Science Curriculum Grade 6

This curricula and accompanying instructional materials have been developed to align with the NJSLS and in accordance with the NJ Department of Education's guidelines to include: Curriculum designed to meet grade level expectations, integrated accommodations and modifications for students with IEPs, 504s, ELLs, and gifted and talented students, assessments including benchmarks, formative, summative, and alternative assessments, a list of core instructional and supplemental materials, pacing guide, interdisciplinary connections, integration of 21st century skills, integration of technology, and integration of 21st Century Life and Career standards.

About the Standards

In 1996, the New Jersey State Board of Education adopted the state's first set of academic standards called the Core Curriculum Content Standards. The standards described what students should know and be able to do upon completion of a thirteen-year public school education. Over the last twenty years, New Jersey's academic standards have laid the foundation for local district curricula that is used by teachers in their daily lesson plans.

Revised every five years, the standards provide local school districts with clear and specific benchmarks for student achievement in nine content areas. Developed and reviewed by panels of teachers, administrators, parents, students, and representatives from higher education, business, and the community, the standards are influenced by national standards, research-based practice, and student needs. The standards define a "Thorough and Efficient Education" as guaranteed in 1875 by the New Jersey Constitution. Currently the standards are designed to prepare our students for college and careers by emphasizing high-level skills needed for tomorrow's world.

The New Jersey Student Learning Standards include Preschool Teaching and Learning Standards, as well as nine K-12 standards for the following content areas: **21st Century Life and Careers, Comprehensive Health and Physical Education, English Language Arts, Mathematics, Science, Social Studies, Technology, Visual and Performing Arts, World Languages**

The 2020 NJSLS in Science were adopted by the State Board of Education on June 3, 2020. Districts are required to implement by September 2022. The 2020 New Jersey Student Learning Standards webpage provides links to the 2020 NJSLS and information regarding curriculum implementation dates.

Cape May City Elementary School District Science Curriculum Science Pacing Guide
Content Area: Science Our elementary science program is founded upon the New Jersey Student Learning Standards for Science, which emphasizes three dimensions to promote scientific literacy for all student scientists. The core three dimensions of science learning, which are integrated into all science learning activities, are: **Science and Engineering Practices, Disciplinary Core Ideas, and Cross Cutting Concepts.** These three dimensions can also be thought of as, **"what scientists do," "what scientists need to know," and "common themes found throughout all science disciplines."**

<table>
<tr><td colspan="2">To implement these standards and corresponding dimensions, our district utilizes highly interactive and engaging activities. These dynamic activities are categorized into three main units of study. and present hands-on, real-world science experiences matched to the developmental level of students.

Three Main Units of Study:
1. Physical Science,
2. Earth & Space Science, and
3. Life Science</td></tr>
<tr><td>Course Title: Science</td><td>Grade Level: 6</td></tr>
<tr><td>Unit I:
MS-PS1-1-6: Matter and its Interactions
MS-PS4-1-3: Waves and Their Applications in Technologies for Information Transfer
Instructional Days: 20
In this unit of study, students will demonstrate a knowledge of:
● The Periodic Table of Elements
● properties of matter: density, conductivity, solubility, magnetic materials
● elements and compounds: physical and chemical changes
● atoms and molecules
● amplitude and energy of a wave
● light and mechanical waves: reflection, absorption, and transmission
● digital vs. analog signals
● Students are also expected to use these practices to demonstrate an understanding of the core ideas.
This unit is based on MS-PS1-1-6 and MS-PS4-1-3</td><td>Dates for Unit: September to November
<u>Pacing Guide: 20 days</u>
Week 1: Periodic Table of Elements
Week 2: Properties of Matter: density, conductivity, solubility, magnetic materials
Week 3: Elements and Compounds: physical and chemical changes
Week 4: Atoms and Molecules
Week 5: Amplitude and Energy of a Wave
Week 6: Light and Mechanical Waves: reflection, absorption, and transmission
Week 7: Digital vs. Analog Signals</td></tr>
<tr><td>Unit II:
MS-PS2-1-5: Motion and Stability: Forces and Interactions
MS-PS3-1-5: Energy
Instructional Days: 20
In this unit of study, students will demonstrate a knowledge of:
● Forces of Energy: describe motion, interactions, effects of forces, Newton’s Laws
● Non-contact Forces: gravity, electricity, magnetism, electromagnetism, affect of gravit and mass, drones
● Kinetic and Potential Energy: Rube Godlberg and chain reactions,forms of energy, measuring kinetic energy, potential energy in systems, energy conservation, transfer, and transformation
● Thermal Energy: Jack Rabbit Ears, deserts, Thermos tests, thermal heat energy, thermal properties of matter
● Students are also expected to use these practices to demonstrate an understanding of the core ideas.
This unit is based on MS-PS2-1-5 and MS-PS3-1-4</td><td>Dates for Unit: November to February
<u>Pacing Guide: 20 days</u>
Week 1: Forces of Energy: describe motion, interactions, effects of forces, Newton’s Laws
Week 2: Non-contact Forces: gravity, electricity, magnetism, electromagnetism, affect of gravit and mass, drones
Week 3: Kinetic and Potential Energy: Rube Godlberg and chain reactions,forms of energy, measuring kinetic energy, potential energy in systems, energy conservation, transfer, and transformation
Week 4: Thermal Energy: Jack Rabbit Ears, deserts, Thermos tests, thermal heat energy, thermal properties of matter</td></tr>
</table>

