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HMH 6–8 Science Solutions:

Your Pathway to Next Generation Learning

SCIENCE FUSION

A correlation of *ScienceFusion* to the
Next Generation Science Standards Disciplinary Core Ideas.

Leading the Way to Next Generation Science Education

There's a revolution in science education underway! Starting in 2011, with the release of the *Framework for K–12 Science Education* by the National Research Council, science educators have begun the transition from old knowledge-based standards to the Next Generation Science Standards (NGSS). Key to this transition are solutions that address all three of the dimensions of science learning as defined by the NRC: *scientific and engineering practices, cross-cutting concepts*, and *disciplinary core ideas*. Rather than simply asking what students know, NGSS challenges students to demonstrate their progress in three-dimensional science education by asking them to meet *performance expectations*.

Houghton Mifflin Harcourt™ offers you a complete science solution seamlessly integrating services and products that will help you, your teachers, and your students make this critical paradigm shift to three-dimensional science education. One essential element for successful implementation of NGSS is teacher professional development. Science education expert Lynn Howard of The Leadership and Learning Center® offers seminars that provide this key ingredient. To ensure that your teachers have the educational resources to engage students in three-dimensional learning, HMH® provides curricular materials that offer students 360° of inquiry to help them meet rigorous performance expectations. Read on to find out more about how HMH's solutions will help you transition seamlessly to next generation science from Grades K–12.

At middle school, NGSS asks students to build on the foundation of *crosscutting concepts* they first started developing in Grades K–5, improving their use of *scientific and engineering practices* to deepen their understanding of *disciplinary core ideas* and demonstrate their mastery of *performance expectations*. As is the case with K–5, Grade 6–8 ***ScienceFusion*** was built on the *Framework for K–12 Science Education*, the same framework that informed NGSS. Thus, ***ScienceFusion* 6–8** can serve as a transition program to help middle school teachers move from purely knowledge-based science standards toward the three-dimensional NGSS. Since NGSS does not spell out standards by grade at middle school, ***ScienceFusion's*** modular approach gives teachers the flexibility to meet NGSS using either an integrated or discipline-specific approach. Moreover, inquiry is at the heart of the *performance expectations*, and ***ScienceFusion*** provides 360° of inquiry across multiple modalities. To see a small sample of how ***ScienceFusion*** can help you achieve the transition to NGSS, see the example on page 3.

MS-ETS1 Engineering Design

Students who demonstrate understanding can:

MS-ETS1-1. **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

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

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.**

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 *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, 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. (MS-ETS1-1)

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems
- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (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)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution
- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- 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)

Crosscutting Concepts

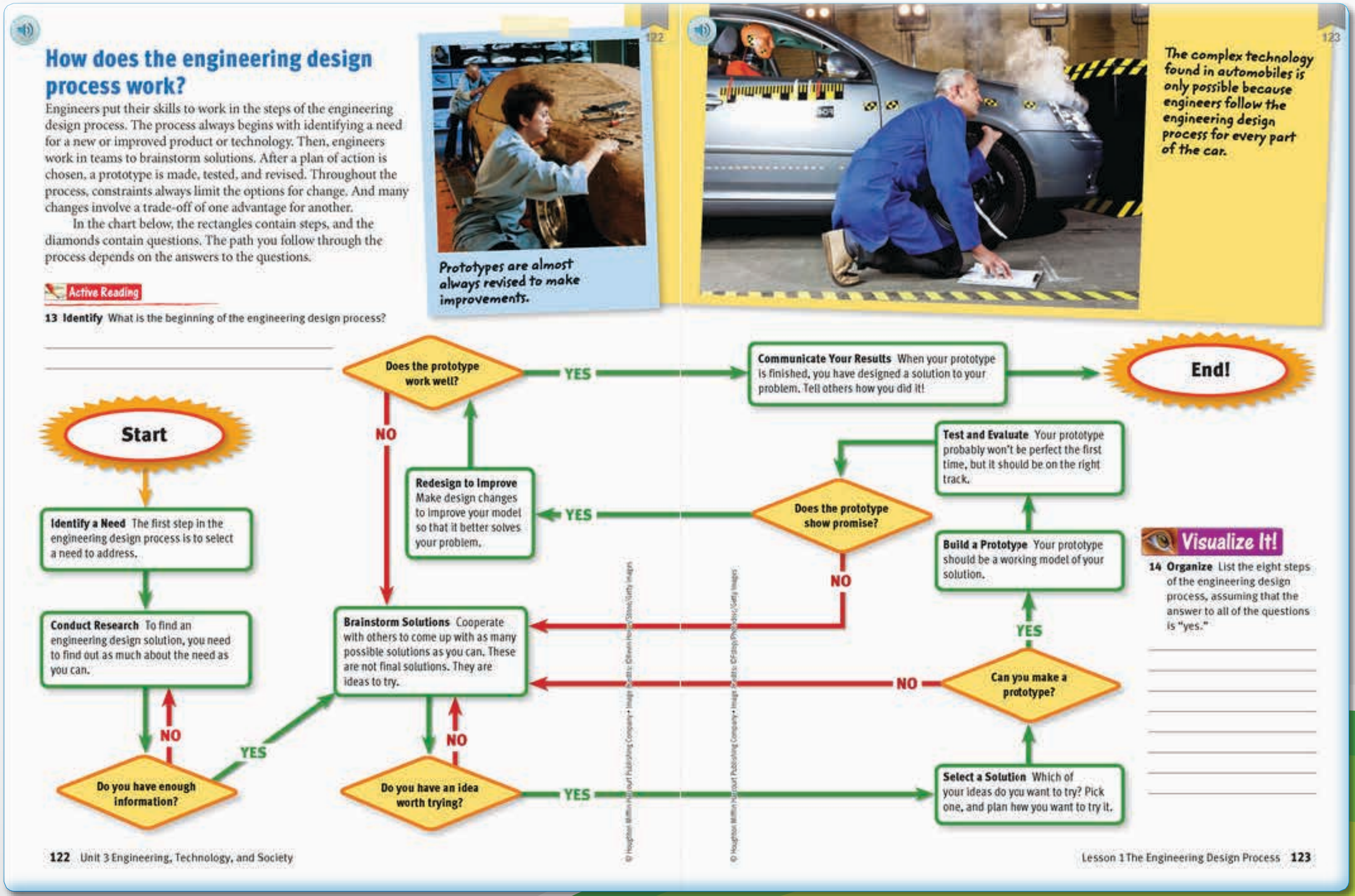
Influence of Science, Engineering, and Technology on Society and the Natural World
- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

A Multi-Modal Approach Prepares Students to Meet Performance Expectations.

