply It! **TE Only:** 21, Differentiated Instruction – L1 Model Convection Currents 57, Differentiated Instruction – Model Rock Formation 61E, Enrich – The Metamorphic Rocks 64, Teacher to Teacher – Describe the Rock Cycle 65, Differentiated Instruction – L3 Make Sequence Drawings 83, Build Inquiry – Model of the Ocean Floor **TLR:** 11, What Forces Shape Earth? 17, Modeling Mantle Convection Currents 40, How Does the Rate of Cooling Affect Crystals? 46, Liquid to Solid 50, How Does Pressure Affect Particles of Rock? 63, Recycling Rocks 76-84, Modeling Sea-Floor Spreading 101, Modeling Stress **MODULE: Earth's Surface** **SE/TE:** 67, Relate Text and Visuals 72, Figure 2 – Stream Formation 75, Figure 5 – Oxbow Lakes 77, Figure 7 – Rolling Through the Hills 82, Apply It! 83, Figure 2 – Glacial Erosion 84, Figure 3 – Glacial Landforms 87, Figure 1 – Wave Erosion 88, Figure 2 – The Changing Coast	**ESS2.A: Earth's Materials and Systems** • All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. **MODULE: Earth's Structure** **SE/TE** 4-9, The Earth System 18-21, Convection and the Mantle 40-42, How Do Minerals Form? 47, Origin 47, Figure 2: Rock Origins 48-50, How Do Geologists Classify Igneous Rocks? 49, Figure 1: Igneous Rock Origins and Textures 52-53, How Do Sedimentary Rocks Form? 53, Figure 1: How Sedimentary Rock Forms 54-56, What Are the Three Major Types of Sedimentary Rocks? 58-60, What Are Metamorphic Rocks 62-65, What Is the Rock Cycle? 63, Figure 1: Stone Mountain 64, Figure 2: Be a Rock Star! 80-85, Sea-Floor Spreading 83, Figure 2: Sea-Floor Spreading 84, Figure 3: Subduction 84, Apply it! **TE Only:** 21E. Enrich – Convection and the Mantle 51E, Enrich – The Same, But Different 57F, Enrich – The Formation of Coal 61, Teacher Demo – Model Foliated Rock 61E, Enrich – The Metamorphic Rocks 65E, Enrich – Alternate Pathways 83, Build Inquiry – Model of the Ocean Floor **TLR:** 11, What Forces Shape Earth? 17, Modeling Mantle Convection Currents 40, How Does the Rate of Cooling Affect Crystals?	**Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. **MODULE: Earth's Structure** **SE/TE:** 4-9, The Earth System 5, Figure 1: All Systems Go! 65, The Rock Cycle and Plate Tectonics **TE Only:** 61E, Enrich – The Metamorphic Rocks **TLR:** 17-24, Modeling Mantle Convection Currents 51, What Causes Layers? 61, A Sequined Rock **MODULE: Earth's Surface** **SE/TE:** 68-69, What Are the Different Types of Mass Movement? 68, Figure 1: Mass Movement 69, Apply It! **TE Only:** 69, Teacher Demo – Modeling Mass Movement 89, Teacher Demo – Model Wave Refraction 89E, Enrich – My Beach Is Shrinking! **TLR:** 65, How Does Gravity Affect Materials on a Slope? 67-74, Sand Hills 83, Shaping a Coastline **MODULE: Ecology and the Enviroment** **SE/TE:** 29, Figure 1 – Primary Succession 30, Apply It! **TLR:** 42, Observing Decomposition 55, Playing Nitrogen Cycle Roles

TE Only: 43, Differentiated Instruction – Model Surface Area 69, Teacher Demo – Modeling Mass Movement 85, Differentiated Instruction – Model Glacial Landforms 89, Teacher Demo – Model Wave Refraction 93E, Enrich – Kinds of Sand Dunes **TLR:** 76, How Does Moving Water Wear Away Rocks? 79, How Do Glaciers Change the Land? 81, Modeling Valleys 84, How Does Moving Air Affect Sediment? 85, Desert Pavement	44, How Do Rocks Compare? 45, Classify These Rocks 46, Liquid to Solid 47, How Do Igneous Rock Form? 49, Acid Test for Rocks 50, How Does Pressure Affect Particles of Rock? 51, What Causes Layers 62, How Do Grain Patterns Compare? 63, Recycling Rocks 64, Which Rock Came First? 66, Weathering and Erosion 74, Mid-Ocean Ridges 76, Modeling Sea-Floor Spreading **MODULE: Earth's Surface** **SE/TE:** 38, Rocks and Weathering 42, Figure 3 – Weathering and Surface Area 46–51, How Soil Forms 51, Figure 4: From Rock to Soil 66-69, Mass Movement 70-79, Water Erosion 73, Figure 3: River Erosion 76, Figure 6: Deposits by Rivers 78, Figure 8: Groundwater Erosion and Deposition 80-85, Glacial Erosion 82, Apply It! 86-89, Wave Erosion 87, Figure 1 – Wave Erosion 88-89, Figure 2 – The Changing Coast 89, Apply It! 90-93, Wind Erosion **TE Only:** 41, Teacher Demo – Mechanical Weathering 43, Teacher Demo – Chemical Weathering 69E, Enrich – It's Creepy and Distributary Channels 79, Differentiated Instruction – L1 Compare and Contrast Table 87, Make Analogies – Wave Abrasion 89, Teacher Demo – Model Wave Refraction 89E, Enrich – My Beach Is Shrinking 93E, Enrich – Kinds of Sand Dunes	

	TLR: 39, Freezing and Thawing 41, It's All on the Surface 42, What Is Soil? 52, The Contents of Soil 66, Weathering and Erosion 76, How Does Moving Water Wear Away Rocks? 79, How Do Glaciers Change the Land? 81, Modeling Valleys 83, Shaping a Coastline 84, How Does Moving Air Affect Sediment? 85, Desert Pavement **MODULE: Ecology and the Environment** **SE/TE:** 29, Primary Succession 30–31, Secondary Succession 42–49, Energy Flow in Ecosystems 46, Figure 3 – Food Chain 47, Figure 4 – Food Web 48, Figure 5 – Energy Pyramid 50–51, What Processes Are Involved in the Water Cycle? 52–53, How Are the Carbon Cycle and Oxygen Cycle Related? 53, Figure 2 – Carbon and Oxygen Cycles 54–55, How Does Nitrogen Cycle Through Ecosystems? Figure 4, Nitrogen Cycle 56–57, Figure 5 – Cycles of Matter 130, Figure 2: Structure of Fertile Soil **TE Only:** 45, Differentiated Instruction – L1 Concept Map 49E, Enrich – Energy Flow in Ecosystems 53, Differentiated Instruction – L3 Research Effects of Carbon Dioxide in the Atmosphere **TLR:** 42, Observing Decomposition 53, Following Water 55, Playing Nitrogen Cycle Roles	

MS.Earth's Systems
MS-ESS2-4

Students who demonstrate understanding can:

Develop a model to describe the cycling of water through Earth's systems by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

INTERACTIVE SCIENCE: The water cycle is presented in the *Water and the Atmosphere* module in Chapter 1, Lesson 1, "Water on Earth" on SE/TE pages 8-9. Students **learn** how the sun's energy is the driving force for the water cycle in Chapter 4, Lesson 1, "Water in the Atmosphere" on SE/TE pages 118-119. They **obtain knowledge** about how water changes state during the process that forms clouds in Chapter 4, Lesson 2 "Clouds" on SE/TE pages 122-125. They **learn** how water changes state during the formation of rain, freezing rain, snow, hail, and sleet in Chapter 4, Lesson 3 "Precipitation" on SE/TE pages 126-129.

