Readington Township Public Schools

Science Grades 6-8
Middle School

Authored by: Blair Alber, Kevin Sanders, and Kristi Dauernheim

Reviewed by: Sarah Pauch
Supervisor of Math, Science, and Technology

Approval Date:

Readington Township Public Schools
www.readington.k12.nj.us

I. OVERVIEW

The New Jersey Student Learning Standards - Science (NJSLS) are based on the Next Generation Science Standards (NGSS) and "Framework for K–12 Science Education" that was created by the National Research Council. They have three dimensions that are integrated into instruction at all levels. The first is core ideas, which consists of specific content and subject areas. The second is science and engineering practices. Students are expected not just to learn content but to understand the methods of scientists and engineers. The third is **cross-cutting concepts:** key underlying ideas that are common to a number of topics. The NGSS give equal emphasis to engineering design and to scientific inquiry. A high-quality science education means that students will develop an in-depth understanding of content and develop key skills—communication, collaboration, inquiry, problem solving, and flexibility—that will serve them throughout their educational and professional lives. (www.nextgenscience.org)

II. STUDENT OUTCOMES (Linked to NJSLS-Science)

- Physical Science
  - MS.PS1: Matter and Its Interactions
  - MS.PS2: Motion and Stability: Forces and Interactions
  - MS.PS3: Energy
  - MS.PS4: Waves and Their Applications in Technology for Information Transfer
- Life Science
  - MS.LS1: From Molecules to Organisms
  - MS.LS2: Ecosystems, Interactions, Energy, and Dynamics
  - MS.LS3: Heredity: Inheritance and Variations of Traits
  - MS.LS4: Biological Evolution: Unity and Diversity
- Earth Science
  - MS.ESS1: Earth's Place in the Universe
  - MS.ESS2: Earth Systems
  - MS.ESS3: Earth and Human Activity
- Engineering Design
  - MS.ETS1.A: Defining and Delimiting Engineering Problems
  - MS.ETS1.B: Developing Possible Solutions
  - MS.ETS1.C: Optimizing the Design Solution

III. STRATEGIES

- Group discussions
- Teacher presentations
- Student projects
- Guided groups
- One to one instruction
- Interactive SmartBoard lessons
- Tutorials
- Online Simulations (gizmos, SciPacks)
- Inquiry Labs (teacher demos, teacher guided, student created)
- Videos
- Teacher Demonstrations
- Scientific Experiments

IV. ACCOMMODATIONS

- **Accommodations and Modification Addendum**

V. ASSESSMENTS

- **Formative**
  - Teacher Observations
  - Do Nows
  - Exit Tickets
  - Independent Class work
  - Homework
  - Labs
  - Quizzes

- **Summative**
  - End of Unit Assessments
  - Unit Project
  - Explanations for Analogous Phenomena

- **Alternative**
  - Poster Presentation
  - Persuasive Letter
  - Simulations
- **Benchmark**
  - Sixth Grade
    - Earth Science and Physical Science Grade Level Benchmark
  - Seventh Grade
    - Life Science and Physical Science Grade Level Benchmark
  - Eighth Grade
    - Earth Science and Life Science Grade Level Benchmark

VI. Materials

- **Core**
  - Discovery Education Science Techbook
- **Supplemental**
  - Explore Learning Gizmos
  - McGraw-Hill iScience textbook
  - PhET simulations
  - YouTube
  - EdPuzzle
  - Newsela
  - CK-12
  - Teacher created materials

VII. SCOPE AND PACING

<table>
<tr><th colspan="2">MS-ETS1: Engineering Design</th></tr>
<tr><th colspan="2">Performance Expectations</th></tr>
<tr><td colspan="2">Students who demonstrate understanding can:
• MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successfulsolution, taking into account relevant scientific principles and potential impacts on people and thenatural environment that may limit possible solutions.
• MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet thecriteria and constraints of the problem.
• MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions toidentify the best characteristics of each that can be combined into a new solution to better meet thecriteria for success.
• MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, orprocess such that an optimal design can be achieved.</td></tr>
<tr><th colspan="2">Disciplinary Core Ideas</th></tr>
<tr><td colspan="2">• 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.
• ETS1.B: Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.
• 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. 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.</td></tr>
<tr><th>Science and Engineering Practices</th><th>Cross-Cutting Concepts</th></tr>
<tr><td>• Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds on K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
• Developing and Using Models</td><td>• 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.) 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.</td></tr>
</table>

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. • **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. • **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.	

8.2 Design Thinking by the End of Grade 8 **Engineering Design**	
Core Ideas	**Performance Expectations**
Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.	• 8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer. • 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem. • 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). • 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.	• 8.2.8.ED.5: Explain the need for optimization in a design process. • 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.

	• 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
Interaction of Technology and Humans	
Core Ideas	**Performance Expectations**
Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.	8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues.
Technology interacts with society, sometimes bringing about changes in a society's economy, politics, and culture, and often leading to the creation of new needs and wants. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.	• 8.2.8.ITH.2: Compare how technologies have influenced society over time. • 8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system. • 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. • 8.2.8.ITH.5: Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
Nature of Technology	
Core Ideas	**Performance Expectations**
Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people. Sometimes a technology developed for one purpose is adapted to serve other purposes. Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources. Scientists use systematic investigation to understand the natural world.	• 8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem. • 8.2.8.NT.2: Analyze an existing technological product that has been repurposed for a different function. • 8.2.8.NT.3: Examine a system, consider how each part relates to other parts, and redesign it for another purpose. • 8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.
Effects of Technology on the Natural World	
Core Ideas	**Performance Expectations**
Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve tradeoffs between environmental and economic needs, while others have positive effects for both the economy and environment.	• 8.2.8.ETW.1: Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs. • 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).