One of the most revolutionary parts of NGSS is the inclusion of **Engineering Design** standards spanning Grades 6–8. ***ScienceFusion*** will help teachers address these brand new ***performance expectations*** by providing multi-modal resources that span the spectrum from structured lessons on the engineering design process to open-ended engineering challenges.

Write-In Worktext Offers Early Introduction of the Engineering Design Process.

Use ***ScienceFusion's*** consumable write-in text to deepen students' understanding of the ***disciplinary core ideas*** of **Defining and Delimiting Engineering Problems, Developing Possible Solutions,** and **Optimizing the Design Solution.**



How does the engineering design process work?

Engineers put their skills to work in the steps of the engineering design process. The process always begins with identifying a need for a new or improved product or technology. Then, engineers work in teams to brainstorm solutions. After a plan of action is chosen, a prototype is made, tested, and revised. Throughout the process, constraints always limit the options for change. And many changes involve a trade-off of one advantage for another.

In the chart below, the rectangles contain steps, and the diamonds contain questions. The path you follow through the process depends on the answers to the questions.

Prototypes are almost always revised to make improvements.

The complex technology found in automobiles is only possible because engineers follow the engineering design process for every part of the car.

Active Reading

13 Identify What is the beginning of the engineering design process?

Visualize It!

14 Organize List the eight steps of the engineering design process, assuming that the answer to all of the questions is "yes."

122 Unit 3 Engineering, Technology, and Society

Lesson 1 The Engineering Design Process 123

Hands-on Labs Engage Students Every Step of the Way.

STEM Labs engage students in the ***scientific and engineering practices*** of **Asking Questions and Defining Problems, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions,** and **Engaging in Argument from Evidence.**

Name ______________________ Class ______________ Date ____________________

QUICK LAB INDEPENDENT Inquiry

Design a Spacecraft

In this lab, you will work with a partner to design a spacecraft that will allow humans to travel farther into space than they have ever travelled before. You will brainstorm a design and then create a detailed drawing of your spacecraft.

OBJECTIVES
- Understand the current limits to humans' extended space exploration.
- Describe how technology can expand human space exploration.
- Design a prototype of an interstellar spacecraft.

MATERIALS

For each pair
- paper, computer
- pencils, colored

PROCEDURE

1. Work with your partner to decide if you will design a spacecraft for interplanetary or interstellar travel. Write your choice below.

   ____

2. As you brainstorm, think about how you will solve the following problems: How will the humans obtain food? How will the spacecraft obtain fuel as it travels? How will the spacecraft communicate with Earth? Write your ideas below.

   ____
   ____
   ____
   ____

3. Work together with your partner to create your spacecraft drawing. Use the colored pencils to sketch specific details, colors, and labels.
4. When your drawing is finished, use the bottom of the paper (or the back side) to write two short paragraphs about your spacecraft. First, explain how your spacecraft will meet the needs of the humans living on board. In the second paragraph, highlight any existing or new technology included in your design that the crew will use to help navigate, collect information, or maintain systems.

Name ______________________ Class ______________ Date ____________________

S.T.E.M. LAB DIRECTED Inquiry

Build a Rocket

In this lab, you will use two inflated balloons to model a two-stage rocket launch. The forward motion created by air escaping from the balloons creates thrust. Thrust is the same force that propels rockets into space.

OBJECTIVES
- Form a hypothesis about rocket travel.
- Model a two-stage rocket.
- Launch a rocket model and evaluate the results.

MATERIALS
- balloon, long (2)
- cup, paper
- meterstick
- monofilament, nylon (15 ft)
- straws, plastic (2)
- tape

For each student
- safety goggles

PROCEDURE

ASK A QUESTION

1. This activity will help you answer the following question: How does a multi-stage rocket help humans explore space?

BUILD A MODEL

2. Secure one end of the **nylon monofilament** to a tree, fence post, or other stable object.
3. Thread the other end of the monofilament through the two **straws**.
4. Stretch the monofilament to another stable object and secure it. Make sure that nobody runs into the line.
5. Cut the **paper cup** in half so that the top half forms an unbroken ring.
6. Blow up one **long balloon about** three-fourths full of air and pinch it closed. Put the ring around the balloon. Be careful not to let the air escape.
7. While one lab partner holds the first balloon, another lab partner will inflate a second balloon inside of the ring. As the second balloon inflates, it will pinch the nozzle of the first balloon against the ring. It may take some practice to accomplish this step.

TEST THE MODEL

8. Carefully move your balloon rocket to the monofilament line and tape each balloon to a straw.
9. Count down from ten and release the second balloon when you get to one. Watch what happens as each balloon releases air.
10. Measure how far your balloon rocket traveled. Record the distance.

    ____
    ____

Virtual Labs Help Students Demonstrate Performance Expectations.

ScienceFusion allows students to demonstrate their mastery of ***performance expectations*** either by responding hands-on to a video-based project challenge or online with a virtual lab. Either way, students get to show that they can **Define the Criteria and Constraints of a Design Process (MS-ETS1-1), Evaluate Competing Design Solutions (MS-ETS1-2), Analyze Data from Tests (MS-ETS1-3),** and **Develop a Model to Generate Data (MS-ETS1-4).**

Video-Based Projects Introduce Real-World Science.