Unit III: **MS-LS1-1-8: From Molecules to Organisms: Structures and Processes** **MS-LS2-1-5: Ecosystems: Interactions, Energy, and Dynamics** **MS-LS3-1-2: Heredity: Inheritance and Variation of Traits** **MS-LS4-1-6: Biological Evolution: Unity and Diversity** **Instructional Days: 20** *In this unit students will demonstrate a knowledge of:* ● Traits for Survival & Reproduction: transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal ● Fossils: patterns, paleontologists, ● Natural Selection: Darwin's Theory, adaptations ● Artificial Selection: social considerations, bioethics ● Cells & Genetics: tissues, organs, nucleus, chloroplasts, mitochondria, genetic variation, Punnett Squares, cause and effect of gene transmission ● Traits for Survival & Reproduction: transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal, changing conditions-(food, light, space, weather) ● Body Systems: digestive, respiratory, muscle, nervous, circulatory, excretory, system function, interactions, coordination, memory, sensory receptors ● Ecosystems: interactions-(competitive,predatory, mutually beneficial), cycles, changes, the Sun, flow of energy & matter, biodiversity, human interactions, solutions to problems ● Students are also expected to use these practices to demonstrate an understanding of the core ideas. This unit is based on MS-LS1-1-8, MS-LS2-1-5, MS-LS3-1-2, MS-LS4-1-6	**Dates for Unit: February to March** **<u>Pacing Guide: 20 days</u>** Week 1: **Traits for Survival & Reproduction:** transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal Week 2: **Fossils:** patterns, paleontologists, Week 3: **Natural Selection:** Darwin's Theory, adaptations Week 4: **Artificial Selection:** social considerations, bioethics Week 5:**Cells & Genetics:** tissues, organs, nucleus, chloroplasts, mitochondria, genetic variation, Punnett Squares, cause and effect of gene transmission Week 6: **Traits for Survival & Reproduction:** transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal, changing conditions-(food, light, space, weather) Week 7: **Body Systems:** digestive, respiratory, muscle, nervous, circulatory, excretory, system function, interactions, coordination, memory, sensory receptors Week 8: **Ecosystems:** interactions-(competitive,predatory, mutually beneficial), cycles, changes, the Sun, flow of energy & matter, biodiversity, human interactions, solutions to problems
Unit IV: **MS-ESS1-1-4: Earth's Place in the Universe** **MS-ESS2-1-6: Earth's Systems** **MS-ESS3-1-5: Earth and Human Activity** **Instructional Days: 20** *In this unit of study, students will develop an understanding of:* ● Earth's Place: tectonic plates, rock cycle, water cycle, natural resources, natural hazards, atmosphere, human activity ● Earth's Systems: Earth, Sun, Moon Systems, Earth's rotation, axis, moon, and eclipses, The Solar System, gravity, inner solar system, outer solar system ● Weather: air pressure, air masses, wind, temperature, forecasts, severe weather events ● Climate: patterns, global circulation, oceans and climate, mountain climates, microclimate, climate history,threats from climate change ● Students are also expected to use these practices to demonstrate an understanding of the core ideas.	**Dates for Unit: March to May** **<u>Pacing Guide: 20 days</u>** Week 1: **Earth's Place:** tectonic plates, rock cycle, water cycle, natural resources, natural hazards, atmosphere, human activity Week 2: **Earth's Systems 1:** Earth, Sun, Moon Systems, Earth's rotation, axis, moon, and eclipses, The Solar System, gravity, inner solar system, outer solar system Week 3: **Earth's Systems 2:** Earth, Sun, Moon Systems, Earth's rotation, axis, moon, and eclipses, The Solar System, gravity, inner solar system, outer solar system Week 4: **Weather:** air pressure, air masses, wind, temperature, forecasts, severe weather events Week 5: **Climate:** patterns, global circulation, oceans and climate, mountain climates, microclimate, climate history, threats from climate change

This unit is based on MS-ESS1-1-4, MS-ESS2-1-6, and MS-ESS3-1-5	
Unit V: **MS-ETS1: Engineering Design** **Instructional Days: 10** *In this unit of study, students will develop an understanding of:* ● defining a simple design problem reflecting a need or a want that includes specified criteria. ● comparing multiple possible solutions to a problem based on how well each is likely to meet the criteria of solving the problem. ● planning and carry out fair tests to identify aspects of a model or prototype that can be improved. ● The crosscutting concepts of how people's needs and wants change over time, as do their demands for new and improved technologies, and how engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands are called out as organizing concepts for the disciplinary core ideas of defining and delimiting engineering problems, as well as developing and optimizing possible solutions. ● Students are also expected to use these practices to demonstrate an understanding of the core ideas. This unit is based on MS-ETS1.	**Dates for Unit: May to June** **<u>Pacing Guide: 10 days</u>** Week 1: **Engineering Project Research-**define a problem, collaborate, discuss, specify criteria to be met Week 2: **Prototype Trials-** recording data, measurement of speed, distance, and time in flight for balloon car improvements and final design choice Week 3: **Final Design Competition-**teams will compete with their final designs, and compare results, materials used, and how the research and design process helped them to create a final design. **The engineering example provided in this unit utilizes balloon cars, but the engineering process could be used to develop any type of simple design that works to solve a simple problem. Feel free to choose what works for your class.**
Date Created:	**Board Approved On:** 8/18/22

Note: The number of instructional days is an estimate based on the information available at this time. 1 day equals approximately 42 minutes of seat time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.