Students **model** the water cycle by completing a diagram in "Figure 3 – The Water Cycle" on SE/TE pages 8-9. In the Differentiated Instruction activity, TE page 9, students **describe** the roles gravity and the sun's energy play in the water cycle. In the RTI activity, TE page 9, students **model** the water cycle pathway by drawing a diagram. Students **model** the water cycle by drawing a cycle diagram in "Figure 6 – An Endless Cycle" on SE/TE page 17. On SE/TE page 119, students **label** the water cycle pathway in Figure 1, Summarize. They **interpret** diagrams to **model** how clouds form in "Figure 1 – How Clouds Form" on SE/TE page 123. They **review** how cold the air temperature needs to be in order for specific types of precipitation to fall in "Figure 3 – Freezing and Precipitation" on SE/TE page 128. They **investigate** the distribution of water on Earth on TLR page 14. They **investigate** the role of trees in the water cycle in "Water From Trees" on TLR, pages 15-23. Students **model** evaporation of liquid water by heat energy in "Where Did the Water Go?" on TLR page 114. They **observe** how water vapor changes into liquid water in "Water in the Air" on TLR page 115. Students **model** the formation of a cloud in "How Clouds Form" on TLR page 118. They model the formation of hail in "How Can You Make Hail?" on TLR page 120. They **observe** how liquid water crystallizes into ice on TLR page 120. They **model** the water cycle in "Following Water" on page 53 of the TLR *Ecology and the Environment.*

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 describe unobservable mechanisms. **MODULE: Water and the Atmosphere** **SE/TE:** 8-9, Figure 3: The Water Cycle 17, Figure 6: An Endless Cycle 119, Figure 1: The Water Cycle 123, How Clouds Form **TLR:** 12, Where Does the Water Come From? 15, Water From Trees 114, Where Did the Water Go? 115, Water in the Air	**ESS2.C: The Roles of Water in Earth's Surface Processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **MODULE: Water and the Atmosphere** **SE/TE:** 8-9, What Is the Water Cycle? 8-9, Figure 3: The Water Cycle 17, Figure 6: An Endless Cycle 118-119, How Does Water Move Through the Atmosphere? 119, Figure 1: The Water Cycle 122-125, Clouds 123, Figure 3: How Clouds Form 126-131, Precipitation 128-129, Figure 3: Freezing Precipitation	**Energy and Matter** ▪ Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter **MODULE: Water and the Atmosphere** **SE/TE:** 8–9, What Is the Water Cycle? 118–199, How Does Water Move Through the Atmosphere? **TE Only:** 9, Differentiated Instruction

120, How Can You Make Hail? **MODULE: Ecology and the Environment** **TLR:** 53, Following Water	**TE Only:** 9, Differentiated Instruction 9, RTI 93, Enrich – Understanding Main Ideas 9F, Enrich – Evaporation, Precipitation, and Runoff 131E, Enrich – Snow Crystals **TLR:** 12, Where Does the Water Come From? 15-22, Water From Trees 114, Where Did the Water Go? 115, Water in the Air 120, How Can You Make Hail? **ESS2.C: The Roles of Water in Earth's Surface Processes** • Global movements of water and its changes in form are propelled by sunlight and gravity. **MODULE: Water and the Atmosphere** 8-9, What Is the Water Cycle? 8-9, Figure 3: The Water Cycle 54-59, Currents and Climate 118-119, How Does Water Move Through the Atmosphere? 119, Figure 1: The Water Cycle 122-125, Clouds 123, Figure 3: How Clouds Form 126-131, Precipitation 128-129, Figure 3: Freezing Precipitation **TE Only:** 9, Differentiated Instruction 9, RTI 57, Differentiated Instruction 93, Enrich – Understanding Main Ideas 9F, Enrich – Evaporation, Precipitation, and Runoff 59E, Enrich – The Sargasso Sea 131E, Enrich – Snow Crystals **TLR:** 15-22, Water From Trees 49-57, Modeling Ocean Currents 58, Deep Currents 114, Where Did the Water Go? 115, Water in the Air 120, How Can You Make Hail?	

MS.Earth's Systems
MS-ESS3-1

Students who demonstrate understanding can:

Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

INTERACTIVE SCIENCE: The various processes that lead to the formation and distribution of minerals are described in the *Earth's Structure* module, Chapter 2, Lesson 1, "Properties of Minerals," on SE/TE pages 40-43. Students **construct a scientific explanation** for the process by which minerals form in geodes in "Figure 10: Geodes" on SE/TE page 40. Students can **discuss** the types of minerals that form in Death Valley in "Differentiated Instruction: Death Valley Minerals" on TE page 41. Students **research** the distribution of evaporative mineral deposits in the United States in "Differentiated Instruction: Mineral Map" on TE page 41. A world map showing the distribution of mineral resources appears on SE/TE page 43. Students **match** minerals to the variety of geologic processes responsible for their formation on SE/TE page 42. Students **model** the affects of mining on landscapes in "How Does Mining Affect the Land?" in the *Ecology and the Environment* TLR on page 107. Students **analyze** costs of mining ores in "Enrich: The Copper Basin" on TE page 133E.

Students **learn** about the distribution of methane hydrates, their possible importance as a new energy resource, and the geoscience processes by which they are formed in the Lead a Discussion activity on TE page 164 in the *Ecology and the Environment* module. The formation of traditional energy resources, including coal, oil, and natural gas, is described in Chapter 5, Lesson 1 "Fossil Fuels" on SE/TE pages 178-184. The uneven distribution of fossil fuels is described on SE/TE page 185. The reason fossil fuels are considered nonrenewable is described on SE/TE page 185. The formation of coal is also described in the *Earth's Surface* module, Chapter 4, Lesson 6, "Eras of Earth's History." In this module, 21st Century Learning, SE/TE page 131, students **locate** the coal deposits in North America that formed during the Carboniferous.

Soil resources are described in the *Earth's Surface* module in "The Process of Soil Formation" on SE/TE page 49. Students **construct a scientific explanation** for the distribution of soil resources in "Figure 2: Soil Layers" on SE/TE page 49. The relationship between volcanic activity and soil fertility is described in the "Apply It!" activity in the *Earth's Structure* module on SE/TE page 149. The distribution of soil as a function of climate is described in "Enrich – Different Soils for Different Climates" on TE page 51E. Soil damage, loss, and conservation as a result of human impacts is discussed in Chapter 2, Lesson 4 "Soil Conservation" on SE/TE page 52-55.

The distribution of water on Earth is described in the *Water and the Atmosphere* module, SE/TE pages 6-7 "Where Is Water Found?" Students **construct a scientific explanation** for the distribution of water into zones in "Figure 2: Groundwater Formation" on SE/TE page 20. A discussion of the distribution of water into aquifers is provided SE/TE pages 21–23. Students **interpret data** related to how humans use water in "Do the Math!" on SE/TE page 21. Students **draw** on a diagram to indicate where they would put a regular well and an artesian well in order to obtain fresh water in "Figure 3 – Springs and Wells" on SE/TE pages 22-23. The ways in which humans are affecting water resources, including water shortages and water pollution, is discussed in the *Ecology and the Environment* module in Chapter 4, Lesson 4 "Water Pollution and Solution" on SE/TE pages 152-159.

A discussion of renewable versus nonrenewable resources and the impact of humans on these resources can be found in the *Ecology and the Environment* module, Chapter 3, Lesson 1 "Introduction to Natural Reources" on SE/TE pages 92-97.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **MODULE: Earth's Structure** **SE/TE:** 40, How Do Minerals Form? 40, Figure 10: Geodes **TE Only:** 57F, Enrich – The Formation of Coal 65E, Enrich – Alternate Pathways **MODULE: Water and the Atmosphere** **TE Only:** 9F, Enrich – Evaporation, Precipitation, and Runoff **MODULE: Ecology and the Environment** **SE/TE:** 181, Figure 3: Coal Formation 182, Figure 4: Oil Formation	**ESS3.A: Natural Resources** • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **MODULE: Earth's Structure** **SE/TE:** 40 Figure 10: Geodes 43, Where Mineral Resources Are Found 43, Figure 13: Ores 51, How Are Igneous Rocks Used? 51, Figure 2: Building Blocks 57, How Are Sedimentary Rocks Used? 57, Figure 4: Building With Limestone 61, How Metamorphic Rocks Are Used 61, Apply It! 70, Struggling to Survive 149, Apply It! **TE Only:** 41, Differentiated Instruction: L1 Death Valley Minerals 41, Differentiated Instruction: L3 Mineral Map 43, Differentiated Instruction: L3 Debate 57F, Enrich – The Formation of Coal 65E, Enrich – Alternate Pathways **TLR:** 48, The Rocks Around Us 52-60, Testing Rock Flooring **MODULE: Earth's Surface** **SE/TE:** 34–55, Weathering and Soil 131, The Carboniferoud Period **TE Only:** 55, Differentiated Instruction: L3 Soil Fertility 55E, Enrich – Does Contour Plowing Work? **TLR:** 43-51, Investigating Soils and Drainage 54, Using it Up	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **MODULE: Earth's Structure** **SE/TE:** 40, Figure 10: Geodes 40-43, How Do Minerals Form? 4, Figure 12: Where Minerals Form 55, Organic Rocks 55, Figure 3: Organic Rocks **TLR:** 51, What Causes Layers? **MODULE: Earth's Surface** **SE/TE:** 49, The Process of Soil Formation 51, Figure 4: From Rock to Soil 55, How Can Soil Be Conserved? **TE Only:** 55E, Enrich – Does Contour Plowing Work? **TLR:** 53, How Can You Keep Soil From Washing Away? 54, Using It Up 55, Soil Conservation **MODULE: Water and the Atmosphere** **SE/TE:** 23, Relate Cause and Effect **TLR:** 30, An Artesian Well **MODULE: Ecology and the Environment** **SE/TE:** 29, Figure 1 – Primary Succession 30, Apply It! 156, Figure 3: Wastewater Treatment