	• 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. • 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.
Ethics & Culture	
Technological disparities have consequences for public health and prosperity.	• 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies. • 8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.
Student Learning Activity	

- **Sixth Grade:**
  Standards covered: 8.2.8.ED.1, 8.2.8.ED.2, 8.2.8.ED.3, 8.2.8.ED.4, 8.2.8.ED.5, 8.2.8.ED.6, 8.2.8.ED.7
  Students will create and design a functioning Rube Goldberg Machine.
  - Review the design process to solve a problem and create a model.
  - Investigate a malfunctioning system, test options to repair, and redesign their model accordingly.
  - Discuss how they can use the design process to solve real-world problems.

- **Seventh Grade:**
  Standards covered: 8.2.8.NT.1, 8.2.8.ETW.1, 8.2.8.ETW.2, 8.2.8.ETW.3, 8.2.8.EC.1, 8.2.8.EC.2
  Throughout the ecosystems unit based on the OpenSciEd curriculum, students will obtain information on how our use of palm oil affects orangutan populations in other countries. Students will use this information for a culminating project that asks them to:
  - Define and refine criteria and constraints for designing a way to use the land to increase precision and to take into account the potential impacts and the ways in which potential solutions are limited by the natural environment.
  - Apply ideas about ways of growing food to design a better way to use the land to minimize human impact on orangutan populations.
  - Integrate qualitative information obtained from written text and media to clarify claims about farming practices that reduce risk to disruptions and that maintain and promote stability of populations in natural systems.
  - Evaluate competing design solutions for supporting and/or increasing a stable orangutan population and meeting people's income needs.
  - Construct an argument grounded in evidence and scientific reasoning to recommend a design solution that will support a stable orangutan population and protect the needs of people (effect).
  - Ask questions about and define problems that arise when humans design land-use systems that have positive and negative effects on biodiversity and ecosystem services.

- **Eighth Grade:**
  Standards covered: 8.2.8.ITH.1, 8.2.8.ITH.2, 8.2.8.ITH.3, 8.2.8.ITH.4, 8.2.8.ITH.5
  - Identify the components of a new technology like cell phones/car batteries. For each component, identify the raw materials needed and how it mining/production process. Include cost/benefits of issues: economic, political, social, and cultural issues
  - Compare the progression of a technology (cars, light bulbs, computers) and show how the design has impacted climate (positively/negatively). (fueleconomy.gov)

- Research renewable energy sources (solar, wind, geothermal, biofuel, tidal) & how they are designed to combat negative effects of fossil fuels
- Collect and analyze data to show that plastic recycling in 1st world countries is a detriment to 3rd world countries due to ocean currents. Propose possible solutions.

Companion Standards

Grades 6-8 Progress Indicators
Reading Science and Technical Subjects

Key Ideas and Details

RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.
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.
RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Craft and Structure

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.
RST.6-8.5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
RST.6-8.6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas

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).
RST.6-8.8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
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.
Range of Reading and Level of Text Complexity
RST.6-8.10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

Grades 6-8 Progress Indicators
Anchor Standards for Writing

Text Types and Purposes

NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

Production and Distribution of Writing

NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or

trying a new approach.
NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
Research to Build and Present Knowledge
NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
Range of Writing
NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Sixth Grade
Earth Science
Space Systems

Performance Expectations

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]
MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).]
MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.]

Enduring Understandings/Big Ideas:
- Motions of Earth and the moon in relation to one another and the sun produce seasons, moon phases, and eclipses.
- Objects in the solar system are classified based on similarities and differences observed from data obtained by a variety of instruments.

Essential Questions:
- How does the Earth move?
- Why is Earth warmer at the equator and colder at the poles?
- Why do the seasons change as Earth moves around the sun?
- How does the Moon move around Earth
- Why does the Moon's appearance change?
- What is a solar eclipse?
- What is a lunar eclipse?
- How does Earth compare to other objects in the solar system?
- Astronomical Units

Disciplinary Core Ideas
ESS1.A: The Universe and Its Stars • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **ESS1.B: Earth and the Solar System** • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.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. • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings.	**Patterns** • Patterns can be used to identify cause and effect relationships. **Scale, Proportion, and Quantity** • Time, space and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **Systems and System Models** • Models can be used to represent systems and their interactions.

Unit Pacing
Lessons And Time Frame (30 days)
• Seasons (13 days) • Moon Phases (4 days) • Eclipses (solar and lunar) (3 days) • Scale Properties (8 days) • Gravity (2 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE
• **Career Ready Practices** Utilize critical thinking to make sense of problems and persevere in solving them **MS-ESS1-1.** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. ***Activity:*** Students use 3D models, daylight/darkness and temperature data, and seasons Gizmo to explain seasonal variations around the globe. • **9.2 Career Awareness, Exploration, and Preparation** **MS-ESS1-1.** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. **9.2.8.CAP.12**: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.

Activity: Lesson reflection on personal interest in earth and space science which may include results from a personality inventory.

- **9.4 Life Literacies and Key Skills**
  MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
  9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
  Activity: Students record data on sunrise/sunset, moon phases, and temperature at different latitudes to identify relationships among the sun, Earth, moon system.

