

Grade 7 Science

Scope and Sequence

Unit of Study 1: Structure and Properties of Matter

Standards that appear this unit: MS-PS1-1, MS-PS1-2

MS. Structure and Properties of Matter		
<p>Students who demonstrate understanding can:</p> <p>MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]</p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>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.</p> <ul style="list-style-type: none"> ▪ Develop a model to predict and/or describe phenomena. (MS-PS1-1) 	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> ▪ Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ▪ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) 	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)
<p><i>Connections to other DCIs in this grade-band:</i> MS.ESS2.C (MS-PS1-1)</p>		
<p><i>Articulation across grade-bands:</i> 5.PS1.A (MS-PS1-1); HS.PS1.A (MS-PS1-1); HS.ESS1.A (MS-PS1-1)</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1)</p> <p><i>Mathematics –</i></p> <p>MP.2 Reason abstractly and quantitatively. (MS-PS1-1)</p> <p>MP.4 Model with mathematics. (MS-PS1-1)</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1)</p> <p>8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)</p>		

MS. Chemical Reactions		
Students who demonstrate understanding can:		
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>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.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">Connections to Nature of Science</p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) 	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) <i>(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)</i> <p>PS1.B: Chemical Reactions</p> <ul style="list-style-type: none"> Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2) <i>(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)</i> 	<p>Patterns</p> <ul style="list-style-type: none"> Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)
<i>Connections to other DCIs in this grade-band:</i> MS.PS3.D (MS-PS1-2); MS.LS1.C (MS-PS1-2); MS.ESS2.A (MS-PS1-2)		
<i>Articulation across grade-bands:</i> 5.PS1.B (MS-PS1-2); HS.PS1.B (MS-PS1-2)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS1-2)	
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-2)	
<i>Mathematics –</i>		
MP.2	Reason abstractly and quantitatively. (MS-PS1-2)	
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-2)	
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)	
6.SP.B.5	Summarize numerical data sets in relation to their context (MS-PS1-2)	

Unit of Study 2: Interactions of Matter

Standards that appear this unit: MS-PS1-3, MS-PS1-4

MS. Structure and Properties of Matter		
Students who demonstrate understanding can:		
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p style="text-align: center; background-color: #4a7ebb; color: white; padding: 2px;">Science and Engineering Practices</p> <p style="background-color: #4a7ebb; color: white; padding: 2px;">Obtaining, Evaluating, and Communicating Information</p> <p>Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> ▪ Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3) 	<p style="text-align: center; background-color: #e67e22; color: white; padding: 2px;">Disciplinary Core Ideas</p> <p style="background-color: #e67e22; color: white; padding: 2px;">PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) <i>(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)</i> <p style="background-color: #e67e22; color: white; padding: 2px;">PS1.B: Chemical Reactions</p> <ul style="list-style-type: none"> ▪ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) <i>(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.)</i> 	<p style="text-align: center; background-color: #27ae60; color: white; padding: 2px;">Crosscutting Concepts</p> <p style="background-color: #27ae60; color: white; padding: 2px;">Structure and Function</p> <ul style="list-style-type: none"> ▪ Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center; background-color: #27ae60; color: white; padding: 2px;">Connections to Engineering, Technology, and Applications of Science</p> <p style="background-color: #27ae60; color: white; padding: 2px;">Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> ▪ Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3) <p style="background-color: #27ae60; color: white; padding: 2px;">Influence of Science, Engineering and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)
Connections to other DCIs in this grade-band: MS.LS2.A (MS-PS1-3); MS.LS4.D (MS-PS1-3); MS.ESS3.A (MS-PS1-3); MS.ESS3.C (MS-PS1-3)		
Articulation across grade-bands: HS.PS1.A (MS-PS1-3); HS.LS2.A (MS-PS1-3); HS.LS4.D (MS-PS1-3); HS.ESS3.A (MS-PS1-3)		
Common Core State Standards Connections:		
ELA/Literacy –		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS1-3)	
WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)	