	55, Soil Conservation **MODULE: Water and the Atmosphere** **SE/TE:** 5, Why is Water Important? 6-7, Where Is Water Found? 18-23, Water Underground 201, Bacterial Rainmakers **TE Only:** 7, Differentiated Instruction: L3 Your Community's Water Source 21, Differentiated Instruction: L3 Groundwater Contaminants 23E, Enrich – Water Underground **TLR:** 13, Water, Water, Everywhere 24, Mapping Surface Waters 30, An Artesian Well **MODULE: Ecology and the Environment** **SE/TE:** 92–97, Introduction to Natural Resources 128–133, Conserving Land and Soil 152–159, Water Pollution and Solutions 160–167, Ocean Resources 162, Figure 1: Ocean Resources 178–185, Fossil Fuels 196–201, Energy Use and Conservation **TE Only:** 164, Lead a Discussion – Future Energy Source 164, Lead a Discussion – Nutrients for Algae 165, Differentiated Instruction – L1 Explaining Upwelling **TLR:** 75, Using Resources 76, Natural Resources 107, How Does Mining Affect the Land? 109, Modeling Soil Conservation 126, How Does the Water Change? 127, Where's the Water? 128, Cleaning Up Oil Spills 129, Getting Clean 140, What's In a Piece of Coal?	-- ***Connections to Engineering, Technology, and Applications of Science*** **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. **MODULE: Earth's Structure** **SE/TE:** 51, How Are Igneous Rocks Used? 56, Apply It! 57, How Are Sedimentary Rocks Used? 61, How Metamorphic Rocks are Used 70, Struggling to Survive 149, Apply It! **TE Only:** 43, Differentiated Instruction – L3 Debate 57F, Enrich – The Formation of Coal **TLR:** 52–60, Testing Rock Flooring **MODULE: Earth's Surface** **SE/TE:** 52-55, Soil Conservation **TLR:** 55, Soil Conservation **MODULE: Water and the Atmosphere** **SE/TE:** 21, How Do People Use Groundwater? 21, Do the Math! **TE Only:** 21, Differentiated Instruction – LE Groundwater Contaminants **MODULE: Ecology and the Environment** **SE/TE:** 128–133, Conserving Land and Soil 129, Figure 1: Land Use 131, Figure 3: Terracing 133, Figure 4: Land Reclamation

	142, Fossil Fuels 155, Human Energy Use	136, Figure 1: Sanitary Landfill Design 152–159, Water Pollution and Solutions 172, Old MacDonald Had a Satellite **TE Only:** 131, Differentiated Instruction – L3 Researching Organic Fertilizers 133E, Enrich – The Copper Basin 155, Differentiated Instruction – L3 Thermal Pollution 159F, Enrich – Sewage Treatment

MS.Weather and Climate
MS-ESS2-5

Students who demonstrate understanding can:

Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]

INTERACTIVE SCIENCE: The four major types of air masses that influence weather in North America are described in the *Water and the Atmosphere* module, Chapter 4, Lesson 4 “Air Masses” on SE/TE pages 132–135. Movement of air masses is discussed in “How Air Masses Move” on SE/TE page 135. Changes in weather caused by colliding air masses are described in “What Are the Main Types of Fronts?” on SE/TE pages 136-137 and in “What Weather Do Cylcones and Anticylones Bring?” on SE/TE pages 138-139. A discussion of the complex interactions that produce various types of storms is provided in Chapter 4, Lesson 5 “Storms” on SE/TE pages 140-147. Forecasting weather is discussed in Chapter 4, Lesson 6, “Predicting the Weather” on SE/TE pages 150–155. Students **collect data** to provide evidence for the interactions of air masses in “Weather Fronts” on TLR page 125. They **collect data** on complex interactions of air masses on TLR page 126.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

MODULE: Water and the Atmosphere
TLR:
49-57, Modeling Ocean Currents
58, Deep Currents
115, Water in the Air
116, Measuring to Find the Dew Point
118, How Clouds Form
123, How Do Fluids of Different Densities Move?
125, Weather Fronts
126, Cyclones and Anticyclones
128, Where Do Hurricanes Come From?
130, Predicting Weather

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth’s Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

MODULE: Water and the Atmosphere
SE/TE:
54-59, Currents and Climate
100–107, Winds
118–121, Water in the Atmosphere
122–125, Clouds
126–131, Precipitation
132–139, Air Masses
140–147, Storms
150–155, Predicting the Weather
170, Distance From Large Bodies of Water
171, Ocean Currents
172-173, What Factors Affect Precipitation?

TE Only:
103, Differentiated Instruction – L1 Compare and Contrast Local Winds
128, Differentiated Instruction – L3 Create a Weather Display

Crosscutting Concepts

Cause and Effect

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

MODULE: Water and the Atmosphere
SE/TE:
54-59, Currents and Climate
101, What Causes Winds?
103, Figure 3: Local Winds
104, Global Winds
104, Figure 4: Heating Earth’s Surface
105, The Coriolis Effect
105, Apply It!
107, Figure 6: Parts of the Atmosphere
122, How Do Clouds Form?
123, Figure 1: How Clouds Form
128–129, Figure 3: Freezing Precipitation
133, What Are the Major Air Masses
134, Figure 2: North American Air Masses
136–137, Figure 4: Types of Fronts
138, What Weather Do Cylcones and Anticyclones Bring?
140–147, Storms

	137, Differentiated Instruction – L3 Weather Forecasts 137, Teacher Demo – Modeling Front Formation 139, Differentaited Instruction – L3 Modeling Cylones 139F, Enrich – Occluded Fronts 143, Differentiated Instruction – L3 Rocky Mountain Thunderstorms 145, Differentiated Instruction – L1 Hurricane Movement 147, Differentiated Instruction – L1 Sequencing Tornado Formation 155, Differentiated Instruction – Generalizations about Fronts 155E, Enrich – Wind and Air Pressure 173, Differentiated Instruction – L1 Illustrate Winds Crossing a Mountain Range **TLR:** 49-57, Modeling Ocean Currents 58, Deep Currents 115, Water in the Air 116, Measuring to Find the Dew Point 117, How Does Fog Form? 118, How Clouds Form 120, How Can You Make Hail? 123, How Do Fluids of Different Densities Move? 125, Weather Fronts 126, Cyclones and Anticyclones 127, Can You Make a Tornado? 130, Predicting Weather 132-140, Reading a Weather Map ▪ Because these patterns are so complex, weather can only be predicted probabilistically. **MODULE: Water and the Atmosphere** **SE/TE Only:** 150–155, Predicting the Weather 154, Limits of Weather Forecasts 161, Tracking Hurricanes with Latitudes and Longitudes **TE Only:** 155, Differentiated Instruction – L3 Accuracy of Local Weather Forecasts **TLR:** 130, Predicting Weather	142, Figure 2: How Thunderstorms Form 144, Figure 4: Hurricane **TE Only:** 57, Differentiate Instruction – L3 News Article 103, 21st Century Learning 105, Differentiated Instruction – L3 Winds and Airplanes 121E, Enrich – Hair Hygrometers 125E, Enrich – Contrails 128, 21st Century Learning 143, Differentiated Instruction – L3 Rocky Mountain Thunderstorms **TLR:** 115, Water in the Air 116, Measuring to Find the Dew Point 117, How Does Fog Form? 118, How Clouds Form 120, How Can You Make Hail? 123, How Do Fluids of Different Densities Move? 125, Weather Fronts 126, Cyclones and Anticyclones 128, Where Do Hurricanes Come From?