- **Computer Science**
  MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
  Activity: Students gather distance and size data to create 3D models of the solar system.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.
  6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
  Activity: Analyze and interpret graphs of daylight and darkness from several worldwide locations at different latitudes.
- **ELA**
  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.
  Activity: Students will read and watch a video to compare and contrast characteristics and the relative size of the inner and outer planets.

Sixth Grade
Physical Science
Forces and Interactions

Performance Expectations

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.]
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is

on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.]
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.]
MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.]
MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• Forces change the movement of objects. • The strength of forces vary. • Forces can be attractive or repulsive.	• What are some contact forces and some non-contact forces? • What is the law of universal gravitation? • How does friction affect the motion of two objects sliding past each other? • What is Newton's 2nd law of motion? • What is Newton's 3rd law of motion? • Why don't the forces in a force pair cancel each other? • What is the law of conservation of momentum?

Disciplinary Core Ideas

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

PS2.B: Types of Interactions
- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
- 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.
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a

ball, respectively).

Science and Engineering Practices	Cross-Cutting Concepts
Asking Questions and Defining Problems • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. **Planning and Carrying Out Investigations** • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. **Explanations and Designing Solutions** • Apply scientific ideas or principles to design an object, tool, process or system. **Engaging in Argument from Evidence** • Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

Unit Pacing

Lessons And Timeframe (40 days)

- Gravity (2 days)
- 1st Law (inertia) (3 days)
- 2nd Law (F=ma) (5 days)
- 3rd Law (equal and opposite) (10 days)
- Strength of Electric and Magnetic Forces (10 days)
- Electric and Magnetic Fields (10 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Demonstrate creativity and innovation.
  MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Activity: *S*tudents work in teams to create an investigation to demonstrate the effect of force and mass on the motion of an object.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.8.CAP.9: Analyze how a variety of activities related to career preparation (e.g., volunteering, apprenticeships, structured learning experiences, dual enrollment, job search, scholarships) impacts postsecondary options
  MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
  Activity: Students work in teams to create an investigation to demonstrate the effect of force and mass on the motion of an object.

- **9.4 Life Literacies and Key Skills**
  9.4.8.CI.2: Repurpose an existing resource in an innovative way.
- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
  MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
  Activity: Students work as a class to create a Rube Goldberg machine using everyday objects to demonstrate Newton's laws.

- **Computer Science**
  8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
  MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
  Activity: Students work in teams to create an investigation to demonstrate the effect of changing force and mass on the motion of an object.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
  7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, 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.
  Activity: After collecting data for penny loads, students determine reasonableness of answers with increasing mass.

- **ELA**

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Activity: Students run a controlled, multi-step experiment to collect force, mass, and acceleration data of the balloon rocket.

6th Grade
Physical Science
Structure and Properties of Matter

Performance Expectations

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.]
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.]
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.]

Enduring Understandings/Big Ideas:
- All types of matter, elements, compounds, and mixtures are made of atoms.
- Physical and energy changes occur as the matter goes from one state to another.

Essential Questions:
- What is the smallest unit of matter?
- What are some physical properties of matter?
- How do particles move in solids, liquids, and gasses?
- How are the forces between particles different in solids, liquids, and gasses?
- How is temperature related to particle motion?
- How are temperature and thermal energy different?
- What happens to thermal energy when matter changes from one state to another?

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

- Gasses and liquids are made of molecules or inert atoms that are moving about relative to each other)
- 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.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

PS3.A: Definitions of Energy

- The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
- 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.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • phenomena. **Obtaining, Evaluating, and Communicating Information** • 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.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Scale, Proportion, and Quantity** • Time, space and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. • Influence of Science, Engineering and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific

	research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Unit Pacing

Lessons And Timeframe (30 days)

- Atomic Composition (10 days)
- Properties of Synthetic Materials (10 days)
- Change of State (10 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  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.
  Activity: Students develop models of molecular motion when thermal energy is added or removed.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.
  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.
  Activity: Students reflect upon their interest and personal strengths when collaborating to develop models and make predictions. Students will participate in a teacher led discussion of what careers connect to different areas of interest and skills.

- **9.4 Life Literacies and Key Skills**
  9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem.
  9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities)
  9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
  9.4.8.TL.3: Select appropriate tools to organize and present information digitally.
  MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.
  Activity: Students compare and contrast atomic composition of gas molecules to observe the effects of climate change (e.g. carbon dioxide, methane, water vapor, CFC's)

- **Computer Science**
  8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
  MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.
  Activity: Students created an infographic for physical properties of simple molecules to be reviewed by peers.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  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.
  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.
  Activity: Students measure temperature before, during, and after endo- and exothermic reactions.

- **ELA**
  RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
  Activity: Students run a controlled, multi-step experiment to collect data on reactants, products, and temperature.

Sixth Grade
Physical Science
Chemical Reactions

Performance Expectations

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.]
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.]
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.]

Enduring Understandings/Big Ideas:
- Matter is identified based on physical and chemical properties.
- Substances chemically react and create new substances with different properties.
- Mass is conserved and does not change.
- Thermal Energy can be released or absorbed by chemical processes.

Essential Questions:
- What is a chemical property?
- What are some signs of chemical change?
- How can a change in energy affect the state of matter?
- What is meant by conservation of mass?
- In what ways can thermal energy be transferred?

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity

under given conditions) that can be used to identify it.

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

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.

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. 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.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models . • Develop a model to describe unobservable mechanisms. **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. **Constructing Explanations and Designing Solutions** • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. The transfer of energy can be tracked as energy flows through a designed or natural system.