Cape May City Elementary School District Grade Grade 6 Science Curriculum **Unit I Overview**
Content Area: Science
Unit Title: Unit I **MS-PS1-1-6: Matter and its Interactions** **MS-PS4-1-3: Waves and Their Applications in Technologies for Information Transfer**
Target Course/Grade Level: 6
Unit Summary: Learning Goal *In this unit of study, students will demonstrate a knowledge of:* ● The Periodic Table of Elements ● properties of matter: density, conductivity, solubility, magnetic materials ● elements and compounds: physical and chemical changes ● atoms and molecules ● amplitude and energy of a wave ● light and mechanical waves: reflection, absorption, and transmission ● digital vs. analog signals

Interdisciplinary Connections:

- Science, Technology, English / Language Arts, Health, Social Emotional Learning, Mathematics, Social Studies

Career Readiness: Life Literacies and Key Skills Standards:

- Career Readiness, Life Literacies and Key Skills
  - These include critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, and interpersonal communication and science.
  - Incorporation of relevant technologies as tools as part of instruction (i.e. Chromebooks, Touch screen devices, manipulatives, certified assistive technologies for students with special needs, etc.)
  - Developing effective communication
  - Developing Independent Learning Strategies
  - Incorporating Science, Technology, Engineering, and Mathematical themes into daily lesson

Learning Targets:

MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

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 gasses 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.]

MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

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.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

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.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

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.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]	
Unit Activity	**Suggested Learning Activities**
I.	**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 not supported by evidence. (MS-PS1-3) 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 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 (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) **DCI: PS4.A:** 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) 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. (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) Wave Properties A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.

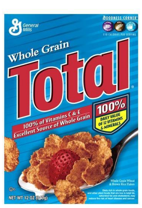
(MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2) PS4.B: Electromagnetic Radiation When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) The path 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)


Lesson Plan Activity #1:

<u>Bouncing Bubbles!</u>

Preview Video: **[Steve Spangler Bubble Science]**

Materials: Water, plain Dawn dish soap, inexpensive cotton gloves, bubble wand or modified pipette, glycerin or Karo Corn Syrup
Objective: Students will witness a liquid change to a solid, and that evaporation is what causes a bubble to pop on your skin, but a gloved hand will protect the bubble from oil and dirt that would cause the bubble to break. They will also learn about reflection and refraction of light waves from a bubble.
Directions: Make the bubble solution. First blow bubbles and let them touch the students hands. Then have each student put on a glove and catch a bubble. The bubble should bounce in their gloved hand. Explain how it works through a discussion of the video and the information below.
How it Works: A bouncing bubble is amazing because most people have never seen a bubble bounce, much less be the person who actually does the bouncing!
Experience shows that bubbles usually burst when they come in contact with just about anything. Why? A bubble's worst enemies are oil, dirt, and gravity.
A "super" bubble will bounce off of a surface if the surface is free of oil or dirt particles that would normally cause a break in the thin soap film of the bubble.
The problem with gravity and evaporation is that the water film gets very thin (down to a millionth of an inch) on the top surface as time passes. It finally gets too thin to hold onto itself and the wall collapses completely.
Similar to the way we perceive the colors in a rainbow or an oil slick, we see the colors in a bubble through the reflection and the refraction of light waves off the inner and outer surfaces of the bubble wall.
You can't color a bubble since its wall is only a few millionths of an inch thick. A bubble reflects color from its surroundings.
Follow Up: Students will write a journal entry about the experience.



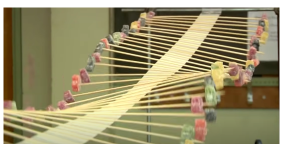
Lesson Plan Activity #2:

<u>Extracting Iron From Cereal!</u>

[Preview Information to Engage Students]

[Preview Video]

Materials:

	1 Box of Total Cereal 1 Strong Ziploc Bag 1 Cup of Warm Water 1 Strong Neodymium Magnet **Directions:** - Pour Total cereal into the bag until it is almost full. - Zip the bag and crush the cereal with your hands. - Fill the bag halfway with warm water, close it and mix it for 10 seconds. - Let the bag sit for 1 hour to soak. - Mix the bag again for 1 min while mushing the cereal. - Place the magnet under the bag and swirl the bag to collect the iron. **How it Works:** Everything around us is made of atoms and molecules. An atom is the basic unit of an element. It consists of protons, neutrons and electrons. Atoms can combine to form molecules as simple as water or as complex as DNA. Our bodies need elements that are naturally found in the foods we eat, but sometimes we need to supplement our diets with extra elements. One of the elements our body needs is iron. Iron is commonly found in beans, spinach and in cereals such as Total. We need iron to help us absorb oxygen into our blood. The iron will be attracted to the magnet. **Follow Up:** Students will write a journal entry about the activity.  **Lesson Plan Activity #3:** **Gummy Candy Wave Machine!** **Preview Video:** Wave Machine **Materials:** Strong masking tape, Large gummy bears or jelly candies, 20 or more wooden kabob sticks, clamps or something sturdy to attached the tape **Objective:** Students should learn that the wave machine demonstrates transverse wave motion and it demonstrates how light waves change when moving through different media such as glass and air. **Directions:** You can make one machine as a whole group or teams of students could each make a machine. Stretch a long piece of tape from one end to another of a a clamp or something sturdy. Lay wooden kabob sticks with gummies attached on each end, about 5 cm apart on the tape. Follow the directions from the video to complete the activity. Discuss students findings before doing the journal write to clear up any questions students might have about the activity. **Follow Up:** Students will write a journal entry about the activity.
Gifted and Talented: Enrichment Links and Writing Prompts	

Links:
The Interactive Periodic Table
Science Max-Big Magnets
Arrangement of Particles in Solids, Liquids, and Gasses
Science Max-Matter
Changes of Matter
Changing Water-Atoms and Molecules
DK Salt Water Density Experiment
Read About Atoms and Molecules!
DK Science Elements
Drawing on Water
Investigating Water Transformations
How Does Water Vapor Turn Into a Liquid?
Intro to Waves
Traveling Waves
Sound Waves-Star Wars Example
Digital vs. Analog Signals-Inputs and Outputs
Energy and Frequency of the Wave
Science Sauce-Wavelength, Frequency, and Amplitude

Writing Prompts:

Draw or write sentences to finish the prompts.
"What do you know about The Periodic Table?"
"What do you know about solubility?"
"What is density?"
"What is conductivity?"
"Describe magnetism, with examples."
"What do you know about elements and compounds?"
"Give an example of a physical and chemical change."
"Tell about atoms and molecules."
"How is amplitude related to the energy of a wave?"
"Define reflection, absorption, and transmission of light and mechanical waves."
"Name some waves that can be used for communication purposes."