Use real-world stories, such as the challenges found in video-based projects, to help refine student understanding of the ***crosscutting concept*** of **The Influence of Science, Engineering,** and **Technology on Society and the Natural World.**

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correlated to the

Next Generation Science Standards: Disciplinary Core Ideas

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
Life Science			
MS-LS1: From Molecules to Organisms: Structures and Processes			
MS-LS1.A: Structure and Function			
MS-LS1.A.1	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)	SE	Print: Mod A U1 L1: The Characteristics of Cells (full) [pp. 4-13] Digital: Mod A U1 L1: The Characteristics of Cells (full)
		TE	Mod A U1 L1: The Characteristics of Cells (full) [pp. 16-28]
MS-LS1.A.2	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)	SE	Print: Mod A U1 L3: Cell Structure and Function (full) [pp. 24-35]; Mod A U1 L1: The Characteristics of Cells (partial) [pp. 4-13] Digital: Mod A U1 L3: Cell Structure and Function (partial)
		TE	Mod A U1 L3: Cell Structure and Function (full) [pp. 44-57]; Mod A U1 L1: The Characteristics of Cells (partial) [pp. 16-28]
MS-LS1.A.3	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)	SE	Print: Mod A U1 L4: Levels of Cellular Organization (full) [pp. 38-49], Mod C U1 L1: Introduction to Body Systems (full) [pp. 4-13] Digital: Mod A U1 L4: Levels of Cellular Organization (full)
		TE	Mod A U1 L4: Levels of Cellular Organization (full) [pp. 60-73], Mod C U1 L1: Introduction to Body Systems (full) [pp. 16-28]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS1.B: Growth and Development of Organisms			
MS-LS1.B.1	Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)	SE	Print: Mod B U2 L6: Animal Behavior (full) [pp. 150-161] Digital: Mod B U2 L6: Animal Behavior (partial)
		TE	Mod B U2 L6: Animal Behavior (full) [pp. 190-203]
MS-LS1.B.2	Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)	SE	Print: Mod B U2 L4: Plant Processes (full) [pp. 120-133] Digital: Mod B U2 L4: Plant Processes (full)
		TE	Mod B U2 L4: Plant Processes (full) [pp. 156-170]
MS-LS1.B.3	Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)	SE	Print: Mod B U2 L4: Plant Processes (partial) [pp. 120-133] Digital: (not covered)
		TE	Mod B U2 L4: Plant Processes (partial) [pp. 156-170]
MS-LS1.B.4	Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (*secondary to MS-LS3-2*)	SE	Print: Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 112-121] Digital: Mod A U2 L3: Sexual and Asexual Reproduction (full)
		TE	Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 158-170]
MS-LS1.C: Organization for Matter and Energy Flow in Organisms			
MS-LS1.C.1	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)	SE	Print: Mod A U1 L6: Photosynthesis and Cellular Respiration (partial) [pp. 66-77]; Mod B U2 L2: Protists and Fungi (partial) [pp. 92-105] Digital: Mod A U1 L6: Photosynthesis and Cellular Respiration (partial); Mod B U2 L2: Protists and Fungi (partial)
		TE	Mod A U1 L6: Photosynthesis and Cellular Respiration (partial) [pp. 92-105]; Mod B U2 L2: Protists and Fungi (partial) [pp. 124-138]

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Next Generation Science Standards: Disciplinary Core Ideas

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		_ScienceFusion National Grades 6-8_
MS-LS1.C.2	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)	SE TE	Print: Mod A U1 L6: Photosynthesis and Cellular Respiration (full) [pp. 66-77] Digital: Mod A U1 L6: Photosynthesis and Cellular Respiration (partial) Mod A U1 L6: Photosynthesis and Cellular Respiration (full) [pp. 92-105]
MS-LS1.D: Information Processing			
MS-LS1.D.1	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)	SE TE	Print: Mod C U1 L2: The Nervous and Endocrine Systems (partial) [pp. 58-71]; Mod A U2 L6: Animal Behavior (partial) [pp. 150-161] Digital: Mod C U1 L2: The Nervous and Endocrine Systems (partial) Mod C U1 L2: The Nervous and Endocrine Systems (partial) [pp. 78-92]; Mod A U2 L6: Animal Behavior (partial) [pp. 190-203]

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Next Generation Science Standards: Disciplinary Core Ideas

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-LS2: Ecosystems: Interactions, Energy, and Dynamics		
MS-LS2.A: Interdependent Relationships in Ecosystems		
MS-LS2.A.1	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)	SE Print: Mod D U1 L1: Introduction to Ecology (full) [pp. 4-15] Digital: Mod D U1 L1: Introduction to Ecology (full) TE Mod D U1 L1: Introduction to Ecology (full) [pp. 12-25]
MS-LS2.A.2	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. (MS-LS2-1)	SE Print: Mod D U1 L4: Interactions in Communities (full) [pp. 42-51] Digital: Mod D U1 L4: Interactions in Communities (full) TE Mod D U1 L4: Interactions in Communities (full) [pp. 56-68]
MS-LS2.A.3	Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)	SE Print: Mod D U1 L3: Population Dynamics (partial) [pp. 30-41] Digital: Mod D U1 L3: Population Dynamics (partial) TE Mod D U1 L3: Population Dynamics (partial) [pp. 42-55]