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MS. Structure and Properties of Matter		
Students who demonstrate understanding can:		
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p style="text-align: center;">Science and Engineering Practices</p> <p>Developing and Using Models</p> <p>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.</p> <ul style="list-style-type: none"> Develop a model to predict and/or describe phenomena. (MS-PS1-4) 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (<i>secondary to MS-PS1-4</i>) 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. (<i>secondary to MS-PS1-4</i>) 	<p style="text-align: center;">Crosscutting Concepts</p> <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
<i>Connections to other DCIs in this grade-band:</i> MS.ESS2.C (MS-PS1-4)		
<i>Articulation across grade-bands:</i> HS.PS1.A (MS-PS1-4); HS.PS1.B (MS-PS1-4); HS.PS3.A (MS-PS1-4)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-4)	
<i>Mathematics –</i>		
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)	

Unit of Study 3: Chemical Reactions

Standards that appear this unit: MS-PS1-5, MS-PS1-6*, MS_ETS1-2, MS-ETS1-3, MS-ETS1-4

MS. Chemical Reactions		
<p>Students who demonstrate understanding can:</p> <p>MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]</p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p>Science and Engineering Practices</p> <p>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.</p> <ul style="list-style-type: none"> ▪ Develop a model to describe unobservable mechanisms. (MS-PS1-5) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">Connections to Nature of Science</p> <p>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</p> <ul style="list-style-type: none"> ▪ Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5) 	<p>Disciplinary Core Ideas</p> <p>PS1.B: Chemical Reactions</p> <ul style="list-style-type: none"> ▪ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-5) (<i>Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.</i>) ▪ The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) 	<p>Crosscutting Concepts</p> <p>Energy and Matter</p> <ul style="list-style-type: none"> ▪ Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
<p><i>Connections to other DCIs in this grade-band:</i> MS.LS1.C (MS-PS1-5); MS.LS2.B (MS-PS1-5); MS.ESS2.A (MS-PS1-5)</p>		
<p><i>Articulation across grade-bands:</i> 5.PS1.B (MS-PS1-5); HS.PS1.B (MS-PS1-5)</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (<i>MS-PS1-5</i>)</p> <p><i>Mathematics –</i></p> <p>MP.2 Reason abstractly and quantitatively. (MS-PS1-5)</p> <p>MP.4 Model with mathematics. (MS-PS1-5)</p> <p>6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-5)</p>		

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MS. Chemical Reactions		
Students who demonstrate understanding can:		
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) 	PS1.B: Chemical Reactions <ul style="list-style-type: none"> Some chemical reactions release energy, others store energy. (MS-PS1-6) ETS1.B: Developing Possible Solutions <ul style="list-style-type: none"> A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (<i>secondary to MS-PS1-6</i>) ETS1.C: Optimizing the Design Solution <ul style="list-style-type: none"> 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. (<i>secondary to MS-PS1-6</i>) 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. (<i>secondary to MS-PS1-6</i>) 	Energy and Matter <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)
<i>Connections to other DCIs in this grade-band:</i> MS.PS3.D (MS-PS1-6)		
<i>Articulation across grade-bands:</i> HS.PS1.A (MS-PS1-6); HS.PS1.B (MS-PS1-6); HS.PS3.A (MS-PS1-6); HS.PS3.B (MS-PS1-6); HS.PS3.D (MS-PS1-6)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)		
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)		

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MS. Engineering Design		
Students who demonstrate understanding can: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2) 	ETS1.B: Developing Possible Solutions <ul style="list-style-type: none"> ▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) 	N/A
<i>Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:</i> Physical Science: MS-PS3-3 <i>Connections to MS-ETS1.B: Developing Possible Solutions Problems include:</i> Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5 <i>Connections to MS-ETS1.C: Optimizing the Design Solution include:</i> Physical Science: MS-PS1-6		
<i>Articulation of DCIs across grade-bands: 3-5.ETS1.A (MS-ETS1-2); 3-5.ETS1.B (MS-ETS1-2); 3-5.ETS1.C (MS-ETS1-2); HS.ETS1.A (MS-ETS1-2); HS.ETS1.B (MS-ETS1-2)</i>		
<i>Common Core State Standards Connections:</i> ELA/Literacy – RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-2) RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2) WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) Mathematics – MP.2 Reason abstractly and quantitatively. (MS-ETS1-2) 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-2)		