At-Risk, Including ELL: Resources to Enhance Understanding

Books: Picture-Perfect Science Lessons Using Children's Books to Guide Inquiry, 3-Grade 6, Karen Ansberry and Emily Morgan. NSTA Press, What is Matter?, Don L. Corey, I Can Change Matter, Frances Spencer, Matter Matters, by Super Science, Matter and Change, School Specialty/Delta, The Phases of Matter, Speedy, Motion and Matter, Foss, Experiments with States of Matter, Discover Books, The Nature of Matter, Debra J. Housel, States of Matter, Matt Mullins, Awesome Physics Experiments for Kids: 40 Fun Science Projects and Why They Work (Awesome STEAM Activities for Kids) Part of: Awesome STEAM Activities for Kids (9 Books) | by Erica l. Colón PhD, Mark Twain - Interactive Notebook: Physical Science, Grades 5 - 8, by Schyrlet Cameron and Carolyn Craig, Energy (A True Book: Physical Science, by Jacob Batchelor
Links:

Physical and Chemical Changes
Chemical Changes Fast and Slow
Denser Than You Think
Condensation
Periodic Table Video for Kids
Wave Properties with Dr. Jeff

Cape May City Elementary School District Grade Grade 6 Science Curriculum Unit II Overview
Content Area: Science
Unit Title: Unit II **MS-PS2-1-5: Motion and Stability: Forces and Interactions** **MS-PS3-1-5: Energy**
Target Course/Grade Level: 6
Unit Summary: Learning Goal *In this unit of study, students will demonstrate a knowledge of:* ● Forces of Energy: describe motion, interactions, effects of forces, Newton's Laws ● Non-contact Forces: gravity, electricity, magnetism, electromagnetism, affect of gravit and mass, drones ● Kinetic and Potential Energy: Rube Godlberg and chain reactions,forms of energy, measuring kinetic energy, potential energy in systems, energy conservation, transfer, and transformation ● Thermal Energy: Jack Rabbit Ears, deserts, Thermos tests, thermal heat energy, thermal properties of matter
Interdisciplinary Connections: ● Science, Technology, English / Language Arts, Health, Social Emotional Learning, Mathematics, Social Studies
Career Readiness: Life Literacies and Key Skills Standards: ● Career Readiness, Life Literacies and Key Skills ● These include critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, and interpersonal communication and science. ● Incorporation of relevant technologies as tools as part of instruction (i.e. Chromebooks, Touch screen devices, manipulatives, certified assistive technologies for students with special needs, etc.) ● Developing effective communication ● Developing Independent Learning Strategies ● Incorporating Science, Technology, Engineering, and Mathematical themes into daily lessons
Learning Targets: **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.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.] **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.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.] **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.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.] **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.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

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.] [Assessment Boundary: Assessment is limited to electric and magnetic fields and limited to qualitative evidence for the existence of fields.] **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.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.] **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.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] **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.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] **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.] [Assessment Boundary: Assessment does not include calculations of energy.]

Unit Activity	**Suggested Learning Activities**
II.	**Science and Engineering Practices:** Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models. Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds from grades K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1) Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds from grades K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

	Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. (MS-PS3-2) Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) **DCI:** 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). (MS-PS2-1) The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) 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. (MS-PS2-2) 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. (MS-PS2-3) Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) 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). (MS-PS2-5)

	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. (MS-PS3-1) A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3), (MS-PS3-4) 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. (MS-PS3-5) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) 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. (MS-PS3-2) ETS1.A: Defining and Delimiting an Engineering Problem The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3) ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3) **Crosscutting Concepts:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3), (MS-PS2-5) 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. (MS-PS2-1), (MS-PS2-4), 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. (MS-PS2-2) 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-PS2-2), (MS-PS2-4) Scale, Proportion, and Quantity Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1), (MS-PS3-4) 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. (MS-PS3-2) Energy and Matter Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5) The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3) 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-PS3-4), (MS-PS3-5)

 **Lesson Plan Activity:**

<u>Rube Goldberg Machine!</u>

Background Knowledge: Rube Goldberg (1883-1970) was a Pulitzer Prize winning cartoonist best known for his zany invention cartoons. He was born in San Francisco on the 4th of July, 1883 – and graduated from U. Cal Berkeley with a degree in engineering. His first job at the San Francisco Chronicle led to early success, but it wasn't until he moved to NYC and began working for Hearst publications that he became a household name. Rube Goldberg is the only person ever to be listed in the Merriam Webster Dictionary as an adjective. It's estimated that he did a staggering 50,000 cartoons in his lifetime. For videos about Rube: https://www.rubegoldberg.com/about/. A Rube Goldberg Machine is "a comically involved, complicated invention, laboriously contrived to preform a simple operation" (Webster's New World Dictionary). Humor and a narrative are what separate a Rube Goldberg machine from a chain-reaction machine. Each of Rube's cartoon's told a story and his entire goal was to get you to laugh. Rube Goldberg, Inc. is dedicated to keeping laughter and invention alive through the legacy of its namesake. Annual competitions, image licensing, merchandising, and museum and entertainment opportunities continue to grow and enhance the brand. At the helm is Rube's granddaughter, Jennifer George, with her recent book, The Art of Rube Goldberg.

Preview Video: Science Max-Rube Goldberg Machine Video

Students will need to discuss the following: • What is a Rube Goldberg Machine? • What are the six simple machines? • How do machines multiply force without multiplying work? • What is an energy transfer? • What are the different types of energy? • What is mechanical energy?