Disciplinary Core Idea (Grades 6-8)	**DCI Descriptor**	***ScienceFusion National Grades 6-8***
MS-LS2.A.4	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. (MS-LS2-2)	SE Print: Mod D U1 L4: Interactions in Communities (partial) [pp. 42-51] Digital: Mod D U1 L4: Interactions in Communities (partial); Digital Inquiry Lesson: Populations in a Food Web (partial) TE Mod D U1 L4: Interactions in Communities (partial) [pp. 56-68]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS2.B: Cycle of Matter and Energy Transfer in Ecosystems			
MS-LS2.B.1	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. (MS-LS2-3)	SE TE	Print: Mod D U1 L2: Roles in Energy Transfer (partial) [pp. 18-29]; Mod D U2 L3: Energy and Matter in Ecosystems (partial) [pp. 88-99] Digital: Mod D U1 L2: Roles in Energy Transfer (partial); Mod D U2 L3: Energy and Matter in Ecosystems (partial); Digital Inquiry Lesson: Populations in a Food Web (partial) Mod D U1 L2: Roles in Energy Transfer (partial) [pp. 28-41]; Mod D U2 L3: Energy and Matter in Ecosystems (partial) [pp. 116-129]
MS-LS2.C: Ecosystem Dynamics, Functioning, and Resilience			
MS-LS2.C.1	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. (MS-LS2-4)	SE TE	Print: Mod D U2 L4: Changes in Ecosystems (partial) [pp. 100-109]; Mod D U2 L5: Human Activity and Ecosystems (partial) [pp. 114-125] Digital: Mod D U2 L4: Changes in Ecosystems (partial); Mod D U2 L5: Human Activity and Ecosystems (partial) Mod D U2 L4: Changes in Ecosystems (partial) [pp. 130-142]; Mod D U2 L5: Human Activity and Ecosystems (partial) [pp. 148-161]
MS-LS2.C.2	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. (MS-LS2-5)	SE TE	Print: Mod D U2 L4: Changes in Ecosystems (partial) [pp. 100-109] Digital: Mod D U2 L4: Changes in Ecosystems (partial) Mod D U2 L4: Changes in Ecosystems (partial) [pp. 130-142]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS3: Heredity: Inheritance and Variation of Traits			
MS-LS3.A: Inheritance of Traits			
MS-LS3.A.1	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)	SE	Print: Mod A U2 L4: Heredity (partial) [pp. 122-133] Digital: Mod A U2 L4: Heredity (partial)
		TE	Mod A U2 L4: Heredity (partial) [pp. 172-185]
MS-LS3.A.2	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)	SE	Print: Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 112-121] Digital: Mod A U2 L3: Sexual and Asexual Reproduction (full); Digital Inquiry Lesson: Crossing Pea Plants (full)
		TE	Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 158-170]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS3.B: Variation of Traits			
MS-LS3.B.1	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)	SE	Print: Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 112-121] Digital: Mod A U2 L3: Sexual and Asexual Reproduction (full)
		TE	Mod A U2 L3: Sexual and Asexual Reproduction (full) [pp. 158-170]
MS-LS3.B.2	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)	SE	Print: Mod A U2 L6: DNA Structure and Function (full) [pp. 146-157] Digital: Mod A U2 L6: DNA Structure and Function (full)
		TE	Mod A U2 L6: DNA Structure and Function (full) [pp. 202-215]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS4: Biological Evolution: Unity and Diversity			
MS-LS4.A: Evidence of Common Ancestry and Diversity			
MS-LS4.A.1	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. (MS-LS4-1)	SE TE	Print: Mod B U1 L4: The History of Life on Earth (full) [pp. 38-49] Digital: Mod B U1 L4: The History of Life on Earth (full) Mod B U1 L4: The History of Life on Earth (full) [pp. 58-71]
MS-LS4.A.2	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. (MS-LS4-2)	SE TE	Print: Mod B U1 L3: Evidence of Evolution (full) [pp. 28-37] Digital: Mod B U1 L3: Evidence of Evolution (full) Mod B U1 L3: Evidence of Evolution (full) [pp. 44-56]
MS-LS4.A.3	Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)	SE TE	Print: Mod B U1 L3: Evidence of Evolution (full) [pp. 28-37] Digital: Mod B U1 L3: Evidence of Evolution (full) Mod B U1 L3: Evidence of Evolution (full) [pp. 44-56]
MS-LS4.B: Natural Selection			
MS-LS4.B.1	Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)	SE TE	Print: Mod B U1 L2: Theory of Evolution by Natural Selection (partial) [pp. 14-25] Digital: Mod B U1 L2: Theory of Evolution by Natural Selection (partial) Mod B U1 L2: Theory of Evolution by Natural Selection (partial) [pp. 28-41]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS4.B.2	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. (MS-LS4-5)	SE TE	Print: Mod B U1 L2: Theory of Evolution by Natural Selection (full) [pp. 14-25] Digital: Mod B U1 L2: Theory of Evolution by Natural Selection (full) Mod B U1 L2: Theory of Evolution by Natural Selection (full) [pp. 28-41]
MS-LS4.C: Adaptation			
MS-LS4.C.1	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. (MS-LS4-6)	SE TE	Print: Mod B U1 L2: Theory of Evolution by Natural Selection (partial) [pp. 14-25] Digital: Mod B U1 L2: Theory of Evolution by Natural Selection (partial) Mod B U1 L2: Theory of Evolution by Natural Selection (partial) [pp. 28-41]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-LS4.D: Biodiversity and Humans			
MS-LS4.D.1	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. *(secondary to MS-LS2-5*)	SE	Print: Mod D U2 L5: Human Activity and Ecosystems (full) [pp. 114-125] Digital: Mod D U2 L5: Human Activity and Ecosystems (full)
		TE	Mod D U2 L5: Human Activity and Ecosystems (full) [pp. 148-161]
Earth and Space Science			