MS. Engineering Design		
Students who demonstrate understanding can: MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p style="text-align: center;">Science and Engineering Practices</p> <p>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.</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) <p>ETS1.C: Optimizing the Design Solution</p> <ul style="list-style-type: none"> Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) 	<p style="text-align: center;">Crosscutting Concepts</p> <p>N/A</p>
<p><i>Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:</i> Physical Science: MS-PS3-3</p> <p><i>Connections to MS-ETS1.B: Developing Possible Solutions Problems include:</i> Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5</p> <p><i>Connections to MS-ETS1.C: Optimizing the Design Solution include:</i> Physical Science: MS-PS1-6</p>		
<p><i>Articulation of DCIs across grade-bands: 3-5.ETS1.A (MS-ETS1-3); 3-5.ETS1.B (MS-ETS1-3); 3-5.ETS1.C (MS-ETS1-3); HS.ETS1.B (MS-ETS1-3); HS.ETS1.C (MS-ETS1-3)</i></p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-3)</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-3)</p> <p><i>Mathematics –</i></p> <p>MP.2 Reason abstractly and quantitatively. (MS-ETS1-3)</p> <p>7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-3)</p>		

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MS. Engineering Design		
Students who demonstrate understanding can: MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) 	ETS1.B: Developing Possible Solutions <ul style="list-style-type: none"> ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ▪ Models of all kinds are important for testing solutions. (MS-ETS1-4) ETS1.C: Optimizing the Design Solution <ul style="list-style-type: none"> ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) 	N/A
<i>Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:</i> Physical Science: MS-PS3-3 <i>Connections to MS-ETS1.B: Developing Possible Solutions Problems include:</i> Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5 <i>Connections to MS-ETS1.C: Optimizing the Design Solution include:</i> Physical Science: MS-PS1-6		
<i>Articulation of DCIs across grade-bands: 3-5.ETS1.B (MS-ETS1-4); 3-5.ETS1.C (MS-ETS1-4); HS.ETS1.B (MS-ETS1-4); HS.ETS1.C (MS-ETS1-4)</i>		
<i>Common Core State Standards Connections:</i> ELA/Literacy – SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ETS1-4) Mathematics – MP.2 Reason abstractly and quantitatively. (MS-ETS1-4)		
7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)		

Unit of Study 4: Structure and Function

Standards that appear this unit: MS-LS1-1, MS-LS1-2

MS. Structure, Function, and Information Processing		
Students who demonstrate understanding can:		
MS-LS1-1. 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 things, and understanding that living things may be made of one cell or many varied cells.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p style="text-align: center;">Science and Engineering Practices</p> <p>Planning and Carrying Out Investigations</p> <p>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.</p> <ul style="list-style-type: none"> ▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> ▪ 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). (MS-LS1-1) 	<p style="text-align: center;">Crosscutting Concepts</p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> ▪ Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> ▪ Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)
<i>Connections to other DCIs in this grade-band: N/A</i>		
<i>Articulation to DCIs across grade-bands: HS.LS1.A (MS-LS1-1)</i>		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)	
<i>Mathematics –</i>		
6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1)	

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MS. Structure, Function, and Information Processing		
Students who demonstrate understanding can:		
MS-LS1-2. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ Develop and use a model to describe phenomena. (MS-LS1-2) 	LS1.A: Structure and Function <ul style="list-style-type: none"> ▪ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) 	Structure and Function <ul style="list-style-type: none"> ▪ 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 structures/systems can be analyzed to determine how they function. (MS-LS1-2)
<i>Connections to other DCIs in this grade-band: MS.LS3.A (MS-LS1-2)</i>		
<i>Articulation to DCIs across grade-bands: 4.LS1.A (MS-LS1-2); HS.LS1.A (MS-LS1-2)</i>		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2)		
<i>Mathematics –</i>		
6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-2)		