MS.Weather and Climate
MS-ESS2-6

Students who demonstrate understanding can:

Develop and use a model to describe how unequal heating and rotation of the Earth causes patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

INTERACTIVE SCIENCE: The *Water and the Atmosphere* module explores ocean currents in Chapter 2, Lesson 3, "Currents and Climate" on SE/TE pages 54–59. The effect of Earth's rotation on ocean currents is described in "Coriolis Effect" on SE/TE page 55. Students **learn** how winds drive surface currents in "What Causes Surface Currents?" on SE/TE pages 55-57. Students **learn** how ocean currents affect climate in "Effects on Climate" on SE/TE page 56. Students **obtain knowledge** about how ocean temperatures and winds can combine to influence weather patterns in "El Niño" and "La Niña" on SE/TE page 57. They **learn** how cold ocean currents and warm ocean currents circulate water in "Figure 3: Global Conveyor" on SE/TE pages 58-59. Circulation of heat within the troposphere is covered in "Figure 3: Heating the Troposphere" on SE/TE page 99. Unequal heating of the air is identified as the cause of wind in "What Causes Winds?" on SE/TE page 101. Local wind and global wind are described in "How Do Local Winds and Global Winds Differ?" on SE/TE page 103. Students **develop a model** of land breezes by drawing on a diagram in "Figure 3: Local Winds" on SE/TE page 103. Students **model** the effects of latitude in "Figure 4 – Heating of Earth's Surface" on SE/TE page 104 and in "Figure 5 – Global Wind Belts" on SE/TE page 106. The effect of Earth's rotation is modeled in the Apply It! feature on SE/TE page 105. Students **model** the cause and effect relationship between unequal heating and winds in "Differentiated Instruction: Model Wind" on TE page 107. Students **develop a model** to illustrate how the sun's radiation drives the formation of global winds in "Figure 6: Parts of the Atmosphere" on SE/TE page 107. Students **learn** how latitude, altitude, distances from oceans, and mountain ranges affect temperature and precipitation patterns in Chapter 5, Lesson 1, "What Causes Climate." Students **obtain knowledge** about latitudinal banding on SE/TE page 168. Students **interpret photos** to describe how temperature contitions at the top of a mountain differ from conditions at the bottom of the same mountain in "Figure 3: Altitude and Temperature" on SE/TE page 169. Students **predict** how ocean currents affect the climate of western Europe in "Figure 4: Currents and Temperature" on SE/TE page 171. Students **model** the effect a mountain range can have on precipitation in "Figure 5: Rain Shadow" on SE/TE pages 172–173. Students **learn** how oceans, heating from the sun, altitude, and ice caps affect the six main climate regions in "What Are the Six Main Climate Regions?" on SE/TE apges 176–182. Students **tell** how winds, oceans, and topography affect climate in "Enrich: Factors That Affect Climate Regions" on TE page 183E.

Students **model** the effect of wind on surface and deep currents in "Bottom to Top" on TLR page 48. Students **develop and use a model** of currents in the North Atlantic in "Modeling Ocean Currents" on TLR pages 49-57, They **model** the effects of temperature on currents in "Deep Currents" on TLR page 58. They **model** global wind systems in "Does the Wind Turn?" on TLR page 98. They **model** global wind belts in "Global Wind Belts" on TLR page 100. They **model** the effect of latitude on temperature in "How Does Latitude Affect Climate?" on TLR page 151. They **develop and use a model** of how the unequal heating of Earth's surface affects temperature in "Sunny Rays and Angles" on TLR pages 152-160.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and use a model to describe phenomena. (MS-ESS2-6) **MODULE: Water and the Atmosphere** **SE / TE:** 55, Figure 1: Surface Currents 57, Figure 2: Warming Sea Temperature 58, Figure 3: Global Ocean Conveyor 104, Figure 4: Heating of Earth's Surface 105, Apply It! 106, Figure 5: Global Wind Belts 107, Figure 6: Parts of the Atmosphere 172, Figure 5: Rain Shadow 173, Figure 6: Monsoons **TE Only:** 107, Differentiated Instruction – L1 Model Wind 171, Make Analogies **TLR:** 47, Modeling Currents 48, Bottom to Top 49-57, Modeling Ocean Currents 58, Deep Currents 98, Does the Wind Turn? 100, Global Wind Belts 151, How Does Latitude Affect Climate? 152–160, Sunny Rays and Angles	**ESS2.C: The Roles of Water in Earth's Surface Processes** ▪ Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **MODULE: Water and the Atmosphere** **SE / TE:** 58–59, What Causes Deep Currents? 58–59, Global Ocean Conveyor **TE Only:** 59, Differentiated Instruction – L3 Surface and Deep Currents **ESS2.D: Weather and Climate** ▪ Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **MODULE: Water and the Atmosphere** **SE / TE:** 54–59, Currents and Climate 100–107, Winds 104, Figure 4 – Heating of Earth's Surface 112, The Aura Mission 118–121, Water in the Atmosphere 122–125, Clouds 126–131, Precipitation 132–139, Air Masses 134, Figure 2 – North American Air Masses 139, Apply It 140–147, Storms 141, Figure 1: Lake-Effect Snow 142, Figure 2: How Thunderstorms Form 144, Figure 4: Hurricanes 150–155, Predicting the Weather 166–173, What Causes Climate? 168, Figure 2 – Latitude and Temperature 169, Figure 3 – Altitude and Temperature 170, Apply It! 171, Figure 4 – Curents and Temperature 172–173, Figure 5 – Rain Shadow 173, Figure 6 – Monsoons	**Systems and System Models** ▪ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. **MODULE: Water and the Atmosphere** **SE / TE:** 55, Figure 1: Surface Currents 57, Figure 2: Warming Sea Temperature 58, Figure 3: Global Ocean Conveyor 104, Figure 4: Heating of Earth's Surface 105, Apply It! 106, Figure 5: Global Wind Belts 160, The S'Cool Project 172, Figure 5: Rain Shadow 173, Figure 6: Monsoons **TE Only:** 107, Differentiated Instruction, L1-Model Wind 171, Make Analogies **TLR:** 47, Modeling Currents 48, Bottom to Top 49-57, Modeling Ocean Currents 58, Deep Currents 98, Does the Wind Turn? 100, Global Wind Belts 131, Modeling Weather Satellites 151, How Does Latitude Affect Climate? 152–160, Sunny Rays and Angles

	174–183, Climate Regions 187–189, What Natural Factors Can Cause Climate Change? 190–195, Human Activities and Climate Change 191, Figure 1: Greenhouse Effect 192, Figure 2: Carbon Dioxide Levels 201, Bacterial Rainmakers **TE Only:** 42, Teacher to Teacher 57, Differentiated Instruction – L3 News Article 59, Differentiated Instruction – L3 Surface and Deep Current 59E, Enrich – The Sargasso Sea 95E, Enrich – Reflection of Solar Radiation 107, Differentiated Instruction – L1 Model Wind 137, Teacher Demo – Modeling Front Formation 139F, Enrich – Occluded Fronts 169, Differentiated Instruction – L1 Angles of Sunlight 169, Teacher Demo – Air Temperature and Altitude 171, Make Analogies 173, Differentiated Instruction – L3, Illustrate Winds Crossing a Mountain Range 173E, Enrich – Earth's Deserts 176, Teach With Visuals 183E, Enrich – Factors that Affect Climate Regions 193, 21st Century Learning 193, Address Misconceptions 195E, Enrich – The Carbon Cycle **TLR:** 47, Modeling Currents 48, Bottom to Top 49-57, Modeling Ocean Currents 58, Deep Currents 86–94, Heating Earth's Surface 98, Does the Wind Turn? 100, Global Wind Belts 125, Weather Fronts 128, Where Do Hurricanes Come From? 151, How Does Latitude Affect Climate? 152–160, Sunny Rays and Angles 161, Inferring United States Precipitation Patterns	

	167, Earth's Movement and Climate 168, What Is the Greenhouse Effect? 169, Greenhouse Gases and Global Warming • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. **MODULE: Water and the Atmosphere** **SE/TE:** 54–59, Currents and Climate 56, Apply It! 57, Figure 2 – Warming Sea Temperatures 58, Figure 3 – Global Conveyor 103, Figure 3: Local Winds 144–145, Hurricanes 170, Distance From Large Bodies of Water 170, Apply It! 171, Ocean Currents 171, Figure 4: Currents and Temperatures **TE Only:** 57, Differentiated Instruction – L3 News Article 170 Build Inquiry – Comparing Water and Soil 171, Make Analogies **TLR:** 86–94, Heating Earth's Surface **Scenario-Based Investigations:** 122–123, What Causes Our Climate?	

