Science Department

Grade 8 Curriculum

Standards in Action: Climate Change Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science as a way to inform decisions that improve quality of life for themselves, their community, and globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems. The topic of climate change can easily be integrated into science classes. At each grade level in which systems thinking, managing uncertainty, and building arguments based on multiple lines of data are included, there are opportunities for students to develop essential knowledge and skills that will help them understand the impacts of climate change on humans, animals, and the environment. For example, in the earlier grades, students can use data from first hand investigations of the school-yard habitat to justify recommendations for design improvements to the school-yard habitat for plants, animals, and humans. In the middle grades, students use resources from New Jersey Department of Environmental Protection, the National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA), to inform their actions as they engage in designing, testing, and modifying an engineered solution to mitigate the impact of climate change on their community. In high school, students can construct models they develop of a proposed solution to mitigate the negative health effects of unusually high summer temperatures resulting from heat islands in cities across the globe and share in the appropriate setting. (NJDOE, Standards Draft Approval, 2020)

UNIT ONE

Timeframe (Approximate)	Unit Breakdown
Week 1-2	Wave Properties
Week 3-5	Introduction to Light
Week 6-8	Electromagnetic Radiation
Week 9-12	Information Technologies and Instrumentation

Unit 1

Waves and their Applications in Technologies for Information Transfer

Summary and Rationale

In this unit of study, students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information in order to describe and predict characteristic properties and behaviors of waves. Students also apply their understanding of waves as a means of sending digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. Students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Recommended Pacing

10-12 weeks

Standards

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.
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
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.

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-PS4-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.
- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

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. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

PS4.C: Information Technologies and Instrumentation
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

Crosscutting Concepts

Patterns
- Graphs and charts can be used to identify patterns in data. (MS-PS4-1)

Structure and Function
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)
- Structures can be designed to serve particular functions. (MS-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Connections to Nature of Science

Science is a Human Endeavor
- Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Interdisciplinary Connections	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)
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. (MS-PS4-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)
MP.2	Reason abstractly and quantitatively. (MS-PS4-1)
MP.4	Model with mathematics. (MS-PS4-1)
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1) 6.RP.A.3
7.RP.A.2	Recognize and represent proportional relationships between quantities. (MSPS4-1)

8.F.A.3	Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)
Integration of Technology	
SL.8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
SL.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
Career Readiness, Life Literacies and Key Skills	
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
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 (e.g., MS-ETS1-2).

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will use mathematical representations to describe and/or support scientific conclusions about how the amplitude of a wave is related to the energy in a wave. Students will use mathematical representations to describe a simple model. Students will develop and use models to describe the movement of waves in various materials Students will integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are.	How are waves formed? What are the parts of a wave? What is the difference between mechanical and electromagnetic waves? How do waves behave when they interact with matter? How are waves used for communication purposes?

Evidence of Learning (Assessments)

Pre-Assessment
Ongoing formative assessments throughout the unit
Post-Assessment: Light Unit Common Assessment
Digital vs. Analog project

Objectives (SLO)	
Students will know: · A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. · Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. · Graphs and charts can be used to identify patterns in data. · Waves can be described with both qualitative and quantitative thinking · 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. · Waves are reflected, absorbed, or transmitted through various materials. · A sound wave needs a medium through which it is transmitted. · Because light can travel through space, it cannot be a matter wave, like sound or water waves. · The structure of a wave can be modified 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 use properties of waves to serve particular functions. · Waves can be used for communication purposes. · Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information than are analog signals. · Wave-related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.	Students will be able to: · 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. · Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. · 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.