Materials: Brainstorm a list of items the students might like to use. They can also bring items from home.

- **You can do this activity in teams or just build one Rube Goldberg machine for the class, with each student participating in the construction.**

Directions:
1. Review history of Pulitzer Prize winning cartoons by Rube Goldberg,
2. Review simple machines with class. Have students brainstorm ways to connect simple machines to make compound machines.
3. Set parameters for each step, what "counts" as a step, such as an energy transfer, plus size allotment for each machine (a table top or a few desks pushed together is recommended for each group of students).
4. Break students into groups of 2-4 each. Give them assignments to be in charge of different parts of the machine.
5. Decide how long they will have to build their machine.
6. Have students build a 5-10 step Rube Goldberg machine. The teacher may assign materials from the Trunk or let students choose.
7. After the allotted period of time, each team of students should "run" their machine to see if it works for the rest of the class.

How it Works: It's all about changing potential and kinetic energy, as well as, energy transfer through chain reactions. Students will understand the basic idea of simple machines.

Follow Up: Students will write and draw pictures of what they learned from the Rube Goldberg Machine activity.

Gifted and Talented: Enrichment Links and Writing Prompts
Links: Newton's Third Law and Bumper Cars How do drones fly? Magnetic Slime Lift water with an Archemedies' Screw Investigate pulleys with Lego Blocks Build an electromagnet Lego slingshot car building Fire and Ice Show-Science World Series and Parallel Circuits with Paul Andersen Energy Transfer in a Trebuchet **Writing Prompts:** Draw or write sentences to finish the prompts. "Tell about Newton's Third Law and bumper cars?" "What is Newton's Law of Universal Gravitation?" "Who was Rube Goldberg?" "Is Earth's mass greater than any object on the face of the Earth?" If so, what is the effect on our earth?" "What can change an object's motion?" "What is kinetic energy?" "What is potential energy? "Describe motion, it's interactions and the effects of different forces. "Make an outline of Newton's Laws." "Define mass, speed, velocity, force, and acceleration." "How does a drone work?" "How do gravity and mass affect the drone's flight?" "Describe the transfers and transformation of energy in a Rube Goldberg Machine." "How do Jack Rabbit Ears help them to survive in a deserts?" "What is the thermal property of matter?" "Why are deserts hot in the daytime, and cold at night?" "What would be the materials to use for a thermos that would work in the desert, and why?"
At-Risk, Including ELL: Resources to Enhance Understanding
Books: Awesome Physics Experiments for Kids: 40 Fun Science Projects and Why They Work (Awesome STEAM Activities for Kids) Part of: Awesome STEAM Activities for Kids (9 Books) | by Erica l. Colón PhD, Mark Twain - Interactive Notebook: Physical Science, Grades 5 - 8, by Schyrlet Cameron and Carolyn Craig, Energy (A True Book: Physical Science, by Jacob Batchelor, Crazy Contraptions: Build Rube Goldberg Machines that Swoop, Spin, Stack, and Swivel: with Hands-On Engineering Activities (Build It Yourself) Paperback, by Laura Perdew (Author), Micah Rauch (Illustrator), The Art of Rube Goldberg: (A) Inventive (B) Cartoon (C) Genius Hardcover, by Jennifer George (Compiler), Rube Goldberg (Illustrator), Geoff Spear (Photographer), Just Like Rube Goldberg: The Incredible True Story of the Man Behind the Machines, by Sarah Aronson (Author), Robert Neubecker (Illustrator) **Video Links:** Transfer of Energy Marble Activity Static Electricity Experiments Magnetic Canon FunScienceDemos-Series and Parallel Circuits The Trash Machine When Life Gives You Lemons! Rube Goldberg Lego Machine

Cape May City Elementary School District Grade Grade 6 Science Curriculum

Unit III Overview

Content Area: Science
Unit Title: Unit III **MS-LS1-1-8: From Molecules to Organisms: Structures and Processes** **MS-LS2-1-5: Ecosystems: Interactions, Energy, and Dynamics** **MS-LS3-1-2: Heredity: Inheritance and Variation of Traits** **MS-LS4-1-6: Biological Evolution: Unity and Diversity**
Target Course/Grade Level: 6
Unit Summary: Learning Goal *In this unit of study students will develop an understanding of:* ● Traits for Survival & Reproduction: transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal ● Fossils: patterns, paleontologists, ● Natural Selection: Darwin's Theory, adaptations ● Artificial Selection: social considerations, bioethics ● Cells & Genetics: tissues, organs, nucleus, chloroplasts, mitochondria, genetic variation, Punnett Squares, cause and effect of gene transmission ● Traits for Survival & Reproduction: transfer of pollen, germination, photosynthesis, abundant and scarce resources, seed dispersal, changing conditions-(food, light, space, weather) ● Body Systems: digestive, respiratory, muscle, nervous, circulatory, excretory, system function, interactions, coordination, memory, sensory receptors ● Ecosystems: interactions-(competitive,predatory, mutually beneficial), cycles, changes, the Sun, flow of energy & matter, biodiversity, human interactions, solutions to problems
Interdisciplinary Connections: ● Science, Technology, English / Language Arts, Health, Social Emotional Learning, Mathematics, Social Studies
Career Readiness: Life Literacies and Key Skills Standards: ● Career Readiness, Life Literacies and Key Skills ● These include critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, and interpersonal communication and science. ● Incorporation of relevant technologies as tools as part of instruction (i.e. Chromebooks, Touch screen devices, manipulatives, certified assistive technologies for students with special needs, etc.) ● Developing effective communication ● Developing Independent Learning Strategies ● Incorporating Science, Technology, Engineering, and Mathematical themes into daily lessons

Learning Targets:
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.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]
MS-LS1-4 Use arguments 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.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]
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.] New Jersey Department of Education December 2020 Page 114 of 200 Grades 6 through 8: Life Science [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]
MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]
MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]
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-LS2-2 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-LS2-3 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.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