MS.Weather and Climate
MS-ESS3-5

Students who demonstrate understanding can:

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

INTERACTIVE SCIENCE: Natural causes of climate change are discussed in the *Water and the Atmosphere* module in Chapter 5, Lesson 3 "Changes in Climate" on SE/TE pages 184–189. Students **interpret data** of a graph showing average global temperatures over time in "Do the Math!" on SE/TE page 188. Global warming is discussed in Chapter 5, Lesson 4 "Human Activities and Climate Change" on SE/TE pages 190–195. Students **obtain knowledge** related to evidence of global warming and the role human activities play in the rise in global temperatures in "Figure 2: Carbon Dioxide Levels" on SE/TE page 192. Students **learn** the effects of global warming in "Figure 3: Sea Level Rise" on SE/TE page 193. They **learn** about solutions to global warming in "Limiting Global Warming" on SE/TE page 194.

Students **ask questions** about the greenhouse effect in the Targeted Reading Skill on SE/TE page 190. Students use a graph to **analyze** carbon dioxide levels over time in "Figure 2: Carbon Dioxide Levels" on SE/TE page 192. Students **interpret maps** showing the vulnerability of the eastern part of the United States to rising sea levels in "Figure 3: Sea Level Rise" on SE/TE page 193. They **make models** of a particular technology that will reduce greenhouse gas emissions on SE/TE page 194. They **evaluate** evidence, reliability, and bias of media coverage of global warming in "Figure 4: Climate in the Media" on SE/TE page 195. They **interpret photographs** showing evidence of how melting glaciers have changed particular landscapes over the past several decades in "Differentiated Instructions: Photographic Evidence" on TE page 195. They **make observations** about a block of ice to understand how scientists use evidence from ice cores to learn about conditions in the atmosphere thousands of years ago in "Greenhouse Gases and Global Warming" on TLR page 169.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, clarify arguments and models. ▪ Ask questions to identify and clarify evidence of an argument. **MODULE: Water and the Atmosphere** **SE/TE:** 191, Ask Questions 195, Figure 4 – Climate in the Media 200, Tracking Earth's Gases From Space **TE Only:** 195, Differentiated Instruction – L3 Photographic Evidence	**ESS3.D: Global Climate Change** ▪ Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. **MODULE: Ecology and the Environment** **SE/TE:** 52, Human Impact **MODULE: Water and the Atmosphere** **SE/TE:** 190–195, Human Activities and Climate Change	**Stability and Change** ▪ Stabillity might be disturbed either by sudden events or gradual changes that accumulate over time. **MODULE: Water and the Atmosphere** **SE/TE:** 188, Do the Math! 189, Figure 5 – Volcanic Activity and Climate 192, Figure 2 – Carbon Dioxide Levels 193, Figure 3 – Sea Level Rise **TE Only:** 184A, Content Refresher – Earth's Changing Orbit 189, Differentiated Instruction – L3 Year Without Summer

	192, Figure 2: Carbon Dioxide Levels 193, Figure 3: Sea Level Rise 194, Apply It! 195, Figure 4: Climate in the Media 200, Tracking Earth's Gases From Space **TE Only:** 192, Teach With Visuals 193, 21st Century Learning 195, Differentiated Instruction – L1 Efficiency **TLR:** 169, Greenhouse Gases and Global Warming	**TLR:** 168, What Is the Greenhouse Effect? 195E, Enrich – The Carbon Cycle **MODULE: Ecology and the Environment** **SE/TE:** 99, Do the Math! 148, The Ozone Hole 148, Figure 6: Ozone Hole

MS.Human Impacts
MS-ESS3-2

Students who demonstrate understanding can:

Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

INTERACTIVE SCIENCE: A discussion of earthquakes and their potential to cause sudden damage appears in Chapter 4, Lesson 2 of the *Earth's Structure* module on SE/TE pages 110–117. How scientists use seismographic data to create maps showing where earthquakes have occurred in the past (and thus, where they are likely to occur in the future) is described in "What Patterns Do Seismographic Data Reveal?" on SE/TE pages 121–123. Students **learn** about earthquake risk in "Earthquake Risk in North America" SE/TE page 121 and "Earthquake Risk Around the World" on SE/TE page 122. Students **interpret data** to **forecast** earthquake risk in the Apply It! on SE/TE page 121. T Students **discuss** the importance of predicting earthquakes and how to mitigate their effects in the "Lead a Discussion" activity on TE page 121.They **analyze data** on the locations of past earthquakes to indicate where buildings should be built to withstand future earthquakes in "Figure 3: Earthquakes Around the World" on SE/TE page 122. They **analyze data** on the probability of an earthquake occurring along the San Andreas fault on TE page 123E. They **obtain knowledge** of how buildings can be engineered to mitigate the effects of earthquakes in "Seismic-Safe Buildings" on SE/TE page 128.

A discussion of volcanoes and plate tectonics appears in the *Earth's Structure* module on SE/TE pages 134–137. Students **analyze data** related to the location of volcanoes around the world in "Figure 1: The Ring of Fire" on SE/TE page 135. Students **learn** that volcanoes can erupt quietly or explosively in "Two Types of Volcanic Eruptions" on SE/TE pages 140–142. They **obtain knowledge** of phenomena that allow for reliable predictions of volcanic eruptions in "What Are the Stages of Volcanic Activity?" on SE/TE page 144. They **interpret data** related to the location and frequency of eruptions in the Cascade range in "Figure 5: Cascade Volcanoes" on SE/TE page 144.

A discussion of tsunamis appears in the *Water and the Atmosphere* module on SE/TE page 51. Students **learn** how the occurrence of tsunamis in the Pacific Ocean led to the development of a tsunami warning system on SE/TE page 51. A discussion of flood plains appears in the *Earth's Surface* module on SE page 74. Students **research** flood plains and ways to mitigate the effects of floods in "Floodwater Fallout" on SE/TE page 98. They **learn** further details about mitigating floods in "Science and Society" on TE page 98. A discussion of floods and droughts appears in the *Water and the Atmosphere* module on SE/TE pages 130–131 "What Are the Causes of Floods and Droughts?" Students **learn** about flood prevention in "Lead a Discussion" on TE page 130. They **learn** about flood control projects in "Differentiated Instruction: Flood Control" on TE page 131.

A discussion of hurricanes appears in the *Water and the Atmosphere* module on SE/TE pages 144–145. Students **interpret data** related to the paths of hurricanes in "Differentiated Instruction: Hurricane Movement" on TE page 145. Students **obtain** knowledge about how scientists predict hurricanes in "Support the Big Question" on TE page 148 and "Think Like a Scientist" on TE page 161. Students can **map** hurricane paths in the Teacher To Teacher activity on TE page 148. A discussion of tornadoes appears on SE/TE pages 146–147. Students **interpret maps** related to tornado alley in "Figure 6: Tornado Formation" on SE/TE page 146. Students **interpret photographs** showing the magnitude of damage due to a hurricane in "Figure 7: Tornado Damage" on SE/TE page 147.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **MODULE: Earth's Structure** **SE/TE:** 129, Forensic Seismology 135, Figure 1 – The Ring of Fire 157, An Explosive Secret **TE Only:** 117F, Enrich – Comparing the Richter and Moment Magnitude Scales 129, Technology and Society 137, Teacher Demo – Interpreting Maps 137E, Enrich – Volcanoes and Plates **MODULE: Earth's Surface** **TLR:** 66, Weathering and Erosion 67–75, Sand Hills **MODULE: Water and the Atmosphere** **TE Only:** 145, Differentiated Instruction – L1 Hurricane Movement **Scenario-Based Investigations:** 95–97, High-Priority Earthquake Zones	**ESS3.B: Natural Hazards** ▪ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events **MODULE: Earth's Structure** **SE/TE:** 86–91, The Theory of Plate Tectonics 90–91, Figure 6: Earth's Changing Crust 97, An Ocean Is Born 121–123, What Patterns Do Seismographic Data Reveal? 121, Apply It! 122–123, Figure 3 – Earthquakes Around the World 134–137, Volcanoes and Plate Tectonics 135, Figure 1 – The Ring of Fire 137, Apply It! 144, What are the Stages of Volcanic Activity? **TE Only:** 83, Differentiated Instruction – L1 Cause-and-Effect Table 88, Teacher to Teacher 98, From the Author 121, Lead a Discussion – Earthquake Predictions 121, Differentiated Instruction – L3 New Madrid Fault 123E, Enrich – Earthquake Probability 128, Technology and Society 137, Teacher Demo – Interpreting Maps 145, Differentiated Instruction – L3 Predict Eruptions **TLR:** 115, Earthquake Patterns 125, Where Are Volcanoes Found on Earth's Surface? **MODULE: Earth's Surface** **SE/TE:** 79, Karst Topography 79, Apply It! 98, Floodwater Fallout **TE Only:** 98, Science and Society	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. **MODULE: Earth's Structure** **SE/TE:** 121, Apply It! 122–123, Figure 3 – Earthquakes Around the World 135, Figure 1 – The Ring of Fire 140, Do the Math! 144, Figure 5 – Cascade Volcanoes 146, Figure 6: Tornado Formation **TE Only:** 123E, Enrich – Earthquake Probability 131, Differentiated Instruction – L1 Droughts and Floods **MODULE: Earth's Surface** **SE/TE:** 79, Apply It! **Scenario-Based Investigations:** 95–97, High-Priority Earthquake Zones 103–105, Jane Versus the Volcano ------------------------------------ ***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 limitations on their use are driven by people's 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. **MODULE: Earth's Structure** **SE/TE:** 119, How Do Seismographs Work? 122–123, Figure 3: Earthquakes Around the World ("Make Judgments") 128, Seismic-Safe Buildings 129, Forensic Seismology 144, What Are the Stages of Volcanic Activity?