Suggested Resources/Technology Tools

Curriculum skeleton built upon NJDOE Model Curriculum for MS.
Resources for the course are teacher designed and based upon class needs, curriculum and aligned to standards.
Framework resource for the curriculum is the STC system from Carolina for which the district owns:
Teacher Guides

Literacy Magazines
Laboratory Exploration Manuals
Carolina Science STC "Exploring the Nature of Light"
Wavelength Animation
Frequency Animation
Waves on a String
Refraction through a Glass Prism Video
PhET Color Vision
TEDEd: What is Color? Video
TEDEd: Light Waves- Visible and Invisible Video
Light & Color: Stage Lighting Interactive

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

MLL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow MLL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments

- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

- ❑ Act as a responsible and contributing citizen and employee.
- ❑ Apply appropriate academic and technical skills.
- ❑ Attend to personal health and financial well being.
- ❑ Communicate clearly and effectively and with reason.
- ❑ Consider the environmental, social, and economic impacts of decisions.
- ❑ Demonstrate creativity and innovation.
- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❑ Model integrity, ethical leadership, and effective management.
- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

LINKS TO CAREERS:
Audio and Video Equipment Technician
Electrician
Film and Video Editor
Nuclear Monitoring Technician
Nuclear Power Reactor Operator
Physicist
Physics Teacher
Pilot
Power Distributor & Dispatcher
Power Plant Operator
Precision Instrument & Equipment Repairer

Sound Engineering Technician
Optional Extensions: Sound Waves Electromagnetic Math Bioluminescence

UNIT TWO

Timeframe (Approximate)	Unit Breakdown
Week 1-2	Basic Chemistry Introduction
Week 3-5	States of Matter and Energy
Week 6-8	Mixtures, Compounds and Pure Substances
Week 9-12	Bonding and Balancing Basics

Unit 2
Matter and Its Interactions
Summary and Rationale
Students build understandings of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide a molecular level account to explain states of matter and changes between states. The crosscutting concepts of cause and effect, scale, proportion and quantity, structure and function, interdependence of science, engineering, and technology, and the influence of science, engineering and technology on society and the natural world provide a framework for understanding the disciplinary core ideas. Students demonstrate grade appropriate proficiency in developing and using models, and obtaining, evaluating, and communicating information. Students are also expected to use the scientific and engineering practices to demonstrate an understanding of the core ideas. Students provide molecular-level accounts of states of matter and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concept of energy and matter provides a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Recommended Pacing	
10-12 weeks	
Standards	
MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.
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.
MS-PS1- 3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
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.
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.
MS-PS1- 6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Science and Engineering Practices

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

- Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4)
- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

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

- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence. (MS-PS1-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2)

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

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. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

PS3.A: Definitions of Energy

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)*
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.*(secondary to MS-PS1-4)*

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(secondary to MS-PS1-6)*

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)*
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)*

Crosscutting Concepts

Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

Connections to Engineering,Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)

Influence of Science, Engineering and Technology on Society and the Natural World

- The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

Interdisciplinary Connections

RST.6- 8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.(MS-PS1-2)
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1),(MS-PS1-2)
WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-3)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-5)
MP.2	Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2)
MP.4	Model with mathematics. (MS-PS1-1)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1),(MS-PS1-2)
8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)
6.SP.B.5	Summarize numerical data sets in relation to their context. (MS-PS1-2)
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)
7.EE.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-3)
Integration of Technology	
8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
Career Readiness, Life Literacies and Key Skills	
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
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 (e.g., MS-ETS1-2).

Substances are made from different types of atoms, which combine with one another in various ways. Gases and liquids are made of molecules 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. Solids may be formed from molecules or from extended structures with repeating subunits (i.e. crystals). Changes of state of matter can occur due to variations in temperature or pressure. 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 mass does not change. Some chemical reactions release energy, others store energy. Heat is the transfer of thermal energy from one object to another. The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.	What is an atom? What are the parts of an atom? How is an atom different for each element? What is a molecule? What is a compound? What are the differences between a molecule and a compound? What are substances made of? What is the difference between a pure substance and a mixture? What are the differences between solids, liquids, and gases? What is energy? What are some different forms of energy? How do changes in state of matter occur? What is a chemical change? What is a physical change? What are chemical reactions? What are the differences between reactants and products? What is the conservation of mass principle? What is the difference between chemical reactions that store energy versus chemical reactions that release energy? What is the meaning of "heat"? What is the difference between temperature and thermal energy? What are some different types of energy in a chemical reaction?