Unit of Study 5: Body Systems

Standards that appear this unit: MS-LS1-3, MS-LS1-8

MS. Structure, Function, and Information Processing		
<p>Students who demonstrate understanding can:</p> <p>MS-LS1-3. 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.]</p>		
<p>The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p style="text-align: center;">Science and Engineering Practices</p> <p>Engaging in Argument from Evidence</p> <p>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).</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. (MS-LS1-3) 	<p style="text-align: center;">Crosscutting Concepts</p> <p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. (MS-LS1-3) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">Connections to Nature of Science</p> <p>Science is a Human Endeavor</p> <ul style="list-style-type: none"> Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)
<p><i>Connections to other DCIs in this grade-band:</i> N/A</p>		
<p><i>Articulation to DCIs across grade-bands:</i> HS.LS1.A (MS-LS1-3)</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3)</p> <p>RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3)</p> <p>WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3)</p> <p><i>Mathematics –</i></p> <p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-3)</p>		

MS. Structure, Function, and Information Processing		
Students who demonstrate understanding can:		
MS-LS1-8. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ 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 <ul style="list-style-type: none"> ▪ 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. (MS-LS1-8) 	Cause and Effect <ul style="list-style-type: none"> ▪ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)
<i>Connections to other DCIs in this grade-band: N/A</i>		
<i>Articulation to DCIs across grade-bands: 4.LS1.D (MS-LS1-8); HS.LS1.A (MS-LS1-8)</i>		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-LS1-8)		

Unit of Study 6: Inheritance and Variations of Traits

Standards that appear this unit: MS-LS3-1, MS-LS3-2

MS. Growth, Development, and Reproduction of Organisms		
Students who demonstrate understanding can:		
<p>MS-LS3-1. 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.]</p>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p>Science and Engineering Practices</p> <p>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.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena. (MS-LS3-1) 	<p>Disciplinary Core Ideas</p> <p>LS3.A: Inheritance of Traits</p> <ul style="list-style-type: none"> 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. (MS-LS3-1) <p>LS3.B: Variation of Traits</p> <ul style="list-style-type: none"> 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. (MS-LS3-1) 	<p>Crosscutting Concepts</p> <p>Structure and Function</p> <ul style="list-style-type: none"> 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 structures/systems can be analyzed to determine how they function. (MS-LS3-1)
<p><i>Connections to other DCIs in this grade-band:</i> MS.LS1.A (MS-LS3-1); MS.LS4.A (MS-LS3-1)</p>		
<p><i>Articulation to DCIs across grade-bands:</i> 3.LS3.A (MS-LS3-1); 3.LS3.B (MS-LS3-1); HS.LS1.A (MS-LS3-1); HS.LS1.B (MS-LS3-1); HS.LS3.A (MS-LS3-1); HS.LS3.B (MS-LS3-1)</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1)</p> <p>RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (MS-LS3-1)</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1)</p> <p>SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-LS3-1)</p>		

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MS. Growth, Development, and Reproduction of Organisms		
Students who demonstrate understanding can:		
MS-LS3-2. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> Develop and use a model to describe phenomena. (MS-LS3-2) 	LS1.B: Growth and Development of Organisms <ul style="list-style-type: none"> Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (<i>secondary to MS-LS3-2</i>) LS3.A: Inheritance of Traits <ul style="list-style-type: none"> Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) LS3.B: Variation of Traits <ul style="list-style-type: none"> 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. (MS-LS3-2) 	Cause and Effect <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)
<i>Connections to other DCIs in this grade-band:</i> N/A		
<i>Articulation to DCIs across grade-bands:</i> 3.LS3.A (MS-LS3-2); 3.LS3.B (MS-LS3-2); HS.LS1.B (MS-LS3-2); HS.LS3.A (MS-LS3-2); HS.LS3.B (MS-LS3-2)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (<i>MS-LS3-2</i>)	
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (<i>MS-LS3-2</i>)	
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-2)	
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (<i>MS-LS3-2</i>)	
<i>Mathematics –</i>		
MP.4	Model with mathematics. (<i>MS-LS3-2</i>)	
6.SP.B.5	Summarize numerical data sets in relation to their context. (<i>MS-LS3-2</i>)	