	MODULE: Water and the Atmopshere **SE/TE:** 51, Tsunami 130–131, What Are the Causes of Floods and Droughts? 144–145, Hurricanes 146–147, Tornadoes 146, Figure 6 – Tornado Formation 147, Figure 7 – Tornado Damage **TE Only:** 130, Lead a Discussion – Flood Prevention 131, Differentiated Instruction – L3 Flood Control 143, Differentiated Instruction – L3 Rocky Mountain Thunderstorms 145, Differentiated Instruction – L1 Hurricane Movement 148, Support the Big Question 148, Teacher to Teacher 161, Think Like a Scientist **Scenario-Based Investigations:** 95–97, High-Priority Earthquake Zones 103–105, Jane Versus the Volcano	**TE Only:** 128, Technology and Society **MODULE: Water and the Atmosphere** **SE/TE:** 46, My Planet Diary – Rogue Waves 51, Tsunami 126, My Planet Diary – Cloud Seeding 152, Using Technology 152, Figure 2 – Weather Technology **TE Only:** 46A, Content Refresher – Wave Power and Tsunamis

MS.Human Impacts
MS-ESS3-3

Students who demonstrate understanding can:

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

INTERACTIVE SCIENCE: Students **design a solution** to minimize the impact of stormwater runoff at their middle school in "The Problem With Runoff" on pages 20–21 of the *Scenario-Based Investigations* book. They **design a solution** for monitoring and reducing energy use in their school in "Energy Audit" on pages 38–42 of the *Chapter Activities and Project* book. They **design** a water filtration system to clean dirty water in "A Precious Resource" on pages 45–49 of the *Chapter Activities and Project* book. They **design a solution** for monitoring water use in "Every Drop Counts" on pages 290–294 of the *Chapter Activities and Project* book. They **design** a landfill to minimize the human impact of wastes in "Waste Away!" on TLR pages 111–119 of the *Ecology and the Environment* module. They **design** a solar cooker to minimize the impact of humans' use of energy resources in "Design and Build a Solar Cooker" on TLR pages 144-152. They **design** a dam and evaluate how it effects the land upstream and downstream in "It's All Water Under the Dam" on pages 17–20 of the *STEM Activity Book.*

A discussion of the human impacts on soil fertility is included in Chapter 2, Lesson 3 "Soil Conservation" on SE/TE pages 52–55 of the *Earth's Surface* module. A discussion of how to minimize the impacts on soil due to agriculture, mining, and development appears in Chapter 4, Lesson 1 "Conserving Land and Soil" on SE/TE pages 128–133. Students **research** methods farmers use to minimize loss of soil fertility in "Differentiated Instruction: Soil Fertility" in the *Earth's Surface* module on TE page 55. Students **learn** about George Washington Carver and the importance of farming techniques such as crop rotation in "The Plant Doctor" on SE/TE page 61.

A discussion of the impact humans have on the supply of natural resources appears in Chapter 3, Lesson 2 "Introduction to Natural Resources" on SE/TE pages 92–97 of the *Ecology and the Environment* module. A discussion of how human population growth impacts natural resources appears in "What Factors Allow the Human Population to Grow?" on SE/TE pages 100–101. A discussion of how humans impact forests and fish populations is presented in Chapter 3, Lesson 4 "Forests and Fisheries" on pages 102–107. A discussion of ways to protect biodiversity is included in "How Do Humans Affect Biodiversity?" on SE/TE pages 114–117. A discussion of how to dispose of waste to minimize pollution appears in Chapter 4, Lesson 2 "Waste Disposal and Recycling" on SE/TE pages 134–141.

A discussion of ways to reduce air pollution appears in Chapter 4, Lesson 3 "Air Pollution and Solutions" on pages SE/TE 142–151 of the *Ecology and the Environment* module. A discussion of ways to reduce water pollution appears in Chapter 4, Lesson 4 "Water Pollution and Solution" on SE/TE pages 152–159. A discussion of ocean resources and ocean pollution appears in Chapter 4, Lesson 5 "Ocean Resources" on SE/TE pages 160–167. A discussion of human use of energy resources appears in Chapter 5, Lesson 1, "Fossil Fuels" on SE/TE pages 178–185. A discussion of alternative energy sources appears in Chapter 5, Lesson 2 "Renewable Energy Sources" on SE/TE pages 195. A discussion of how humans can minimize the impact of energy use appears in Chapter 5, Lesson 3 "Energy Use and Conservation" on SE/TE pages 196–201.

Students **map** the Chesapeake Bay watershed to show how fertilizers enter the bay in "A Pearl of a Solution" on SE/TE page 34 of the *Water and the Atmosphere* module. Students **design a plan** to help minimize global warming in the Apply It! on SE/TE page 194 of the *Water and the Atmosphere* module.

Students **devise a method** to increase fish harvests in the "Apply It!" activity on SE/TE page 161 of the *Ecology and the Environment* module. Students **solve problems** by identifying a method to reduce oil pollution in "Do the Math" on SE/TE page 166. Students **research** the use of satellites to help protect water supplies from agricultural contamination in "Old MacDonald Had a Satellite" on SE/TE page 172. Using scientific principles, they **evaluate** how energy technologies minimize human impact in "How Low Is Low Impact?" on SE/TE page 206.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

A Correlation of
Pearson Interactive Science, 12 Module Series, ©2011
to the Next Generation Science Standards – May, 2013
Grades 6-8

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 principles to design an object, tool, process or system. **MODULE: Ecology and the Environment** **SE/TE:** 161, Apply It! **TLR:** 116–119, Waste Away! 149–152, Design and Build a Solar Cooker **MODULE: Water and the Atmosphere** **SE/TE:** 194, Apply It! **Scenario-Based Investigations:** 20–21, The Problem With Runoff **Chapter Activities and Projects** 38–42, Energy Audit 45–49, A Precious Resource	**ESS3.C: Human Impacts on Earth Systems** ▪ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **MODULE: Earth's Structure** **SE/TE:** 27, Save the Seeds, Save the World **TE Only:** 7, Differentiated Instruction – L3 Human Impact **MODULE: Earth's Surface** **SE/TE:** 52–55, Soil Conservation 61, The Plant Doctor **TE Only:** 55, Differentiated Instruction – L3 Soil Fertility **MODULE: Water and the Atmosphere** **SE/TE:** 16, How Can Lakes Change? 21, Do the Math! 28–29, Why Are Wetlands Important? 34, A Pearl of a Solution **TE Only:** 17, Differentiated Instruction – L3 Fertilizers 18A, Content Referesher 29, Differentiated Instruction – L3 Wetland Advocacy 29E, Enrich – The Shrinking Everglades **MODULE: Ecology and the Environment** **SE/TE:** 93, What Are Natural Resources? 102–107, Forests and Fisheries 104, Figure 2 – Tree Harvest 107, Figure 3 – Aquaculture 113, Exinction of Species 114–117, How Do Humans Affectana	**Cause and Effect** ▪ Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **MODULE: Water and the Environment** **SE/TE:** 16, The Human Role 21, Do the Math! 192, Figure 2 – Carbon Dioxide Levels 193, Figure 3 – Sea Level Rise **TE Only:** 17, Differentiated Instruction – L3 Fertilizers **MODULE: Earth's Surface** **SE/TE:** 54, Soil Damage and Loss **MODULE: Ecology and the Environment** **SE/TE:** 88, Population Growth 101, Identify the Main Idea 106, How Can Fisheries Be Managed for a Sustainable Yield? 110, Figure 2: Keystone Otters 114–115, How Do Humans Affect Biodiversity? 131, Soil Use Problems 131, Figure 3: Terracing 143-145, Outdoor Air Pollution 145, Apply It! 148, The Ozone Hole 148, Figure 7 – Ozone and Ultraviolet Radiation 154–155, What Are the Major Sources of Water Pollution? 154, Figure 2 – Farm Pollution 155, Outline 161, Apply It 166, Human Activities 166, Do the Math! 190, Apply It **TE Only:** 88, Teacher to Teacher 91E, Enrich – Congestion Pricing 102A, Content Refresher – Deforestation and Climate Change 133E, Enrich – The Copper Basin 149, Differentiated Instruction – LE Researching Ozone Depletion