Unit Pacing

Lessons And Timeframe (35 days)

- Properties of Substances (15 days)
- Law of Conservation (5 days)
- Chemical Processes Design Project -- Release/Absorb Thermal Energy (15 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Demonstrate creativity and innovation.
  MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
  Activity: Students design a device that transfers energy from a heat source to an object.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.
  MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
  Activity: Students reflect upon their interest and personal strengths on project design and possible career options.

- **9.4 Life Literacies and Key Skills**
  9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.
  9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products.
  9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
  MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
  Activity: Students explore the role of creativity and innovation in the process of energy transfer and chemical reactions (e.g. careers in green energy, solar power)

- **Computer Science**
  8.1.8.CS.3: Justify design decisions and explain potential system trade-offs.
  MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
  Activity: Students research materials' properties and their trade-offs to create a device that releases or absorbs energy.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  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.
  MP.4 Model with mathematics.
  Activity: Create a model to show the conservation of mass.

- **ELA/Literacy**
  RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
  Activity: Students run a controlled, multi-step experiment to collect data on conservation of mass.

Sixth Grade
Physical Science
Energy

Performance Expectations

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]
MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a

classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.]]

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.]

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.]

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• Energy is the ability to cause change. • Energy can be transferred from one object or system to another.	• What is energy? • What are potential and kinetic energy? • What is temperature? • How is energy related to work? • What is the law of conservation of energy? • How can energy be transferred from one object or system to another?

Disciplinary Core Ideas

PS3.A: Definitions of Energy
- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- 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.

PS3.B: Conservation of Energy and Energy Transfer
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- 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.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

PS3.C: Relationship Between Energy and Forces
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

Science and Engineering Practices	**Cross-Cutting Concepts**
Developing and Using Models • Develop a model to describe unobservable mechanisms. **Planning and Carrying Out Investigations** • Plan an investigation individually and	**Scale, Proportion, and Quantity** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of

collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Analyzing and Interpreting Data

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

Constructing Explanations and Designing Solutions

- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.)

Engaging in Argument from Evidence

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

properties and processes.

Systems and System Models

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

Energy and Matter

- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

Unit Pacing

Lessons And Time Frame (30 days)

- Kinetic Energy (10 days)
- Potential Energy (10 days)
- Thermal Energy (10 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
  Activity: Students create a Rube Goldberg Machine.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
  9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.
  Activity: Students reflect upon their value and talent in constructing, using, and presenting arguments.

- **9.4 Life Literacies and Key Skills**
  MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
  9.4.8.TL.3: Select appropriate tools to organize and present information digitally.
  9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.

9.4.8.DC.5: Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
Activity: Students choose an electronic resource (e.g. Google slides, Google Sheets, Canva, video) to present their argument to the class.

- **Computer Science**
  MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
  MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
  Activity: Students use a simulation to create their own skate park tracks to manipulate potential and kinetic energy.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
  MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
  7.RP.A.2 Recognize and represent proportional relationships between quantities.
  Activity: Students collect data to explain the relationship between kinetic and potential energy in the skate park simulation.

- **ELA**
  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.
  Activity: Students researched about energy transfer to create a Rube Goldberg Machine.

Seventh Grade
Life Science
Growth, Development, and Reproduction of Organisms

Performance Expectations

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]
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.]
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.]
MS-LS4-5. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

Enduring Understandings/Big Ideas:

- Sexual reproduction results in genetic variation among individuals of a species.
- Asexual reproduction occurs without meiosis or fertilization, allowing for organisms to reproduce quickly.
- Genes that code for traits are found on chromosomes.
- A mutation in the DNA can change a protein, causing the trait to change as well.

Essential Questions:

- What are the different ways by which organisms reproduce?
- What determines the expression of traits?
- How do changes in the DNA Pacing affect traits?

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.
- Genetic factors as well as local conditions affect the growth of the adult plant.

LS3.A: Inheritance of Traits

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

LS3.B: Variation of Traits

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.)
- 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.

LS4.B: Natural Selection

- In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. **Constructing Explanations and Designing Solutions** • 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. **Engaging in Argument from Evidence** • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **Obtaining, Evaluating, and Communicating Information** • 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.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Unit Pacing

Lessons And Timeframe (30 days)

- Reproduction, growth, and development (10 days)
- Inheritance and variation of traits (15 days)
- Natural and artificial selection (5 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
Activity: Students will develop an argument using evidence, citing text, data, or media to support an explanation for how animal behaviors and specialized plant structures support successful reproduction.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.
  Activity: Students will reflect upon their interest in engaging in argument based on empirical evidence based on scientific evidence to support an explanation.

- **9.4 Life Literacies and Key Skills**
  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
  9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
  Activity: Students will research information about genetic information that is passed on to offspring through asexual and sexual reproduction, construct a spreadsheet to organize their data, and cite their sources

- **Computer Science**
  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
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
  Activity: Students will research information about genetic information that is passed on to offspring through asexual and sexual reproduction, construct a spreadsheet to organize their data, and cite their sources.

INTERDISCIPLINARY CONNECTIONS

- **ELA**
  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.
  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)
  Activity: Students will create a model to identify and describe adaptations in animals and plants by integrating visuals with text that allow for increased success in reproduction. Students will cite their sources on their models.

- **ELA**
  MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
  WHST.6-8.1 Write arguments focused on discipline content

Activity: Students will develop an argument using evidence, citing text, data, or media to support an explanation for how animal behaviors and specialized plant structures support successful reproduction. Students will evaluate each others' arguments and offer feedback.