Evidence of Learning (Assessments)
Pre-Assessment Ongoing formative assessments throughout the unit Post-Assessment: Chemistry Unit Common Assessment

Periodic Table/Element Project	
Objectives (SLO)	
Students will know: Substances are made from different types of atoms. Atoms are the basic units of matter. Substances combine with one another in various ways. Molecules are two or more atoms joined together. Atoms form molecules that range in size from two to thousands of atoms. Molecules can be simple or very complex. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules; these new substances have different properties from those of the reactants The analysis of data on the properties of products and reactants can be used to determine whether a chemical process has occurred. Density, melting point, boiling point, solubility, flammability, and odor are characteristic properties that can be used to identify a pure substance. Macroscopic patterns are related to the nature of the atomic-level structure of a substance. Changes in particle motion, temperature, and state of a pure substance occurs when thermal energy is added or removed. Qualitative molecular-level models of solids, liquids, and gases can be used to show that adding or removing thermal energy increases or decreases the kinetic energy of the particles until a change of state occurs. Gases 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, the molecules are widely spaced except when they happen to collide.	Students will be able to: Develop a model of a simple molecule. Use the model of the simple molecule to describe its atomic composition. Develop a model of an extended structure. Use the model of the extended structure to describe its repeating subunits Analyze and interpret data to determine similarities and differences from the results of chemical reactions between substances before and after they undergo a chemical process. Analyze and interpret data on the properties of substances before and after they undergo a chemical process. Identify and describe possible correlation and causation relationships evidenced in chemical reactions. Make logical and conceptual connections between evidence that chemical reactions have occurred and explanations of the properties of substances before and after they undergo a chemical process. Develop a model that predicts and describes changes in particle motion that could include molecules or inert atoms or pure substances. Use cause-and-effect relationships to predict changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural or designed systems. Obtain, evaluate, and communicate information to show that synthetic materials come from natural resources and affect society. Gather, read, and synthesize information about how synthetic materials formed from natural resources affect society. Assess the credibility, accuracy, and possible bias of each publication and methods used within the publication. Describe how information about how synthetic materials formed from natural resources affect society is supported or not supported by evidence. Use physical models or drawings, including digital forms, to represent atoms in a chemical process. Use mathematical descriptions to show that the number of atoms before and after a chemical process is the same. Undertake a design project, engaging in the design cycle, to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using models of matter. The term heat as used in everyday language refers both to thermal energy and the transfer of thermal energy from one object to another. Thermal energy is the motion of atoms or molecules within a substance. In science, heat is used to refer 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 the relationship between the average internal kinetic energy and the potential energy per atom or molecule 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. Cause-and-effect relationships may be used to predict and describe changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural systems. Each pure substance has characteristic physical and chemical properties that can be used to identify it. Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules. New substances that result from chemical processes have different properties from those of the reactants. Natural resources can undergo a chemical process to form synthetic material. Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. Engineering advances have led to discoveries of important synthetic materials, and scientific	Specific criteria are limited to amount, time, and temperature of a substance. Analyze and interpret data for the amount, time, and temperature of a substance in testing a device that either releases or absorbs thermal energy by chemical processes to determine similarities and differences in findings. Develop a model to generate data for testing a device that either releases or absorbs thermal energy by chemical processes, including those representing inputs and outputs of thermal energy. Track the transfer of thermal energy as energy flows through a designed system that either releases or absorbs thermal energy by chemical processes.

discoveries have led to the development of entire industries and engineered systems using these materials. Technology use varies from region to region and over time. The uses of technologies (engineered/synthetic materials) and any limitations on their use are driven by individual or societal needs, desires, and values. The uses of technologies (engineered/synthetic materials) and any limitations on their use are driven by the findings of scientific research and by differences in such factors as climate, natural resources, and economic conditions. Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules. New substances created in a chemical process have different properties from those of the reactants. The total number of each type of atom in a chemical process is conserved, and thus the mass does not change (the law of conservation of matter). Matter is conserved because atoms are conserved in physical and chemical processes. The law of conservation of mass is a mathematical description of natural phenomena. Some chemical reactions release energy, while others store energy. The transfer of thermal energy can be tracked as energy flows through a designed or natural system. Models of all kinds are important for testing solutions. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. 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. A solution needs to be tested and then modified on the basis of the test results in order for it to be improved. 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.	