	ESS3.C: Human Impacts on Earth Systems ▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **MODULE: Ecology and the Environment** **SE/TE:** 101, Medical Care and Technology 101, Identify the Main Idea 128–131, Conserving Land and Soil 129, Figure 1 – Land Use 149, What's Being Done? 150–151, How Can Air Pollution Be Reduced? 156–157, How Can Water Pollution Be Reduced? 156, Figure 3 – Wastewater Treatment 158–159, Figure 4 – Pollution and Solutions 186–193, Renewable Sources of Energy 188, Figure 2 – Solar-Powered House 189, Figure 3 – Hydroelectric and Wind Power 191, Figure 5 – Geothermal Power in Iceland 192-193, Figure 6 – The Energy Around Us 192, Electric Cars and Hydrogen Fuel Cells 194, Figure 7: Nuclear Power Plants 198–201, How Can We Ensure There Will Be Enrough Energy for the Future? **TE Only:** 88, 21st Century Learning 96, Teach With Visuals 97, Differentiated Instruction – L1 Calculate Your Ecological Footprint 101, 21st Century Learning 101, Differentiated Instruction – L1 Medical Care and Human Survival 124, From the Author **TLR:** 25, Elbow Room 75, Using Resources	Potential 167E, Enrich – Fishing on Georges Bank 195, Differentiated Instruction – L1 Relate Cause and Effect **TLR:** 87, Human Population Growth 89, What Happened to the Tuna? 91, Managing Fisheries 93, Modeling Keystone Species 107, How Does Mining Affect the Land? 129, Getting Clean 155, Human Energy Use ------------------------------------- ***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 limitations on their use are driven by people's 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. **MODULE: Water and the Atmosphere** **SE/TE:** 35, What Was Fort Miami? 126, My Planet Diary – Cloud Seeding **MODULE: Ecology and the Environment** **SE/TE:** 136, Landfills 136, Figure 1 – Sanitary Landfill Design 163, Figure 2 – Desalination Process 191, Tapping Earth's Energy 191, Figure 5 – Geothermal Power in Iceland 192, Electric Cars and Hydrogen Fuel Cells 194–195, How Does a Nuclear Power Plant Produce Electricity? 194, Figure 7 – Nuclear Power Plants 206, How Low Is Low Impact? 207, Hydrokinetic Energy **TE Only:** 107E, Enrich – Modern Fishing

	76, Natural Resources 86, Doubling Time 87, Human Population Growth 108, Land Use **MODULE: Water and the Atmosphere** **SE/TE:** 4, Planet Diary – How Much Water Do You Use? **TE Only:** 29E, Enrich – The Shrinking Everglades	Equipment 134A, Content Refresher – Municipal Solid Waste Disposal 193, Differentiated Instruction – L3 Hydrogen Power Plants 198, Teacher to Teacher 201, Differentiated Instruction – L3 Timeline of Automotive Efficiency 206, Quick Facts **TLR:** 155, Human Energy Use

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

MS.Human Impacts
MS-ESS3-4

Students who demonstrate understanding can:

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

INTERACTIVE SCIENCE: A discussion of how population growth of all living organisms is affected by the availability of food and water, the amount of available space, and climate appears in "What Factors Limit Population Growth?" on SE/TE pages 15–17 in the *Ecology and the Environment* module. Water shortages as a result of population growth are discussed in "Population Growth" on SE/TE page 88. Factors affecting human population growth are discussed in Chapter 3, Lesson 3 "Human Population Growth" on SE/TE pages 98–101. Consumption of natural resources as it relates to population growth is discussed in "Population Growth and Natural Resources" on SE/TE page 101. Students **model** how space can be a limiting factor for population growth in "Differentiated Instruction: Classroom Density" on TE page 17.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Construct an oral and written argument 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.

MODULE: Ecology and the Environment
SE/TE:
145, Apply It
148, The Ozone Hole

TLR:
25, Elbow Room

MODULE: Water and the Environment:
192, Figure 2 – Carbon Dioxide Levels

TLR:
168, What Is the Greenhouse Effect?

SCENARIO-BASED INVESTIGATIONS:
20–21, The Problem With Runoff

Disciplinary Core Ideas

ESS3.C: Human Impacts on Earth Systems

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

MODULE: Ecology and the Environment
SE/TE:
15–17, What Factors Limit Population Growth
88, Population Growth
95, Why Are Natural Resources Important?
96, Apply It!
98–101, Human Population Growth
101, Population Growth and Natural Resources
101, Identify the Main Idea
110, Figure 2 – Keystone Otters
129, Development
129, Figure 1 – Land Use

TE Only:
17, Differentiated Instruction – L1 Classroom Density
88, 21st Century Learning
96, Teach With Visuals
97, Differentiated Instruction – L1 Calculate Your Ecological Footprint
98A, Content Refresher – Human

Crosscutting Concepts

Cause and Effect

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

MODULE: Ecology and the Environment
SE/TE:
101, Identify the Main Idea
110, Figure 2 – Keystone Otters
122, Sustainable Seafood
131, Soil Use Problems
148–149, Figure 6 – The Ozone Hole
149, What's Being Done
143–146, What Causes Outdoor and Indoor Air Pollution?
154–155, What Are the Major Sources of Water Pollution?
161, Apply It!

TE Only:
97E, Enrich – Keeping Water Clean
133E, Enrich – The Copper Basin
167E, Enrich – Fishing on Georges Bank

TLR:
25, Elbow Room
89, What Happened to the Tuna?
91, Managing Fisheries
93, Modeling Keystone Species
107, How Does Mining Affect the

	Population Studies 101, 21st Century Learning 101, Differentiated Instruction – L1 Medical Care and Human Survival 124, From the Author **TLR:** 25, Elbow Room 75, Using Resources 76, Natural Resources 86, Doubling Time 87, Human Population Growth 108, Land Use **MODULE: Water and the Atmosphere** **SE/TE:** 4, Planet Diary – How Much Water Do You Use? **TE Only:** 29E, Enrich – The Shrinking Everglades	Land? 109, Modeling Soil Conservation **MODULE: Water and the Atmosphere** **SE/TE:** 191, Greenhouse Effect 191, Figure 1 – Greenhouse Effect 192, Effects of Global Warming 192, Figure 3 – Sea Level Rise --- ***Connections to Engineering, Technology, and Applications of Science*** **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-ESS3-4) **MODULE: Ecology and the Environment** **SE/TE:** 104, Figure 2 – The Harvest 107, Figure 3 – Aquaculture 107E, Enrich – Modern Fishing Equipment 114, Figure 5 – Habitat Fragmentation 122, Sustainable Seafood 128–129, How Do People Use Land? 131, Figure 3 – Terracing 133, Figure 4 – Land Reclamation 148–149, Figure 6 – The Ozone Hole 149, What's Being Done 150, How Can Air Pollution Be Reduced? 156–157, How Can Water Pollution Be Reduced? 156, Figure 3 – Wastewater Treatment 157, Apply It! 163, Figure 2 – Desalination Process 172, Old MacDonald Had a Satellite 206, How Low Is Low Impact? 207, Hydrokinetic Energy **TE Only:** 97, Differentiated Instruction – L1 Ecological Footprints and Food Choices 133E, Enrich – The Copper Basin 159F, Enrich – Sewage Treatment