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.] **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.] **MS-LS3-1** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.] **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-LS4-1** 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.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.] **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.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.] **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-LS4-5** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these **scientific discoveries.]** **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.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.	
Unit Activity	**Suggested Learning Activities**

III.	**Science and Engineering Practices:** Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-LS1-2) Develop a model to describe unobservable mechanisms. (MS-LS1-7) Planning and Carrying Out Investigations Planning and carrying out investigations in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5), (MS-LS1-6) Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) 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. (MS-LS1-4) Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.(MS-LS1-8) Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe phenomena. (MS-LS2-3) Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4) Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5) Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2

	DCI: 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). (MS-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) LS1.B: Growth and Development of Organisms Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) 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. (MS-LS1-6) Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) 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. (MS-LS1-8) PS3.D: Energy in Chemical Processes and Everyday Life The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1- 7) 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. (MS-LS2-1) In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) 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. (MS-LS2-3) 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. (MS-LS2-4) Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) 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. (secondary to MS-LS2-5) 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. (secondary to MS-LS2-5)

	LS1.B: Growth and Development of Organisms Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MSLS3-2) 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. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) 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. (MS-LS3-1) 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. (MS-LS3-2) In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1) **Crosscutting Concepts:** Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4), (MS-LS1-5) Scale, Proportion, and Quantity Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) Systems and System Models Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. (MS-LS1-3) Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7) Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6) 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. (MS-LS1-2) 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-LS1-1) Connections to Nature of Science Science is a Human Endeavor Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3) Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6) Patterns can be used to identify cause and effect relationships. (MS-LS2-2) Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) Energy and Matter The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) Stability and Change Small changes in one part of a system might cause large changes in another part. (MS-LS2-4), (MS-LS2-5) Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. (MS-LS2-5) Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3) Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5) Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

	Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) 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. (MS-LS3-1)  **Lesson Plan Activity:** **Reef Builders and Limestone Formation!** **Materials:** Print out the cards and pictures from these links. Then watch the video before the activity. **Cards the students will using during the activity.** **Fossils that can be found in Wind Cave** **Background Video of Wind Cave National Park in South Dakota:** **Lesson Plan Credit: National Park South Dakota** **Background:** Thanks to its layers of limestone, experts predict Wind Cave dates back to the Mississippian period, making it 358.9 to 323.2 million years old. During the Mississippian Period, most of the United States was under large, shallow sea (Rheic Ocean). Since North America was in a very different location at this time, the sea was also tropical as the equator ran through this area. On this reef lived a variety of sea dwelling organisms. Swimming amongst the reef was a number of vertebrates including sharks and various fish. But most of the organisms living on the reef were invertebrates. The shells of many of these invertebrates formed the limestone that Wind Cave is in. Probably the most plentiful fossils in the cave are brachiopods. Brachiopods are small shelled creatures that resemble modern day clams but are actually unrelated. These were one of the most numerous reef-building organisms during the Mississippian Period. Bryozoans were plentiful at this point. These are aquatic, colonial organisms that were frequently calcareous, composed of calcium carbonate. Bryozoans are found in tidal areas and most commonly encrust surfaces such as coral, seashells, or kelp. Along with calcium carbonate producing algae and some corals, they form a large part of the limestone layer that Wind Cave exists in. Mollusks and specifically gastropods (snails) are found as fossils in Wind Cave. Gastropods would glide along on a wide flat foot and feed of the abundant algae during the Mississippian Period. Cephalopods are a class of animals in the mollusk phylum as well. They include octopus, squids, and nautilus. During the Mississippian Period this class was represented by ammonites. Echinodermata is a diverse phylum of organisms including starfish, sea urchins and sand dollars. But in the reef that formed the limestone the crinoids were the most common. These creatures are sometimes called “sea lilies” for the appearance (somewhat similar to flowers). Their stem parts are occassionally found as fossils but the rest of the skeletal remains tended to disintegrate and scatter upon death. But they were so numerous they formed a significant amount of limestone. **Directions:** Introduce the fact that limestone is made from the shells and skeletal remains of ancient animals.

	1. Give an attached PowerPoint presentation introducing the variety of fossils that are in Wind Cave. **Activity:** 2. Tell students that they are going to use their knowledge of reef-building organisms from the Mississippian Period in a game. Have students form into groups of three or four. 3. Hand out a complete set of the Reef Builder cards, face down, to each group of students and instruct them not to look at the cards before being told to do so. 4. Explain that each card lists four characteristics of a reef-building organism from the Mississippian Period. They will try to guess what the organism is while being given the clues. 5. The person initially given the cards will read a clue, one at a time in order, until someone in the group guesses the organism or until all clues are used without a successful guess. 6. Students will read the clues while others in the group attempt to guess the name of the organism. Points are given for successful answers as shown below. The student who successfully answers will be the reader for the next card. ○ One clue - 4 points ○ Two clues - 3 points ○ Three clues - 2 points ○ Four clues - 1 point The game continues until all of the cards have been read. For those students with the highest score, or who score more than a predetermined number of points could get some type of reward. **Discussion Questions:** 1. Discuss what might happen to the reef if any of the environmental conditions changed (change in water temperature, sea level, available oxygen, etc.). Have students theorize about what might have brought about the eventual end of growth on the reef. 2. Discuss current reefs, the Great Barrier Reef is an example, and any conditions that may be threatening their growth (ocean warming, acidification, sea level changes, other organisms that feed on reef builders, etc.). Have students describe how studying ancient environments can help us better understand our Earth today. **Follow Up:** Students can write thoughts about the lesson in their journal.