Seventh Grade
Life Science
Interdependent Relationships in Ecosystems

Performance Expectations

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

Enduring Understandings/Big Ideas:
- Organisms and their environments are interconnected.
- Changes in one part of the system will affect other parts of the system.
- Humans can alter the living and nonliving factors within an ecosystem, thereby creating changes to the overall system.

Essential Questions:
- What would happen if living things could not interact with the nonliving parts of the environment?
- How can change in one part of an ecosystem affect change in other parts of the ecosystem?
- How do humans have an impact on the diversity and stability of ecosystems?

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

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

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

ETS1.B: Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

Science and Engineering Practices	**Cross-Cutting Concepts**

Constructing Explanations and Designing Solutions • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. **Engaging in Argument from Evidence** • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	**Patterns** • Patterns can be used to identify cause and effect relationships. **Stability and Change** • Small changes in one part of a system might cause large changes in another part.

Unit Pacing

Lessons And Timeframe (24 days)

- Interdependent relationships in ecosystems (12 days)
- Biodiversity and ecosystem services (12 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Consider the environmental, social and economic impacts of decisions.
  MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
  Activity: Students will obtain and combine information from various online resources to investigate the causes for the changes in Yellowstone ecosystem for a period of 20 years.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
  9.2.8.CAP.10: Evaluate how careers have evolved regionally, nationally, and globally.
  Activity: As a group, students will research how the effects of human impact have changed the evolution of careers within the region.

- **9.4 Life Literacies and Key Skills**
  MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
  9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
  9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
  9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose .
  9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).
  Activity: As a group, students will research the effectiveness of solutions on past issues of an ecosystem and identify solutions to current problems.

- **Computer Science**
  MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
  8.1.8.AP.4: Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.
  Activity: Students will analyze problems and solutions from past in order to implement new innovative solutions.

INTERDISCIPLINARY CONNECTIONS
• **ELA** **MS-LS2-2.** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. **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 **SL.8.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. ***Activity:*** Students will develop a presentation that explains and predicts patterns of interactions among organisms across multiple ecosystems. • **Math** **MS-LS2-2.** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. **6.SP.B.5** Summarize numerical data sets in relation to their context ***Activity:*** Using evidence from multiple sources and given data, students will identify and describe patterns in competitive, predatory, and mutually beneficial interactions between organisms.

Seventh Grade
Life Science
Matter and energy in Organisms and Ecosystems

Performance Expectations
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.] **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.] **MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.] **MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] **MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Enduring Understandings/Big Ideas:	Essential Questions:
• Matter needed to sustain life is continually recycled among and between organisms and the environment.	• How do matter and energy link organisms to each other and their environments? • Why is sunlight essential to life on Earth?

• Energy from the sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.	

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.
- 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.

LS2.A: Interdependent Relationships in Ecosystems
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
- 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.
- Growth of organisms and population increases are limited by access to resources.

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

PS3.D: Energy in Chemical Processes and Everyday Life
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.
- 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.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop a model to describe phenomena. • Develop a model to describe unobservable mechanisms. **Analyzing and Interpreting Data** • Analyze and interpret data to provide evidence for phenomena. **Constructing Explanations and Designing Solutions** • 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	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a natural system. **Stability and Change** • Small changes in one part of a system

and will continue to do so in the future. **Engaging in Argument from Evidence** • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	might cause large changes in another part.

Unit Pacing

Lessons And Timeframe (24 days)

- Flow of energy and matter in organisms (12 days)
- Flow of energy and matter in ecosystems (12 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  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
  Activity: Students will describe the role of photosynthesis in the cycling of matter and flow of energy using information obtained through various references**.**

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.
  Activity: Students will reflect upon their interest in developing models to describe a system.

- **9.4 Life Literacies and Key Skills**
  MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
  9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem
  9.4.8.DC.1: Analyze the resource citations in online materials for proper use.
  9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
  9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem.
  Activity: Students will obtain information from a variety of resources to use as evidence in an argument that describes the causes of the decrease in the hawk population.

- **Computer Science**
  MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
  MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
  8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
  Activity: Students will obtain information from a variety of resources to use as evidence in an argument that describes the causes of the decrease in the hawk population.

INTERDISCIPLINARY CONNECTIONS

- **ELA**
  MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
  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).
  Activity: Students will develop a model that describes how matter cycles and energy flows through the living and nonliving parts of an ecosystem.

- **ELA**
  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
  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.
  Activity: Students will develop an explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

Seventh Grade
Life Science
Structure, Function, and Information Processing

Performance Expectations

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 and varied cells.]
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.]
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.]
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.

Enduring Understandings/Big Ideas:	**Essential Questions:**
• Organisms share common characteristics of life. • Cells have organized structures and systems necessary to maintain life. • Structure is related to function at all levels of biological organization.	• How do you know if something is alive? • How does life result from the structure and function of cells? • How are cells organized in multicellular organisms?

Disciplinary Core Ideas

LS1.A: Structure and Function
- All living things are made up of cells, which is the smallest unit that can be said to be alive. An

organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.
- 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.

LS1.D: Information Processing
- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. **Planning and Carrying Out Investigations** • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **Engaging in Argument from Evidence** • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. **Obtaining, Evaluating, and Communicating Information** • 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.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. **Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. **Systems and System Model**s • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Unit Pacing

Lessons And Timeframe (35 days)

- Microscopes (5 days)
- Characteristics of life (5 days)
- Cell structure and function (15 days)
- Levels of organization (5 days)
- Information processing (5 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Work productively in teams while using cultural/global competence.
  MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells
  Activity: Students will work in a group to gather and analyze information to use as evidence to support the claim that the body is a system of interacting subsystems composed of a group of cells.