		TLR: 153, Producing Electricity **MODULE: Water and the Atmosphere** **SE/TE:** 126, My Planet Diary – Cloud Seeding 192, Figure 2 – Carbon Dioxide Levels 194, Limiting Global Warming 194, Apply It! **TLR:** What Is the Greenhouse Effect? --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** ▪ Science knowledge can describe consequences of actions but does not make the decisions that society takes. (MS-ESS3-4) **MODULE: Ecology and the Environment** **SE/TE:** 101, Identify the Main Idea 104, Logging Methods 107, Fishing Methods 110, Figure 2 – Keystone Otters 122, Sustainable Seafood 131, Soil Use Problems 135–139, What Are Three Solid Waste Disposal Methods? 148–149, Figure 6 – The Ozone Hole 148–149, Figure 6 – The Ozone Hole 149, What's Being Done 143–146, What Causes Outdoor and Indoor Air Pollution? 154–155, What Are the Major Sources of Water Pollution? 161, Apply It! 198–201, How Can We Ensure There Will Be Enough Energy for the Future? **TE Only:** 97, Differentiated Instruction – L1 Ecological Footprints and Food Choices 97E, Enrich – Keeping Water Clean 133E, Enrich – The Copper Basin 167E, Enrich – Fishing on Georges Bank

		TLR: 89, What Happened to the Tuna? 91, Managing Fisheries 93, Modeling Keystone Species 107, How Does Mining Affect the Land? 109, Modeling Soil Conservation **MODULE: Water and the Atmosphere** **SE/TE:** 192, Levels of Greenhouse Gases 192, Figure 2 – Carbon Dioxide Levels

MS.Engineering Design
MS-ETS1-1

Students who demonstrate understanding can:

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.

INTERACTIVE SCIENCE: Chapter 4, Lesson 2 of the *Science and Technology* module explores the steps for designing technology. On SE/TE page 128, students **obtain information** about evaluating constraints of a design. In Apply It!, students **model** stages of the design process. On SE/TE page 138, Values and Trade-offs, students **learn** the process of evaluating technology's risks and benefits, taking long and short term consequences into consideration. On TLR page 118, students **brainstorm** possible solutions to a problem and evaluate ideas.

In the *Ecology and the Environment* module, students **learn** about costs and benefits of making environmental decisions, SE/TE pages 90-91. In Differentiated Instruction, TE page 91, students **present** two proposals to solve issues for evaluation. Students **compare and contrast** the pros and cons of three methods of solid waste disposal on SE/TE pages 135-137.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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, clarify arguments and models. ▪ Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **MODULE: Science and Technology** **SE/TE:** 128, Apply It! **TE Only:** 127, 21st Century Learning, Critical Thinking **TLR:** 117, Inquiry Warm-Up-Why Redesign? **Chapter Activities and Projects:** 15-21, Design and Build a Chair **STEM Activity Book** 17-20, It's All Water Under the Dam	**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 are likely to limit possible solutions. **MODULE: Science and Technology** **SE/TE:** 127, Design a Solution 128, Apply it 128, Evaluate Constraints, Apply it! 131, Assess Your Understanding **TE Only:** 131A, Lab zone- After the Inquiry Warm-Up: Technological Design 131B, Assess Your Understanding 131C, Key Concept Summary **TLR:** 117, Inquiry Warm-Up-Why Redesign? 118, Quick Lab-Watch Ideas take Off	**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. **MODULE: Ecology and the Environment** **SE/TE:** 86-91, Introduction to Environmental Issues 90, Apply It! 91, Figure 3, Weighing Costs and Benefits **TE Only:** 91, Differentiated Instruction, Multimedia Presentation **TLR:** 74, Quick Lab, Comparing Costs and Benefits ▪ The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

	MODULE: Ecology and the Environment **SE/TE:** 135-137, What Are Three Solid Waste Disposal Methods? **TE Only:** 137, Differentiated Instruction	**MODULE: Science and Technology** **SE/TE:** 132-133, How Has Technology Impacted Society? 134-136, What Are the Consequences of Technology? 137-139, How Do You Decide Whether to Use a Technology? **TE Only:** 137, Differentiated Instruction, Choose Technology 138, 21st Century Learning, Information Literacy **TLR:** 119, Inquiry-Technology Hunt 120, Quick Lab-Time-Saving Technology 121, Quick Lab-How Does Technology Affect Your Life? 122, Quick Lab-Considering Impacts

MS.Engineering Design
MS-ETS1-2

Students who demonstrate understanding can:

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

INTERACTIVE SCIENCE: In the *Science and Technology* module, Chapter 4, Lesson 2, SE/TE pages 124-131, students **learn** how to design a solution to a problem.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. ▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **Scenario-Based Investigations:** 7-9, This Isn't Science **STEM Activity Book** 1-4, Shake, Ratte, and Roll 17-20, It's All Water Under the Dam 37-40, Sail Away **Chapter Activities and Projects** 218-224, Design and Build an Earthquake Safe-House	**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. **MODULE: Science and Technology** **SE/TE:** 127-128, Design a Solution 129, Build a Prototype 130, Troubleshoot and Redesign 131, Communicate the Solution **TLR:** 117, Inquiry Warm-Up, Why Redesign? **Scenario-Based Investigations:** 7-9, This Isn't Science **STEM Activity Book** 1-4, Shake, Ratte, and Roll 17-20, It's All Water Under the Dam 37-40, Sail Away	

MS.Engineering Design
MS-ETS1-3

Students who demonstrate understanding can:

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.

INTERACTIVE SCIENCE: In the *Science and Technology* module, Chapter 4, Lesson 2, SE/TE pages 124-131, students **learn** how to design a solution to a problem and redesign if necessary.

In "Why Redesign?" on TLR page 117, students **design** a boat and then **redesign** the boat based on observations of the first design.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	
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. **STEM Activity Book** 9-12, I Wouldn't Drink That 21-24, Energy Boosters 45-48, Optical Security	**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. **MODULE: Science and Technology** **SE/TE:** 127-128, Design a Solution 129, Build a Prototype 130, Troubleshoot and Redesign 131, Communicate the Solution **TLR:** 117, Inquiry Warm-Up, Why Redesign? ▪ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **MODULE: Science and Technology** **SE/TE:** 130, Troubleshoot and Redesign **TLR:** 117, Inquiry Warm-Up, Why Redesign? **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.	

	MODULE: Science and Technology **SE/TE:** 130, Troubleshoot and Redesign 130, Figure 6-Troubleshooting and Redesigning **TE Only:** 130, Lead a Discussion, Identifying Problems and Redesigning 131A, After the Inquiry Warm-Up: Technological Design 131E, Enrich, A Redesigned Mouse **TLR:** 117, Inquiry Warm-Up, Why Redesign?	

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Grades 6-8

MS.Engineering Design
MS-ETS1-4

Students who demonstrate understanding can:

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.

INTERACTIVE SCIENCE: In the *Science and Technology* module, Chapter 3, Lesson 4, SE/TE pages 92-99, students **learn** how to use models and systems.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. **MODULE: Science and Technology** **SE/TE:** 98, Figure 5, How Arctic Sea Ice Melts **TE Only:** 97, 21st Century Learning, Creativity 99, Build Inquiry, Earth Systems Model **TLR:** 89, Quick Lab, Systems 108-116, Lab Investigation, Investigating a Technological System **STEM Activity Book:** 1-4, Shake, Rattle, and Roll **Chapter Activities and Projects** 295-301, Design and Build an Erosion-Proof Beach 435-441, Design and Build an Optical Instuments	**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. **MODULE: Science and Technology** **SE/TE:** 130, Troubleshoot and Redesign **STEM Activity Book** 13-16, Life on Mars 21-24, Energy Boosters 33-36, Crystal Clear 45-48, Optical Security **Chapter Activities and Projects** 435-441, Design and Build an Optical Instuments ▪ Models of all kinds are important for testing solutions. **MODULE: Science and Technology** **SE/TE:** 92-99, Models as Tools in Science **TE Only:** 98, Lead a Discussion, Model Storms 99, Differentiated Instruction, Telephone Model 99F, Enrich, A Scientific Model **TLR:** 89, Quick Lab, Systems 90, Quick Lab, Models in Nature	

	ETS1.C: Optimizing the Design Solution ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. **STEM Activity Book** 21-24, Energy Boosters 37-40, Sail Away **Chapter Activities and Projects** 15-21, Design and Build a Chair	