Gifted and Talented: Enrichment Links and Writing Prompts

Links:
Fossils Tell a Story
Fossils and Paleontology
Punnett Squares
Short Simple Science Food Chains and Webs
Study Jams Food Chains and Webs
Food Webs
How the Sun Heats the Earth-Fusion
Environmental Studies Consumers, Producers, Decomposers
The Earth as a System
Energy and the Earth
DK Earth-Human Impact
Conservation of Energy and Energy Transfer with Paul Andersen
Newton’s Cradle with Paul Andersen
Make Your Own Wet or Dry Terrarium
Flow of Matter and Energy in Ecosystems Read & Quiz
Estuary Energy Flow
Fun Science Demos-Multiple Science Subjects
Writing Prompts:
Draw or write sentences to finish the prompts.

“What do you know about traits for survival and reproduction?”
“Describe the transfer of pollen.”
“Discuss germination, photosynthesis, abundant/scarce resources, and seed dispersal.”
Tell something you know about fossils: patterns, and paleontologists.”
“Define Natural Selection, and adaptations of organisms.”
“What are the social and bioethical components of Artificial Selection?”
“Define tissues, organs, nucleus, chloroplasts, mitochondria, genetic variation,”
“What is a Punnett Square?”
“What is the cause and effect of gene transmission?
“How do changing conditions-(food, light, space, weather) affect an ecosystem?”
“Draw a picture of the Body Systems: digestive, respiratory, muscle, nervous, circulatory, excretory.”
“What body system handles coordination and memory problems?”
“What do you know about sensory receptors and memories?”
“Discuss competitive,predatory, mutually beneficial interactions in an ecosystem.”
“Draw a chart to show the flow of energy & matter in an ecosystem.
“How do biodiversity and human interactions affect an ecosystem?”
“Brainstorm some solutions to ecosystem problems in your area.”

At-Risk, Including ELL: Resources to Enhance Understanding

Books: Who Eats What?: Food Chains and Food Webs (Let's-Read-and-Find-Out Science 2), by Patricia Lauber, Staying Alive, The Story of a Food Chain, by Jaqui Bailey and Matthew Lilly, Food Webs and Food Chains, Southern Fried Teacher, National Geographic Kids Readers: Animal Homes by Shira Evans, Books for Kids, Habitats Link, Animal Life Cycles, by Joseph Midthun and Samuel Hiti, National Geographic Readers: Seed to Plant Paperback ,by Kristin Rattini

Video Links:
Food Webs
Food Chains as Told by the Lion King
Free School-Food Chains
Explanation of Food Chains and Webs
50 Year old sealed ecosphere
Farming Fish with Vegetables
Air Plants - No Soil Needed
Algae Fuel and Food
Why Do Sunflowers Follow the Sun?
The Ecosystem Song
Videos from Wind Cave National Park

Cape May City Elementary School District Grade Grade 6 Science Curriculum

Unit IV Overview

Content Area: Science

Unit Title: Unit IV
MS-ESS1-1-4: Earth’s Place in the Universe
MS-ESS2-1-6: Earth’s Systems
MS-ESS3-1-5: Earth and Human Activity

Target Course/Grade Level: 6

Unit Summary: Learning Goal
In this unit of study, students will develop an understanding of:

- Earth’s Place: tectonic plates, rock cycle, water cycle, natural resources, natural hazards, atmosphere, human activity
- Earth’s Systems: Earth, Sun, Moon Systems, Earth’s rotation, axis, moon, and eclipses, The Solar System, gravity, inner solar system, outer solar system

- Weather: air pressure, air masses, wind, temperature, forecasts, severe weather events
- Climate: patterns, global circulation, oceans and climate, mountain climates, microclimate, climate history,threats from climate change

Interdisciplinary Connections:

- Science, Technology, English / Language Arts, Health, Social Emotional Learning, Mathematics, Social Studies

Career Readiness: Life Literacies and Key Skills Standards:

- [Career Readiness, Life Literacies and Key Skills]
  - These include critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, and interpersonal communication and science.
  - Incorporation of relevant technologies as tools as part of instruction (i.e. Chromebooks, Touch screen devices, manipulatives, certified assistive technologies for students with special needs, etc.)
  - Developing effective communication
  - Developing Independent Learning Strategies
  - Incorporating Science, Technology, Engineering, and Mathematical themes into daily lessons

Learning Targets:

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).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

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.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

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).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

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.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.] **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.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.] **MS-ESS3-1** Constructs 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 nonrenewable, 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) **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.] **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 gasses 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.]

Unit Activity	**Suggested Learning Activities**
IV.	**Science and Engineering Practices:** Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-ESS1- 1), (MS-ESS1-2) Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)

	Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-ESS2-1), (MS-ESS2-6) Develop a model to describe unobservable mechanisms. (MS-ESS2-4) Planning and Carrying Out Investigations Planning and carrying out investigations in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5) Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2 Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models. Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5) Analyzing and Interpreting Data Analyzing data 6–8 builds on grades 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-ESS3-2) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on grades K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on grades K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4) **DCI:** 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. (MS-ESS1-1) Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) 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. (MS-ESS1-2), (MS ESS1-3) This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) 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. (MS-ESS1-4)

	ESS1.C: The History of Planet Earth Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) 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. (MS-ESS2-1) The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) ESS2.B: Plate Tectonics and LargeScale 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. (MS-ESS2-3) 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. (MS-ESS2-4) 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. (MS-ESS2-5) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2) 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. (MS ESS2-6) Because these patterns are so complex, weather can only be predicted probabilistically. (MS ESS2-5) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) 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. (MS-ESS3-1) 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. (MS-ESS3-2) 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. (MS-ESS3-3) 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. (MS-ESS3-3), (MS-ESS3-4) ESS3.D: Global Climate Change Human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5) **Crosscutting Concepts:** Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) 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-ESS1-3), (MS ESS1-4)Systems and System Models Models can be used to represent systems and their interactions. (MS-ESS1-2) 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-ESS1-3) Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1), (MS-ESS1-2) Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) 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-ESS2-2) 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. (MS-ESS2-6) Energy and Matter Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4) 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. (MS-ESS2-1) Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)