Use technology to enhance productivity, increase collaboration and communicate effectively.
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.
Activity: Students will use various internet sources (Google Slides, Drawings, Prezi, Storyboard that, etc) to develop a presentation to support or refute the idea that sensory input results in memories or behavior change.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells
  9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.
  Activity: Students will evaluate each others' communication in their group presentation to support the claim that the body is a system of interacting subsystems composed of a group of cells. Students will assess their interest and strengths in working in groups to support an argument.

- **9.4 Life Literacies and Key Skills**
  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.
  9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem.
  9.4.8.TL.3: Select appropriate tools to organize and present information digitally.
  9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information.
  Activity: Students will research and analyze information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. They will create a digital product to communicate the information.

- **Computer Science**
  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.
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
  Activity: Students will research and analyze information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. They will determine the credibility and accuracy of the information they found.

INTERDISCIPLINARY CONNECTIONS

- **ELA**
  MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells
  WHST.6-8.1 Write arguments focused on discipline content.
  Activity: Students will construct a group argument, using evidence from investigations and literature, that supports the claim that the body is a system of interacting subsystems composed of a group of cells. Groups will present their argument to the class and receive feedback from peers about their argument.

- **ELA**
  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.
  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.
Activity: Students will create a presentation that evaluates information based on credibility, accuracy, bias, and ability to support or refute the idea that sensory input results in memories or behavior change.

Seventh
Physical Science
Waves and Electromagnetic Radiation

Performance Expectations

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.]
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.]
MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.]

Enduring Understandings/Big Ideas:
- A wave has a specific wavelength, frequency, and amplitude.
- Information can be transmitted using the wave's properties.
- Waves transfer energy when they interact with matter.

Essential Questions:
- How can energy be transferred from one object or system to another?
- What are the characteristic properties of waves and how can they be used?
- How do waves send digital information?
- How do waves behave when they interact with matter?

Disciplinary Core Ideas

PS4.A: Wave Properties
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- A sound wave needs a medium through which it is transmitted.

PS4.B: Electromagnetic Radiation
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- 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.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

PS4.C: Information Technologies and Instrumentation
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. **Using Mathematics and Computational Thinking** • Use mathematical representations to describe and/or support scientific conclusions and design solutions. **Obtaining, Evaluating, and Communicating Information** • Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings.	**Patterns** • Graphs and charts can be used to identify patterns in data. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. • Structures can be designed to serve particular functions.

Unit Pacing

Lessons And Timeframe (20 days)

- Wave properties (5 days)
- Electromagnetic radiation (10 days)
- Waves and information technology (5 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Demonstrate creativity and innovation.
  MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
  Activity: Plan and carry out an investigation, using the resources available, to create a string telephone that will transfer the speaker's energy to a listener standing 8 meters away. The listener needs to be able to hear and understand what the speaker is saying in a noisy classroom.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
  9.2.8.CAP.10: Evaluate how careers have evolved regionally, nationally, and globally.
  Activity: Research how telecommunication careers have changed throughout the years.

- **9.4 Life Literacies and Key Skills**
  MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
  9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
  9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products.
  9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information
  9.4.8.TL.3: Select appropriate tools to organize and present information digitally.
  Activity: Obtain information from multiple online resources to use as evidence in an explanation for the uses of digital vs analog signals. Students will cite their resources in their explanation.

- **Computer Science**
  MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that

digitized signals are a more reliable way to encode and transmit information than analog signals.
8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options.
Activity: Obtain information from multiple online resources to use as evidence in an explanation for the uses of digital vs analog signals. Students will cite their resources in their explanation.

INTERDISCIPLINARY CONNECTIONS

- **ELA**
  MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
  RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
  Activity: Gather evidence from various sources to support a claim that using waves to carry digital signals is a more reliable way to encode and transmit information than using waves to carry analog signals.

- **Math**
  MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
  MP.4 Model with mathematics.
  Activity: Create a graph showing the relationship between the amplitude of a wave and the energy in a wave.

Eighth Grade
Earth Science
Earth's Systems

Performance Expectations

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.]
MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.]
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• The matter within rocks are constantly going through different processes of weathering.	• How do the materials in and on Earth's crust change over time? • How does water influence weather, circulate

• Water goes through many different phases and is involved in many different processes that can model and shape the Earth. • Humans require resources and have been removing them from Earth and the location of these resources depends on years of formation underground.	in the oceans, and shape Earth's surface?

Disciplinary Core Ideas

ESS2.A: Earth's Materials and Systems
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

ESS2.C: The Roles of Water in Earth's Surface Processes
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- Global movements of water and its changes in form are propelled by sunlight and gravity.

ESS3.A: Natural Resources
- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Science and Engineering Practices	Cross-Cutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. • Develop a model to describe unobservable mechanisms. **Constructing Explanations and Designing Solutions** • 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.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.