Unit of Study 7: Organization of Matter and Energy Flow in Organisms

Standards that appear this unit: MS-LS1-6, MS-LS1-7

MS. Matter and Energy in Organisms and Ecosystems		
Students who demonstrate understanding can:		
<p>MS-LS1-6. 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.]</p>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p style="text-align: center;">Science and Engineering Practices</p> <p>Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> 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. (MS-LS1-6) <p style="text-align: center;">-----</p> <p style="text-align: center;">Connections to Nature of Science</p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6) 	<p style="text-align: center;">Disciplinary Core Ideas</p> <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> 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. (<i>secondary to MS-LS1-6</i>) <p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <ul style="list-style-type: none"> 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. (MS-LS1-6) 	<p style="text-align: center;">Crosscutting Concepts</p> <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)
Connections to other DCIs in this grade-band: MS.PS1.B (MS-LS1-6); MS.ESS2.A (MS-LS1-6)		
Articulation across grade-bands: 5.PS3.D (MS-LS1-6); 5.LS1.C (MS-LS1-6); 5.LS2.A (MS-LS1-6); 5.LS2.B (MS-LS1-6); HS.PS1.B (MS-LS1-6); HS.LS1.C (MS-LS1-6); HS.LS2.B (MS-LS1-6) HS.ESS2.D (MS-LS1-6)		
Common Core State Standards Connections:		
ELA/Literacy –		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-6)	
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (<i>MS-LS1-6</i>)	
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and	

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WHST.6-8.9	information through the selection, organization, and analysis of relevant content. (MS-LS1-6)
6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6)

MS. Matter and Energy in Organisms and Ecosystems		
Students who demonstrate understanding can:		
MS-LS1-7. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ Develop a model to describe unobservable mechanisms. (MS-LS1-7) 	PS3.D: Energy in Chemical Processes and Everyday Life <ul style="list-style-type: none"> ▪ 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. (<i>secondary to MS-LS1-7</i>) LS1.C: Organization for Matter and Energy Flow in Organisms <ul style="list-style-type: none"> ▪ 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. (MS-LS1-7) 	Energy and Matter <ul style="list-style-type: none"> ▪ Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)
Connections to other DCIs in this grade-band: MS.PS1.B (MS-LS1-7)		
Articulation across grade-bands: 5.PS3.D (MS-LS1-7); 5.LS1.C (MS-LS1-7); 5.LS2.B (MS-LS1-7); HS.PS1.B (MS-LS1-7); HS.LS1.C (MS-LS1-7); HS.LS2.B (MS-LS1-7)		
Common Core State Standards Connections:		
ELA/Literacy –		
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-7)		

Unit of Study 8: Earth Systems

Standards that appear this unit: MS-ESS1-4, MS-ESS2-2, MS-ESS2-1, MS-ESS2-3

MS. History of Earth		
Students who demonstrate understanding can:		
<p>MS-ESS1-4. 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.]</p>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<p>Science and Engineering Practices</p> <p>Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> ▪ 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. (MS-ESS1-4) 	<p>Disciplinary Core Ideas</p> <p>ESS1.C: The History of Planet Earth</p> <ul style="list-style-type: none"> ▪ 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. (MS-ESS1-4) 	<p>Crosscutting Concepts</p> <p>Scale Proportion and Quantity</p> <ul style="list-style-type: none"> ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4)
<p><i>Connections to other DCIs in this grade-band:</i> MS.LS4.A (MS-ESS1-4); MS.LS4.C (MS-ESS1-4)</p>		
<p><i>Articulation of DCIs across grade-bands:</i> 3.LS4.A (MS-ESS1-4); 3.LS4.C (MS-ESS1-4); 4.ESS1.C (MS-ESS1-4); HS.PS1.C (MS-ESS1-4); HS.LS4.A (MS-ESS1-4); HS.LS4.C (MS-ESS1-4); HS.ESS1.C (MS-ESS1-4); HS.ESS2.A (MS-ESS1-4)</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-4)</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4)</p> <p><i>Mathematics –</i></p> <p>6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-4)</p> <p>7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-4)</p>		