MS-ESS1: Earth's Place in the Universe			
MS-ESS1.A: The Universe and Its Stars			
MS-ESS1.A.1	Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	SE	Print: Mod G U3 L1: Earth's Days, Years, and Seasons (partial) [pp. 140-149]; Mod G U3 L2: Moon Phases and Eclipses (partial) [pp. 152-161] Digital: Mod G U3 L1: Earth's Days, Years, and Seasons (partial); Mod G U3 L2: Moon Phases and Eclipses (partial)
		TE	Mod G U3 L1: Earth's Days, Years, and Seasons (partial) [pp. 184-196]; Mod G U3 L2: Moon Phases and Eclipses (partial) [pp. 200-212]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-ESS1.A.2	Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)	SE Print: Mod G U1 L1: Structure of the Universe (full) [pp. 4-13] Digital: Mod G U1 L1: Structure of the Universe (full) TE Mod G U1 L1: Structure of the Universe (full) [pp. 12-24]
MS-ESS1.B: Earth and the Solar System		
MS-ESS1.B.1	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. (MS-ESS1-2),(MSESS1-3)	SE Print: Mod G U1 L1: Structure of the Universe (full) [pp. 4-13] Digital: Mod G U1 L1: Structure of the Universe (full) TE Mod G U1 L1: Structure of the Universe (full) [pp. 12-24]
MS-ESS1.B.2	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. (MS-ESS1-1)	SE Print: Mod G U3 L1: Earth's Days, Years, and Seasons (partial) [pp. 140-149]; Mod G U3 L2: Moon Phases and Eclipses (partial) [pp. 152-161] Digital: Mod G U3 L1: Earth's Days, Years, and Seasons (partial); Mod G U3 L2: Moon Phases and Eclipses (partial) TE Mod G U3 L1: Earth's Days, Years, and Seasons (partial) [pp. 184-196]; Module G U3 L2: Moon Phases and Eclipses (partial) [pp. 200-212]
MS-ESS1.B.3	The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)	SE Print: Mod G U2 L2: Gravity and the Solar System (full) [pp. 60-73] Digital: Mod G U2 L2: Gravity and the Solar System (full) TE Mod G U2 L2: Gravity and the Solar System (full) [pp. 90-104]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-ESS1.C: The History of Planet Earth		
MS-ESS1.C.1	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)	SE Print: Mod E U2 L4: The Geologic Time Scale (full) [pp. 118-129] Digital: Mod E U2 L4: The Geologic Time Scale (full) TE Mod E U2 L4: The Geologic Time Scale (full) [pp. 150-163]
MS-ESS1.C.2	Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3)	SE Print: Mod E U4 L2: Plate Tectonics (full) [pp. 200-213] Digital: Mod E U4 L2: Plate Tectonics (full) TE Mod E U4 L2: Plate Tectonics (full) [pp. 256-270]
MS-ESS2: Earth's Systems		
MS-ESS2.A: Earth Materials and Systems		
MS-ESS2.A.1	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)	SE Print: Mod E U1 L1: Earth's Spheres (partial) [pp. 4-16] Digital: Mod E U1 L1: Earth's Spheres (partial) TE Mod E U1 L1: Earth's Spheres (partial) [pp. 14-28]
MS-ESS2.A.2	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)	SE Print: Mod E U2 L1: Geologic Change over Time (partial) [pp. 78-91] Digital: Mod E U2 L1: Geologic Change over Time (partial) TE Mod E U2 L1: Geologic Change over Time (partial) [pp. 104-118]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ESS2.B: Plate Tectonics and Large-Scale System Interactions			
MS-ESS2.B.1	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)	SE TE	Print: Mod E U4 L2: Plate Tectonics (full) [pp. 200-213] Digital: Mod E U4 L2: Plate Tectonics (full) Mod E U4 L2: Plate Tectonics (full) [pp. 256-270]
MS-ESS2.C: The Roles of Water in Earth's Surface Processes			
MS-ESS2.C.1	Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)	SE TE	Print: Mod F U1 L2: The Water Cycle (full) [pp. 14-25] Digital: Mod F U1 L2: The Water Cycle (full) Mod F U1 L2: The Water Cycle (full) [pp. 26-39]
MS-ESS2.C.2	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. (MSESS2- 5)	SE TE	Print: Mod F U4 L3: What Influences Weather? (partial) [pp. 180-193] Digital: Mod F U4 L3: What Influences Weather? (partial) Mod F U4 L3: What Influences Weather? (partial) [pp. 234-248]
MS-ESS2.C.3	Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)	SE TE	Print: Mod F U1 L2: The Water Cycle (full) [pp. 14-25] Digital: Mod F U1 L2: The Water Cycle (full) Mod F U1 L2: The Water Cycle (full) [pp. 26-39]
MS-ESS2.C.4	Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)	SE TE	Print: Mod F U2 L3: Ocean Currents (full) [pp. 80-93] Digital: Mod F U2 L3: Ocean Currents (full) Mod F U2 L3: Ocean Currents (full) [pp. 104-118]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ESS2.C.5	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)	SE	Print: Mod E U1 L2: Weathering (partial) [pp. 18-27]; Mod E U1 L3: Erosion and Deposition by Water (partial) [pp. 28-41] Digital: Mod E U1 L2: Weathering (partial); Mod E U1 L3: Erosion and Deposition by Water (partial)
		TE	Mod E U1 L2: Weathering (partial) [pp. 30-42]; Mod E U1 L3: Erosion and Deposition by Water (partial) [pp. 44-58]
MS-ESS2.D: Weather and Climate			
MS-ESS2.D.1	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. (MS-ESS2-6)	SE	Print: Mod F U4 L3: What Influences Weather? (partial) [pp. 180-193]; Mod F U4 L6: Climate (partial) [pp. 224-237] Digital: Mod F U4 L3: What Influences Weather? (partial); Mod F U4 L6: Climate (partial)
		TE	Mod F U4 L3: What Influences Weather? (partial) [pp. 234-248]; Mod F U4 L6: Climate (partial) [pp. 284-298]
MS-ESS2.D.2	Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)	SE	Print: Mod F U4 L5: Weather Maps and Weather Prediction (partial) [pp. 208-221] Digital: Mod F U4 L5: Weather Maps and Weather Prediction (partial)