Unit Pacing

Lessons And Timeframe (22 days)

- Rock Cycle (5 days)
- Types of Rocks (5 days)
- Water Cycle (3 days)
- Carbon and Nitrogen cycles (5 days)
- Fossil Fuels with renewable and nonrenewable resources (4 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**

Utilize critical thinking to make sense of problems and persevere in solving them.
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
Activity: Students will research geological processes and use critical thinking to explain how the Grand Canyon was formed.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
  9.2.8.CAP.9: Analyze how a variety of activities related to career preparation (e.g., volunteering, apprenticeships, structured learning experiences, dual enrollment, job search, scholarships) impacts postsecondary options.
  Activity: Develop a model to explain why some areas have more frequent and intense geological events.

- **9.4 Life Literacies and Key Skills**
  MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
  9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas.
  9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
  9.4.8.IML.13: Identify the impact of the creator on the content, production, and delivery of information.
  9.4.8.DC.7: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
  Activity: Students will use multiple forms of evidence to support the theory of continental drift.

- **Computer Science**
  MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
  Activity: Students will compare wave data collected on a spreadsheet to determine boundaries and materials that make up Earth's layers.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
  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.
  8.EE.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. How can scientific notation and units of appropriate size be used to represent measurements of very large or very small quantities?
  8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities
  Activity: Develop a model of the water cycle to explain the quantity of rainfall on different sides of the Rockies.

- **ELA**
  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.
  Activity: Research local impacts of rain/drought on either side of the Rockies.

Eighth Grade
Earth Science
History of Earth

Performance Expectations

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.]
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.]
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).]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• The Earth and the organisms today has gone through many changes over time. • The continents and oceans have changes in 4.6 billion years through fast and slow processes. • Studying earth's artifacts can provide evidence of plate motion.	• How do people figure out that Earth and life on Earth have changed over time? • How does the movement of tectonic plates impact the surface of Earth?

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth
- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at

trenches.

ESS2.A: Earth's Materials and Systems

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

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

- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

Science and Engineering Practices	Cross-Cutting Concepts
Analyzing and Interpreting Data • Analyze and interpret data to provide evidence for phenomena. • **Constructing Explanations and Designing Solutions** 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.	**Patterns** • Patterns in rates of change and other numerical relationships can provide information about natural systems. **Scale Proportion and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Unit Pacing

Lessons And Timeframe (18 days)

- History of the Planet (2 days)
- Volcanoes, Earthquakes, Meteor Impacts, and Fossils as evidence for changes on Earth (3 days)
- Erosion and deposition (3 days)
- Theory of Plate tectonics with Pangaea and continental drift (10 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  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.
  Activity: Analyze and interpret data on the distribution of fossils and rocks to determine relative age of the organism.

- **9.2 Career Awareness, Exploration, and Preparation**
  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
  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.
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.
  Activity: Students will assess their interest in analyzing and interpreting data & engaging in argument using evidence to support a theory.

- **9.4 Life Literacies and Key Skills**
  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
  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.
  9.4.8.TL.4: Synthesize and publish information about a local or global issue or event.
  9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
  9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
  Activity: Students will explain a recent geological event based on their knowledge of plate tectonics.

- **Computer Science**
  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.
  8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
  Activity: Students will analyze the magnetic field and distance/depth of the seafloor to determine geologic time.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  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.
  MP.2 Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)
  8.EE.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. How can scientific notation and units of appropriate size be used to represent measurements of very large or very small quantities?
  8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities
  Activity: Students will analyze the fossil data according to rock layer, continent, and/or seafloor structures to explain common ancestry.

- **ELA**
  SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. **(MS-ESS2-1),(MS-ESS2-2),(MSESS2-6)**
  Activity: Students will create a video to explain their fossil's common ancestry.

Eighth Grade
Life Science
Natural Selection and Adaptations

Performance Expectations

MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the

assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.]
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]
MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.]
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.]

Enduring Understandings/Big Ideas:

- Fossils can help determine how life was in the past.
- Anatomical similarities can be seen among different organisms on Earth with supports the idea of a common ancestor.
- The embryological development shows similarities between vertebrates and supports the idea of a common ancestor.
- Look at DNA evidence shows strong similarities between certain organisms that indicate common ancestry.
- Phenotypic traits can provide advantages and disadvantages that can affect the success of a population over time.

Essential Questions:

- How does genetic variation among organisms in a species affect survival and reproduction?
- How does the environment influence genetic traits in populations over multiple generations?

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
- 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.
- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.

LS4.B: Natural Selection

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others.

LS4.C: Adaptation

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.

Science and Engineering Practices	Cross-Cutting Concepts
Analyzing and Interpreting Data • Analyze displays of data to identify linear and nonlinear relationships. • Analyze and interpret data to determine similarities and differences in findings. **Using Mathematics and Computational Thinking**. • Use mathematical representations to support scientific conclusions and design solutions. **Constructing Explanations and Designing Solutions** • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. • Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.	**Patterns** • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. **Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Unit Pacing

Lessons And Timeframe (12 days)

- Evidence of Evolution to include the following:
  - Fossil Patterns (3 days)
  - Anatomical similarities and differences (2 days)
  - Embryological development (1 day)
  - DNA Evidence (2 days)
- Natural Selection and variation within a population (4 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
  Activity: Construct an explanation to communicate how genetic variations of traits in a population increased some individuals' probability of surviving and reproducing.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
  9.2.8.CAP.2: Develop a plan that includes information about career areas of interest.

Activity: As a group, students will analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species. Students will then reflect upon their interest in comparing patterns of similarities and identify the professionals involved in the care of the species.

- **9.4 Life Literacies and Key Skills**
  MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
  9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas.
  9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information.
  Activity: Students will compare images of embryos from several organisms developing over a period of time to identify common anatomical structures not present in the mature organism.