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MS. Earth's Systems		
Students who demonstrate understanding can: MS-ESS2-1. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> Develop and use a model to describe phenomena. (MS-ESS2-1) 	ESS2.A: Earth's Materials and Systems <ul style="list-style-type: none"> 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. (MS-ESS2-1) 	Stability and Change <ul style="list-style-type: none"> 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. (MS-ESS2-1)
<i>Connections to other DCIs in this grade-band:</i> MS.PS1.A (MS-ESS2-1); MS.PS1.B (MS-ESS2-1); MS.PS3.B (MS-ESS2-1); MS.LS2.B (MS-ESS2-1); MS.LS2.C (MS-ESS2-1); MS.ESS1.B (MS-ESS2-1); MS.ESS3.C (MS-ESS2-1)		
<i>Articulation of DCIs across grade-bands:</i> 4.PS3.B (MS-ESS2-1); 4.ESS2.A (MS-ESS2-1); 5.ESS2.A (MS-ESS2-1); HS.PS1.B (MS-ESS2-1); HS.PS3.B (MS-ESS2-1); HS.LS1.C (MS-ESS2-1); HS.LS2.B (MS-ESS2-1); HS.ESS2.A (MS-ESS2-1); HS.ESS2.C (MS-ESS2-1); HS.ESS2.E (MS-ESS2-1)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1)		

MS. History of Earth		
Students who demonstrate understanding can:		
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> 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. (MS-ESS2-2) 	ESS2.A: Earth's Materials and Systems <ul style="list-style-type: none"> 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. (MS-ESS2-2) ESS2.C: The Roles of Water in Earth's Surface Processes <ul style="list-style-type: none"> Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2) 	Scale Proportion and Quantity <ul style="list-style-type: none"> Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)
<i>Connections to other DCIs in this grade-band:</i> MS.PS1.B (MS-ESS2-2); MS.LS2.B (MS-ESS2-2)		
<i>Articulation of DCIs across grade-bands:</i> 4.ESS1.C (MS-ESS2-2); 4.ESS2.A (MS-ESS2-2); 4.ESS2.E (MS-ESS2-2); 5.ESS2.A (MS-ESS2-2); HS.PS3.D (MS-ESS2-2); HS.LS2.B (MS-ESS2-2); HS.ESS1.C (MS-ESS2-2); HS.ESS2.A (MS-ESS2-2); HS.ESS2.B (MS-ESS2-2); HS.ESS2.C (MS-ESS2-2); HS.ESS2.D (MS-ESS2-2); HS.ESS2.E (MS-ESS2-2); HS.ESS3.D (MS-ESS2-2)		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2)	
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)	
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-2)	
<i>Mathematics –</i>		
MP.2	Reason abstractly and quantitatively. (MS-ESS2-2)	
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS2-2)	
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS2-2)	

MS. History of Earth		
Students who demonstrate understanding can:		
MS-ESS2-3. 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.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
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. <ul style="list-style-type: none"> ▪ Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">Connections to Nature of Science</p> Scientific Knowledge is Open to Revision in Light of New Evidence <ul style="list-style-type: none"> ▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3) 	Disciplinary Core Ideas ESS1.C: The History of Planet Earth <ul style="list-style-type: none"> ▪ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (<i>HS.ESS1.C GBE</i>) (<i>secondary to MS-ESS2-3</i>) ESS2.B: Plate Tectonics and Large-Scale System Interactions <ul style="list-style-type: none"> ▪ 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. (MS-ESS2-3) 	Crosscutting Concepts Patterns <ul style="list-style-type: none"> ▪ Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)
<i>Connections to other DCIs in this grade-band: MS.LS4.A (MS-ESS2-3)</i>		
<i>Articulation of DCIs across grade-bands: 3.LS4.A (MS-ESS2-3); 3.ESS3.B (MS-ESS2-3); 4.ESS1.C (MS-ESS2-3); 4.ESS2.B (MS-ESS2-3); 4.ESS3.B (MS-ESS2-3); HS.LS4.A (MS-ESS2-3); HS.LS4.C (MS-ESS2-3); HS.ESS1.C (MS-ESS2-3); HS.ESS2.A (MS-ESS2-3); HS.ESS2.B (MS-ESS2-3)</i>		
<i>Common Core State Standards Connections:</i>		
<i>ELA/Literacy –</i>		
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (<i>MS-ESS2-3</i>)	
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3)	
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3)	
<i>Mathematics –</i>		
MP.2	Reason abstractly and quantitatively. (MS-ESS2-3)	
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (<i>MS-ESS2-3</i>)	
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (<i>MS-ESS2-3</i>)	