		TE	Mod F U4 L5: Weather Maps and Weather Prediction (partial) [pp. 266-280]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ESS2.D.3	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. (MS-ESS2-6)	SE	Print: Mod F U4 L3: What Influences Weather? (partial) [pp. 180-193]; Mod F U4 L6: Climate (partial) [pp. 224-237]; Mod F U2 L3: Ocean Currents (partial) [pp. 80-93] Digital: Mod F U4 L3: What Influences Weather? (partial); Mod F U4 L6: Climate (partial); Mod F U2 L3: Ocean Currents (partial)
		TE	Mod F U4 L3: What Influences Weather? (partial) [pp. 234-248]; Mod F U4 L6: Climate (partial) [pp. 284-298]; Mod F U2 L3: Ocean Currents (partial) [pp. 104-118]
MS-ESS3: Earth and Human Activity			
MS-ESS3.A: Natural Resources			
MS-ESS3.A.1	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. (MS-ESS3-1)	SE	Print: Mod D U3 L2: Natural Resources (partial) [pp. 146-157]; Mod D U3 L3: Nonrenewable Energy Resources (partial) [pp. 158-169]; Mod D U3 L4: Renewable Energy Resources (partial) [pp. 170-181] Digital: Mod D U3 L2: Natural Resources (partial); Mod D U3 L3: Nonrenewable Energy Resources (partial); Mod D U3 L4: Renewable Energy Resources (partial)
		TE	Mod D U3 L2: Natural Resources (partial) [pp. 192-205]; Mod D U3 L3: Nonrenewable Energy Resources (partial) [pp. 206-219]; Mod D U3 L4: Renewable Energy Resources (partial) [pp. 220-233]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ESS3.B: Natural Hazards			
MS-ESS3.B.1	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. (MS-ESS3-2)	SE	Print: Mod E U4 L4: Volcanoes (partial) [pp. 226-237; Mod E U4 L5: Earthquakes (partial) [pp. 238-247]; Mod F U4 L4: Severe Weather and Weather Safety (partial) [pp. 194-207] Digital: Mod E U4 L4: Volcanoes (partial); Mod E U4 L5: Earthquakes (partial); Mod F U4 L4: Severe Weather and Weather Safety (partial)
		TE	Mod E U4 L4: Volcanoes (partial) [pp. 288-301]; Mod E U4 L5: Earthquakes (partial) [pp. 302-314; Mod F U4 L4: Severe Weather and Weather Safety (partial) [pp. 250-264]
MS-ESS3.C: Human Impacts on Earth Systems			
MS-ESS3.C.1	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. (MS-ESS3-3)	SE	Print: Mod D U2 L5: Human Activity and Ecosystems (partial) [pp. 114-125] Digital: Mod D U2 L5: Human Activity and Ecosystems (partial)
		TE	Mod D U2 L5: Human Activity and Ecosystems (partial) [pp. 148-161]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ESS3.C.2	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. (MSESS3-3),(MS-ESS3-4)	SE	Print: Mod D U4 L1; Human Impact on Water (partial) [pp. 206-219]; Mod D U4 L2: Human Impact on Land (partial) [pp. 222-231]; Mod D U4 L3: Human Impact on the Atmosphere (partial) [pp. 232-243]; Mod D U4 L4: Protecting Earth's Water, Land, and Air (partial) [pp. 244-257] Digital: Mod D U4 L1; Human Impact on Water (partial); Mod D U4 L2: Human Impact on Land (partial); Mod D U4 L3: Human Impact on the Atmosphere (partial); Mod D U4 L4: Protecting Earth's Water, Land, and Air (partial)
		TE	Mod D U4 L1; Human Impact on Water (partial) [pp. 266-280; Mod D U4 L2: Human Impact on Land (partial) [pp. 284-296]; Mod D U4 L3: Human Impact on the Atmosphere (partial) [pp. 298-311]; Mod D U4 L4: Protecting Earth's Water, Land, and Air (partial) [pp. 312-326]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-ESS3.D: Global Climate Change		
MS-ESS3.D.1	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. (MS-ESS3-5)	SE Print: Mod F U4 L7: Climate Change (full) [pp. 238-253] Digital: Mod F U4 L7: Climate Change (full) TE Mod F U4 L7: Climate Change (full) [pp. 300-315]
Physical Science		
MS-PS1: Matter and Its Interactions		
MS-PS1.A: Structure and Properties of Matter		
MS-PS1.A.1	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)	SE Print: Mod H U3 L3: Electrons and Chemical Bonding (full) [pp. 180-189] Digital: Mod H U3 L3: Electrons and Chemical Bonding (partial) TE Mod H U3 L3: Electrons and Chemical Bonding (full) [pp. 228-240]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS1.A.2	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), (MS-PS1-3)	SE	Print: Mod H U1 L4: Pure Substances and Mixtures (partial) [pp. 50-63]; Mod H U3 L2: The Periodic Table (partial) [pp. 168-179] Digital: Mod H U1 L4: Pure Substances and Mixtures (partial); Mod H U3 L2: The Periodic Table (partial)
		TE	Mod H U1 L4: Pure Substances and Mixtures (partial) [pp. 68-82]; Mod H U3 L2: The Periodic Table (partial) [pp. 214-227]
MS-PS1.A.3	Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)	SE	Print: Mod H U1 L6: Changes of State (full) [pp. 74-87] Digital: Mod H U1 L6: Changes of State (full)
		TE	Mod H U1 L6: Changes of State (full) [pp. 98-112]
MS-PS1.A.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)	SE	Print: Mod H U1 L5: States of Matter (full) [pp. 64-73] Digital: Mod H U1 L5: States of Matter (full)
		TE	Mod H U1 L5: States of Matter (full) [pp. 84-96]
MS-PS1.A.5	Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).(MS-PS1-1)	SE	Print: Mod H U3 L4: Ionic, Covalent, and Metallic Bonding (full) [pp. 192-201] Digital: Mod H U3 L4: Ionic, Covalent, and Metallic Bonding (partial)
		TE	Mod H U3 L4: Ionic, Covalent, and Metallic Bonding (full) [pp. 244-256]
MS-PS1.A.6	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)	SE	Print: Mod H U1 L6: Changes of State (partial) [pp. 74-87] Digital: Mod H U1 L6: Changes of State (partial)
		TE	Mod H U1 L6: Changes of State (partial) [pp. 98-112]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS1.B: Chemical Reactions			