- **Computer Science**
  MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
  8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose
  Activity: Students will create a visual representation of the data to show increases and/or decreases in a specific population over time.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
  6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
  Activity:Use the peppered moth gizmo to identify ratios of light- and dark-peppered moths each year for 5 years.

- **ELA**
  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.
  Activity: Students worked in groups of 3 to read current event articles from one of 3 political perspectives.

Eighth Grade
Earth Science
Weather and Climate

Performance Expectations

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden

changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps,diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).]

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.]

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused climate change over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• Air masses can result in changes to the daily weather. • Using various types of atmospheric evidence can help predict weather changes. • Human activities such as burning fossil fuels are affecting the global weather and climate patterns.	• What factors interact and influence weather and climate?

Disciplinary Core Ideas

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

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- 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.

ESS3.D: Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

Science and Engineering Practices	**Cross-Cutting Concepts**

Asking Questions and Defining Problems • Ask questions to identify and clarify evidence of an argument. **Developing and Using Models** • Develop and use a model to describe phenomena. **Planning and Carrying Out Investigations** • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. **Stability and Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Unit Pacing

Lessons And Timeframe (20 days)

- Air masses (3 days)
- Pressure systems (2 days)
- Fronts (5 days)
- Factors affecting Climate (5 days)
- Human Activities and Climate Change (5 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Use technology to enhance productivity, increase collaboration and communicate effectively.
  MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
  Activity: Students use technology to collect real-time data to explain how air masses interact and produce changes in weather conditions.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused climate change over the past century
  9.2.8.CAP.10: Evaluate how careers have evolved regionally, nationally, and globally.
  Activity: Students research the role of climatologists, meteorologists, and engineers have changed, especially with increasing severity of natural disasters due to the rise in global temperatures. They will predict which occupations will help improve climate change solutions.

- **9.4 Life Literacies and Key Skills**
  MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused climate change over the past century
  9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
  9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
  9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
  9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change.

Activity: Students will formulate questions to research specific data to improve their understanding of the impact of climate change and mitigation efforts.

- **Computer Science**
  MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
  8.1.8.IC.1: Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options.
  8.1.8.IC.2: Describe issues of bias and accessibility in the design of existing technologies.
  Activity: Students will compare advantages/disadvantages of access to weather resources and advantages from developed and underdeveloped regions.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
  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.
  Activity: Develop a model and write a weather report using positive and negative temperatures and elevations to describe local/regional weather conditions.

- **ELA**
  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).
  Activity: Develop a model and write a weather report using positive and negative temperatures and elevations to describe local/regional weather conditions.

Eighth Grade
Earth Science
Human Impact

Performance Expectations

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

Enduring Understandings/Big Ideas:	**Essential Questions:**
• Technologies are used to collect data on locations, magnitudes, and frequencies to make predictions on the occurrences of natural hazards. • There are solutions to reduce human impacts (water usage, land usage, and pollution) on the environment,. • Changes in human population directly affect appearance, composition, and structure of Earth's systems.	• How does human activity/population impact the earth? • What solutions exist to mitigate the negative impact on climate change?

Disciplinary Core Ideas

ESS3.B: Natural Hazards
- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

ESS3.C: Human Impacts on Earth Systems
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- 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.

Science and Engineering Practices	**Cross-Cutting Concepts**
Analyzing and Interpreting Data • Analyze and interpret data to determine similarities and differences in findings.) **Constructing Explanations and Designing Solutions** • Apply scientific principles to design an object, tool, process or system. **Engaging in Argument from Evidence** • Construct an oral and written argument	**Patterns** • Graphs, charts, and images can be used to identify patterns in data. **Cause and Effect** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Cause and effect relationships may be used to predict phenomena in natural or

supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	designed systems.

Unit Pacing

Lessons And Timeframe (20 days)

- Technologies are used to collect data on locations, magnitudes, and frequencies to make predictions on the occurrences of natural hazards. (10 days)
- Changes in human population directly affect appearance, composition, and structure of Earth's systems. (5 days)
- There are solutions to reduce human impacts (water usage, land usage, and pollution) on the environment. (10 days)

CAREER READINESS, LIFE LITERACIES & KEY SKILLS, COMPUTER SCIENCE

- **Career Ready Practices**
  Consider the environmental, social and economic impacts of decisions.
  MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
  Activity: Students identify the relationship among human population, greenhouse gases, and global temperatures.

- **9.2 Career Awareness, Exploration, and Preparation**
  MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
  9.2.8.CAP.10: Evaluate how careers have evolved regionally, nationally, and globally.
  Activity: Students identify the evolution of careers with increasing global temperatures and predict which occupations will help improve climate change solutions.

- **9.4 Life Literacies and Key Skills**
  MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
  9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective.
  9.4.8.DC.5: Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
  9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping
  9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem.
  Activity: Students produce a video identify a local/global climate change problem, identify effective current solutions, and propose future steps of mitigation.

- **Computer Science**
  MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
  8.1.8.DA.6: Analyze climate change computational models and propose refinements.

Activity: Students will analyze current climate data to suggest factors that produce validity and reliability issues from the data.

INTERDISCIPLINARY CONNECTIONS

- **Math**
  MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
  7.RP.A.2 Recognize and represent proportional relationships between quantities.
  Activity: Students identify the relationship among human population, greenhouse gases, and global temperatures.

- **ELA**
  MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
  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.
  Activity: Students identify the relationship among human population, greenhouse gases, and global temperatures.