Some of the characteristics identified as having the best performance may be incorporated into the new design.	

Suggested Resources/Technology Tools

Curriculum skeleton built upon NJDOE Model Curriculum for MS.
Resources for the course are teacher designed and based upon class needs, curriculum and aligned to standards.
Framework resource for the curriculum is the STC system from Carolina for which the district owns:
Teacher Guides
Literacy Magazines
Laboratory Exploration Manuals
Carolina Science STC "Experimenting with Mixtures, Compounds, and Elements"
Build An Atom Interactive
What causes rust? Newsela Reading
http://www.chem4kids.com/
Interactive Periodic Table
http://teachers.oregon.k12.wi.us/mahr/assignments/thermal_energyvs_temp.pdf - Temperature vs. Thermal Energy
https://jondyer.weebly.com/uploads/5/8/7/9/58794479/ls3_3-3.pdf - Temperature vs. Thermal Energy
https://studylib.net/doc/6926369/states-of-matter---virtual-lab - States of Matter Virtual Lab
https://phet.colorado.edu/sims/html/states-of-matter/latest/states-of-matter_en.html - States of Matter Virtual Lab
https://owlcation.com/stem/hands-on-experiments-to-learn-about-chemistry - Chemical Changes Labs
Interactive Bonding Tutorial
EdPuzzle - 6 Chemical Reactions That Changed History
https://phet.colorado.edu/sims/html/balancing-chemical-equations/latest/balancing-chemical-equations_en.html - Balancing Chemical Reactions Simulation

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

MLL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.

- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow MLL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

- ❏ Act as a responsible and contributing citizen and employee.
- ❏ Apply appropriate academic and technical skills.
- ❏ Attend to personal health and financial well being.
- ❏ Communicate clearly and effectively and with reason.

- ❑ Consider the environmental social and economics impacts of decisions.
- ❑ Demonstrate creativity and innovation.
- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❑ Model integrity, ethical leadership, and effective management.
- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

LINKS TO CAREERS:

Careers in Chemistry -
https://www.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/chemist
https://www.sciencebuddies.org/science-engineering-careers/health/pharmacist

Optional Extensions:

- Introduction to Chemistry WebQuest
- Element Superhero Project and Rubric
- Filter Feeder Project and Rubric - A biology extension to the process of filtration.
- Atomic Bomb Newsela Reading
- Element Acrostic Poem
- https://www.middleschoolchemistry.com/lessonplans/chapter1

UNIT THREE

Timeframe (Approximate)	Unit Breakdown
Week 1-2	Inheritance of Traits- DNA, Genes, Chromosomes, & Alleles
Week 3-5	Growth and Development of Organisms- Asexual (Mitosis) vs. Sexual Reproduction (Meiosis)
Week 6-8	Growth and Development of Organisms- Asexual (Mitosis) vs. Sexual Reproduction (Meiosis)
Week 9-12	Variation of Traits- Punnett Squares

Unit 3
Heredity: Inheritance and Variation of Traits Biological Evolution: Unity and Diversity

Summary and Rationale

Heredity: Inheritance and Variation of Traits- Students develop and use models to describe how gene mutations and sexual reproduction contribute to genetic variation. Students understand how genetic factors determine the growth of an individual organism. They also demonstrate understanding of the genetic implications of sexual and asexual reproduction. The crosscutting concepts of cause and effect and structure and function provide a framework for understanding how gene structure determines differences in the functioning of organisms. Students are expected to demonstrate proficiency in developing and using models. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Biological Evolution: Unity and Diversity- In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. The crosscutting concepts of cause and effect, patterns, and structure and function are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing graphical displays and gathering, reading, and communicating information. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. The crosscutting concepts of patterns and structure and function are called out as organizing concepts that students use to describe biological evolution. Students use the practices of constructing explanations, obtaining, evaluating, and communicating information, and using mathematical and computational thinking. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Recommended Pacing

10-12 Weeks

Standards

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 on the structure and function of the organism.
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.
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
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.

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.
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.
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
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.