MS-PS1.B.1	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),(MS-PS1-3),(MS-PS1-5)	SE TE	Print: Mod H U4 L1: Chemical Reactions (full) [pp. 212-223] Digital: Mod H U4 L1: Chemical Reactions (full) Mod H U4 L1: Chemical Reactions (full) [pp. 272-285]
MS-PS1.B.2	The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	SE TE	Print: Mod H U4 L1: Chemical Reactions (full) [pp. 212-223] Digital: Mod H U4 L1: Chemical Reactions (full) Mod H U4 L1: Chemical Reactions (full) [pp. 272-285]
MS-PS1.B.3	Some chemical reactions release energy, others store energy.(MS-PS1-6)	SE TE	Print: Mod H U4 L1: Chemical Reactions (full) [pp. 212-223] Digital: Mod H U4 L1: Chemical Reactions (full) Mod H U4 L1: Chemical Reactions (full) [pp. 272-285]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS2: Motion and Stability: Forces and Interactions			
MS-PS2.A: Forces and Motion			
MS-PS2.A.1	For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)	SE TE	Print: Mod I U1 L3: Forces (full) [pp. 28-41] Digital: Mod I U1 L3: Forces (full) Mod I U1 L3: Forces (full) [pp. 44-58]
MS-PS2.A.2	The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)	SE TE	Print: Mod I U1 L3: Forces (full) [pp. 28-41] Digital: Mod I U1 L3: Forces (full) Mod I U1 L3: Forces (full) [pp. 44-58]
MS-PS2.A.3	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. (MSPS2-2)	SE TE	Print: Mod I U1 L1: Motion and Speed (partial) [pp. 4-17] Digital: Mod I U1 L1: Motion and Speed (partial) Mod I U1 L1: Motion and Speed (partial) [pp. 14-28]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS2.B: Types of Interactions			
MS-PS2.B.1	Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)	SE	Print: Mod I U3 L4: Magnets and Magnetism (partial) [pp. 156-165]; Mod I U3 L1: Electric Charge and Static Electricity (partial) [pp. 126-135] Digital: Mod I U3 L4: Magnets and Magnetism (partial); Mod I U3 L1: Electric Charge and Static Electricity (partial)
		TE	Mod I U3 L4: Magnets and Magnetism (partial) [pp. 212-224]; Mod I U3 L1: Electric Charge and Static Electricity (partial) [pp. 172-184]
MS-PS2.B.2	Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)	SE	Print: Mod I U1 L4: Gravity and Motion (full) [pp. 42-51] Digital: Mod I U1 L4: Gravity and Motion (full)
		TE	Mod I U1 L4: Gravity and Motion (full) [pp. 60-72]
MS-PS2.B.3	Forces that act at a distance (electric and magnetic) can be explained by fields that extend through space and can be mapped by their effect on a test object (a ball, a charged object, or a magnet, respectively). (MS-PS2-5)	SE	Print: Mod 1 U3 L4: Magnets and Magnetism (partial) [pp. 156-165] Digital: Mod 1 U3 L4: Magnets and Magnetism (partial)
		TE	Mod 1 U3 L4: Magnets and Magnetism (partial) [pp. 212-224]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-PS3: Energy		
MS-PS3.A: Definitions of Energy		
MS-PS3.A.1	The term "heat" as used in everyday language refers both to thermal motion (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.(*secondary to MS-PS1-4*)	SE Print: Mod H U2 L3: Thermal Energy and Heat (full) [pp. 122-133] Digital: Mod H U2 L3: Thermal Energy and Heat (full) TE Mod H U2 L3: Thermal Energy and Heat (full) [pp. 158-171]
MS-PS3.A.2	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*)	SE Print: Mod H U2 L2: Temperature (full) [pp. 112-116] Digital: Mod H U2 L2: Temperature (full) TE Mod H U2 L2: Temperature (full) [pp. 144-154]
MS-PS3.A.3	Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)	SE Print: Mod I U2 L2: Kinetic and Potential Energy (full) [pp. 88-97] Digital: Mod I U2 L2: Kinetic and Potential Energy (full) TE Mod I U2 L2: Kinetic and Potential Energy (full) [pp. 120-132]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS3.A.4	A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)	SE TE	Print: Mod I U2 L2: Kinetic and Potential Energy (full) [pp. 88-97] Digital: Mod I U2 L2: Kinetic and Potential Energy (full) Mod I U2 L2: Kinetic and Potential Energy (full) [pp. 120-132]
MS-PS3.A.5	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)	SE TE	Print: Mod H U2 L2: Temperature (partial) [pp. 112-119] Digital: Mod H U2 L2: Temperature (partial) Mod H U2 L2: Temperature (partial) [pp. 144-155]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-PS3.B: Conservation of Energy and Energy Transfer			
MS-PS3.B.1	When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)	SE	Print: Mod H U2 L1: Introduction to Energy (partial) [pp. 100-111] Digital: Mod H U2 L1: Introduction to Energy (partial)
		TE	Mod H U2 L1: Introduction to Energy (partial) [pp. 130-143]
MS-PS3.B.2	The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)	SE	Print: Mod H U2 L3: Thermal Energy and Heat (partial) [pp. 122-133]; Mod H U1 L6: Changes of State (partial) [pp. 74-87] Digital: Mod H U2 L3: Thermal Energy and Heat (partial); Mod H U1 L6: Changes of State (partial)
		TE	Mod H U2 L3: Thermal Energy and Heat (partial) [pp. 158-171]; Mod H U1 L6: Changes of State (partial) [pp. 98-112]
MS-PS3.B.3	Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)	SE	Print: Mod H U2 L3: Thermal Energy and Heat (full) [pp. 122-133] Digital: Mod H U2 L3: Thermal Energy and Heat (full)
		TE	Mod H U2 L3: Thermal Energy and Heat (full) [pp. 158-171]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-PS3.C: Relationship Between Energy and Forces		