Science and Engineering Practices

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

- Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4)
- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

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

- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence. (MS-PS1-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2)

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

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. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

PS3.A: Definitions of Energy

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)*
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.*(secondary to MS-PS1-4)*

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(secondary to MS-PS1-6)*

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)*
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)*

Crosscutting Concepts

Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)

Influence of Science, Engineering and Technology on Society and the Natural World

- The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

Interdisciplinary Connections	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1),(MS-LS3-2

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-LS4-1),(MS LS4-2),(MS-LS4-3),(MS-LS4-4),(MS-LS4-5)
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (MS-LS3-1),(MS-LS3-2)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1),(MS-LS4-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3),(MS-LS4-4)
SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2),(MS-LS4-4)
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. (MS-LS4-2),(MS-LS4-4)
SL.8.5	Integrate multimedia and visual displays in presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1),(MS-LS3-2)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2),(MS-LS4-4)
WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2),(MS-LS4-4)
MP.4	Model with mathematics. (MS-LS3-2),(MS-LS4-6)
6.SP.B.5	Summarize numerical data sets in relation to their context. (MS-LS3-2),(MS-LS4-4),(MS-LS4-6)
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4),(MS-LS4-6)
6.EE.B.6	6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-1),(MS-LS4-2)
7.RP.A.2	Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6)

Integration of Technology	
8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
Career Readiness, Life Literacies and Key Skills	
9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
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 (e.g., MS-ETS1-2).

Enduring Understandings:	**Essential Questions:**
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 on the structure and function of the organism. 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. 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. 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. 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. 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.	What is the relationship between DNA, genes, and chromosomes? How do structural changes to genes (mutations) located on chromosomes affect proteins or affect the structure and function of an organism? How do asexual reproduction and sexual reproduction affect the genetic variation of offspring? How does an offspring obtain traits from their parents? What is the purpose of a Punnett Square? How do we know when an organism (fossil) was alive? How are scientists able to identify the evolutionary relationship(s) among organisms? How can changes to the genetic code increase or decrease an individual's chances of survival? How can the environment affect natural selection? What is artificial selection? How can humans influence the inheritance of desired traits?

Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	

Evidence of Learning (Assessments)

Pre-Assessment
Ongoing formative assessments throughout the unit
Post-Assessment: Heredity & Biological Evolution Common Assessment
Selective Breeding Project

Objectives (SLO)

Students will know:	Students will be able to:
Complex and microscopic structures and systems, such as genes located on chromosomes, can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among the parts of the system; therefore, complex natural structures/systems can be analyzed to determine how they function. 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 affect the traits of the individual. In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations. Some changes to genetic material are beneficial, others harmful, and some neutral to the organism. Changes in genetic material may result in the production of different proteins. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. 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. Though rare, mutations may result in changes to the structure and function of proteins.	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. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information. Develop and use a model to describe why sexual reproduction results in offspring with genetic variation. Use 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. Use graphs, charts, and images to identify patterns within the fossil record. Analyze and interpret data within the fossil record to determine similarities and differences in findings. Make logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on Earth Apply scientific ideas to construct explanations for evolutionary relationships. Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of evolutionary relationships. Apply scientific ideas about evolutionary history to construct an explanation for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures

Organisms reproduce either sexually or asexually and transfer their genetic information to their offspring. Asexual reproduction results in offspring with identical genetic information. Sexual reproduction results in offspring with genetic variation. Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. 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. Punnett squares, diagrams, and simulations can be used to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation. The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record. Relative fossil dating is achieved by examining the fossil's relative position in sedimentary rock layers. Objects and events in the fossil record occur in consistent patterns that are understandable through measurement and observation. Patterns exist in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers. Patterns can occur within one species of organism or across many species. Similarities and differences exist in the gross anatomical structures of modern organisms. There are anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms. Similarities and differences exist in the gross anatomical structures of modern organisms and their fossil relatives.	Use diagrams or pictures to identify patterns in embryological development across multiple species. Analyze displays of pictorial data to identify where the embryological development is related linearly and where that linear nature ends Infer general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. Construct an explanation that includes probability statements regarding variables and proportional reasoning of how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. Use probability to describe some cause-and-effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment. Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time. Use mathematical representations to support conclusions about how natural selection may lead to increases and decreases of genetic traits in populations over time. Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) from multiple appropriate sources. Describe how information from publications about technologies and methods that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) used are supported or not supported by evidence. Assess the credibility, accuracy, and possible bias of publications and the methods they used when gathering information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection).