MS-PS3.C.1	When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	SE Print: Mod I U1 L3: Forces (partial) [pp. 28-41]; Mod I U2 L1: Work, Energy, and Power (partial) [pp. 78-87] Digital: Mod I U1 L3: Forces (partial); Mod I U2 L1: Work, Energy, and Power (partial) TE Mod I U1 L3: Forces (partial) [pp. 44-58]; Mod I U2 L1: Work, Energy, and Power (partial) [pp. 106-118]
MS-PS3.D: Energy in Chemical Processes and Everyday Life		
MS-PS3.D.1	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*)	SE Print: Mod B U2 L4: Plant Processes (full) [pp. 120-133] Digital: Mod B U2 L4: Plant Processes (full) TE Mod B U2 L4: Plant Processes (full) [pp. 156-170]
MS-PS3.D.2	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*)	SE Print: Mod A U1 L6: Photosynthesis and Cellular Respiration (full) [pp. 66-77] Digital: Mod A U1 L6: Photosynthesis and Cellular Respiration (full) TE Mod A U1 L6: Photosynthesis and Cellular Respiration (full) [pp. 92-105]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-PS4: Waves and Their Applications in Technologies for Information Transfer		
MS-PS4.A: Wave Properties		
MS-PS4.A.1	A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)	SE Print: Mod J U1 L2: Properties of Waves (full) [pp. 16-25] Digital: Mod J U1 L2: Properties of Waves (full) TE Mod J U1 L2: Properties of Waves (full) [pp. 26-38]
MS-PS4.A.2	A sound wave needs a medium through which it is transmitted. (MS-PS4-2)	SE Print: Mod J U2 L2: Interactions of Sound Waves (full) [pp. 48-59] Digital: Mod J U2 L2: Interactions of Sound Waves (full) TE Mod J U2 L2: Interactions of Sound Waves (full) [pp. 68-81]
MS-PS4.B: Electromagnetic Radiation		
MS-PS4.B.1	When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)	SE Print: Mod J U3 L2: Interactions of Light (full) [pp. 94-103] Digital: Mod J U3 L2: Interactions of Light (full) TE Mod J U3 L2: Interactions of Light (full) [pp. 128-140]
MS-PS4.B.2	The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)	SE Print: Mod J U3 L2: Interactions of Light (full) [pp. 94-103] Digital: Mod J U3 L2: Interactions of Light (full) TE Mod J U3 L2: Interactions of Light (full) [pp. 128-140]
MS-PS4.B.3	A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)	SE Print: Mod J U3 L1: The Electromagnetic Spectrum (partial) [pp. 82-93] Digital: Mod J U3 L1: The Electromagnetic Spectrum (partial) TE Mod J U3 L1: The Electromagnetic Spectrum (partial) [pp. 114-127]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor	*ScienceFusion National Grades 6-8*
MS-PS4.B.4	However, because light can travel through space, it cannot be a matter wave, like sound or water waves.(MS-PS4-2)	SE Print: Mod J U1 L1: Waves (full) [pp. 4-13] Digital: Mod J U1 L1: Waves (full) TE Mod J U1 L1: Waves (full) [pp. 10-22]
MS-PS4.C: Information Technologies and Instrumentation		
MS-PS4.C.1	Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	SE Print: Mod J U2 L3: Sound Technology (partial) [pp. 62-71] Digital: Mod J U2 L3: Sound Technology (partial) TE Mod J U2 L3: Sound Technology (partial) [pp. 84-96]
Engineering, Technology, and the Application of Science		
MS-ETS1: Engineering Design		
MS-ETS1.A: Defining and Delimiting an Engineering Problem		
MS-ETS1.A.1	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. (MS-ETS1-1) (*secondary to MS-PS3-3*)	SE Print: Mod K U3 L1: The Engineering Design Process (full) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (partial) TE Mod K U3 L1: The Engineering Design Process (full) [pp. 150-163]
MS-ETS1.B: Developing Possible Solutions		
MS-ETS1.B.1	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) (*secondary to MS-PS1-6*)	SE Print: Mod K U3 L1: The Engineering Design Process (full) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (full) TE Mod K U3 L1: The Engineering Design Process (full) [pp. 150-163]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion National Grades 6-8*
MS-ETS1.B.2	There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. MS-ETS1-2),(MS-ETS1-3) (secondary to MS-PS3-3) (*secondary to MS-LS2-5*)	SE	Print: Mod K U3 L1: The Engineering Design Process (partial) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (partial)
		TE	Mod K U3 L1: The Engineering Design Process (partial) [pp. 150-163]
MS-ETS1.B.3	Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)	SE	Print: Mod K U3 L1: The Engineering Design Process (partial) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (full)
		TE	Mod K U3 L1: The Engineering Design Process (partial) [pp. 150-163]
MS-ETS1.B.4	Models of all kinds are important for testing solutions. (MS-ETS1-4)	SE	Print: Mod K U3 L1: The Engineering Design Process (full) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (full)
		TE	Mod K U3 L1: The Engineering Design Process (full) [pp. 150-163]

Disciplinary Core Idea (Grades 6-8)	DCI Descriptor		*ScienceFusion Grades 6-8* Page Citations
MS-ETS1.C: Optimizing the Design Solution			
MS-ETS1.C.1	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. (MS-ETS1-3 (*secondary to MS-PS1-6*)	SE	Print: Mod K U3 L1: The Engineering Design Process (partial) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (full)
		TE	Mod K U3 L1: The Engineering Design Process (partial) [pp. 150-163]
MS-ETS1.C.2	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. (MSETS1-4) (*secondary to MS-PS1-6*)	SE	Print: Mod K U3 L1: The Engineering Design Process (full) [pp. 114-125] Digital: Mod K U3 L1: The Engineering Design Process (full)
		TE	Mod K U3 L1: The Engineering Design Process (full) [pp. 150-163]

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