Similarities and differences in the gross anatomical structures of modern organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships. Science assumes that objects and events in evolutionary history occur in consistent patterns that are understandable through measurement and observation. Relationships between embryos of different species show similarities in their development. General patterns of relatedness among embryos of different organisms can be inferred by comparing the macroscopic appearance of diagrams or pictures. Pictorial data can be used to identify patterns of similarities in embryological development across multiple species. Similarities in embryological development across multiple species show relationships that are not evident in the fully formed organisms. Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment. Natural selection leads to the predominance of certain traits in a population and the suppression of others. Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability. Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions. The distribution of traits in a population changes. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Natural selection may have more than one cause, and some cause-and-effect relationships in natural selection can only be described using probability. Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding.	

In artificial selection, humans choose desirable, genetically determined traits to pass on to offspring. Phenomena, such as genetic outcomes in artificial selection, may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. Technologies have changed the way humans influence the inheritance of desired traits in organisms. Engineering advances have led to important discoveries in the field of selective breeding. Engineering advances in the field of selective breeding have led to the development of entire industries and engineered systems. Scientific discoveries have led to the development of entire industries and engineered systems.	

Suggested Resources/Technology Tools

Curriculum skeleton built upon NJDOE Model Curriculum for MS.
Resources for the course are teacher designed and based upon class needs, curriculum and aligned to standards. Framework resource for the curriculum is the STC system from Carolina for which the district owns:
Teacher Guides
Literacy Magazines
Laboratory Exploration Manuals
Carolina Science STC "Studying the Development and Reproduction of Organisms"
https://www.sustainablejerseyschools.com/resources/resource-library/climate-change-curriculum/
YouTube: Amoeba Sisters Biology Videos
Genetic Mutations Simulation
Layers of Time Fossil Game
Fossil Record Virtual Lab
Homologous, Analogous and Vestigial Structures
Embryonic Similarities Worksheet
Natural Selection Interactive
Natural Selection Virtual Lab
Newsela: Natural Selection Reading
Artificial Selection CER

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:
- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.

- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

MLL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow MLL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement

Visual warning system for lab emergencies

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

- ❏ Act as a responsible and contributing citizen and employee.
- ❏ Apply appropriate academic and technical skills.
- ❏ Attend to personal health and financial well being.
- ❏ Communicate clearly and effectively and with reason.
- ❏ Consider the environmental social and economic impacts of decisions.
- ❏ Demonstrate creativity and innovation.
- ❏ Employ valid and reliable research strategies.
- ❏ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❏ Model integrity, ethical leadership, and effective management.
- ❏ Plan education and career paths aligned to personal goals.
- ❏ Use technology to enhance productivity.
- ❏ Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

LINKS TO CAREERS:

Careers in Life Sciences-
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/agricultural-inspector
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/agricultural-technician
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/animal-breeder
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/animal-trainer
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/anthropologist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/athletic-trainer
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/biochemist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/biological-technician
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/biologist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/biology-teacher
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/marine-biologist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/microbiologist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/plant-scientist
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/science-manager
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/veterinarian
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/veterinary-technologist-technician
https://www.sciencebuddies.org/science-engineering-careers/life-sciences/zoologist-and-wildlife-biologist

Optional Extensions:
Meiosis: How Does the Process of Meiosis Reduce the Number of Chromosomes in Reproductive Cells?
Pedigrees and the Inheritance of Lactose Intolerance
    Student Guide and Answer Key
How do Siamese Cats Get Their Color?
    Student and Teacher Guide
NOVA: Judgement Day: Intelligent Design on Trial: Human Chromosome 2
The Day the Mesozoic Died
99.99% Antibacterial Products and Natural Selection
An Origin of Species: Pollenpeepers

Making Sense of Natural Selection
Color Variation over Time in Rock Pocket Mouse Populations
Catch Up on Tomato Technology