Patterns, Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2) Cause and Effect Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3) Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1), (MS-ESS3-4) Stability and Change Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5) Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1), (MS-ESS3-4) The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. (MS-ESS3-2), (MS-ESS3-3) Connections to Nature of Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-ESS3-4)

**Lesson Plan Activity:**

<u>Egg in a Bottle-Air Pressure Lesson!</u>

Preview Video: Egg in a Bottle

Materials: small glass bottle with a wide mouth, larger glass bottle with a wide mouth, a regular plastic water bottle, 3 or 4 hard boiled eggs without the shell, newspaper strips, safety googles, matches, birthday candles

Directions: This should be done as a teacher demonstration lesson.- Please follow multiple steps as described in the Preview Video to get the best results.

Make sure that you cool the eggs before proceeding.
Now, take the newspaper and tear one page into strips. Insert the strips of newspaper into the bottle, and use your match to light it. Drop the lit matchsticks into the bottle so it burns the newspaper strips inside. Quickly take the egg and place it in front of the opening of the bottle. Watch what happens!

To take it out? Put your mouth on the bottle opening and blow air into the mouth of the bottle. Be aware that the egg will pop right out of the bottle again when you do this!

How Does it Work:
Amazing huh? You just managed to insert a hard-boiled egg into a bottle with a narrower opening and you were even able to take it back out without destroying it! How is this possible? Air pressure is the answer! The experiment just showed you the behavior of air pressure.
In this Egg in a Bottle experiment, after setting the newspapers on fire with the use of the lit matchsticks, the oxygen in the bottle is used up. When you placed the egg in front of the opening, the air inside created a vacuum sucking the egg into the bottle.

The burning newspapers heats the air trapped inside the bottle causing it to expand. After a short while, the fire inside the bottle dies, thus causing the air inside to cool down then resulting in a lower pressure inside the bottle. The egg is forced into the bottle because there is a lower pressure inside, and a greater pressure outside the bottle.

Now, after turning the bottle upside down and blowing air into the bottle, the air pressure inside the bottle increases then pushes the egg back out its opening while at the same time keeping it intact!

Follow Up: Students will write a journal entry about the activity.

Gifted and Talented: Enrichment Links and Writing Prompts
Links: Physical Geography: Distribution of Water How Does the Water Cycle Work? Experiment for Water Distribution National Geographic-Water Worlds-Multiple Articles Pattern Recognition-Paul Andersen Make Sun S'mores Earth, Moon, and Sun Facts World of Change-Earth Observatory NASA Earth Observatory Glossary Strangest Planets 10 Weird Facts About Earth 10 Strangest Things in the Solar System About Stars Game and Information-NASA Sirius-The Brightest Star in the Night NASA Spaceplace-Multiple Video Links NOAA SciJinks NASA Armstrong Flight Research Center Hubble and the Farthest Star Climate Kids-Multiple Questions and Answers Information about the Geosphere, Biosphere, Hydrosphere, and Atmosphere Total Solar Eclipse How Do Sundials Work 3D Tour of Constellations Seeing the Moon During the Day Compare Sun Sizes Monster Stars! The Rock Cycle-Igneous, Sedimentary, Metamorphic NASA Climate Kids-The Water Cycle Extreme Heating in Polar Areas The Weather Station and Air Pressure How do straws work? Learn About Greta Thunberg What is the difference between weather and climate? Plate Tectonics-Heat Moves Matter Rain in the Classroom Fun Science Demos-Multiple Videos **Writing Prompts:** Draw or write sentences to finish the prompts. "What are tectonic plates?" "Describe the rock cycle and the water cycle?" "What causes seasons." "Name at least three natural resources of the Earth." "Describe some natural hazards, and their effect on the Earth." "Describe Earth's atmosphere." "How can humans affect the Earth in a positive way?" "What do you know about the Earth's rotation?" "What do you know about the axis of the Earth?" "Tell about the moon phases." "What do you know about eclipses?" "Describe the inner solar system." "Describe the outer solar system." "Tell what you know about air pressure and air masses."

"How do patterns in forecasts and severe weather events help humans?" "What is a microclimate?" "How does climate change affect humans and the Earth?" "What is the difference between weather and climate?
At-Risk, Including ELL: Resources to Enhance Understanding
Books: Earth! My First 4.54 Billion Years (Our Universe, 1) Book 1 of Grade 6: Our Universe | by Stacy McAnulty and David Litchfield, The Ultimate Book of Planet Earth Hardcover by Anne-Sophie Baumann (Author), Didier Balicevic (Illustrator), Amazing Earth: The Most Incredible Places From Around The World Hardcover, by DK (Author), Anita Ganeri (Author), The Atmosphere: An Introduction to Meteorology (13th Edition) (MasteringMeteorology Series) 13th Edition, by Frederick K. Lutgens (Author), Edward J. Tarbuck (Author), Dennis G. Tasa (Author), Greta Thunberg to publish a 'go-to source' book on the climate crisis in 2023-https://www.theguardian.com/books/2022/mar/31/greta-thunberg-the-climate-book-crisis **Video Links:** Britannica Kids Vocabul**ary** Atmospheric Pressure Space Compilation The Solar System The Water Cycle Lunar Eclipses How Was the Grand Canyon Formed? Augmented Reality Sandbox -Topography Why Do Rivers Curve? Epic Mudslide Caught on Camera Retreating Glaciers Glaciers and Landforms How Much Could Sea Levels Rise? Climate Change and Antarctica's Ice How to Make a Cloud in Your Mouth The Mystery of the Missing Bees Make an Edible Ocean Ecosystem No Shadow of Doubt Worksheet Sunlight and Seasons Compare Star Sizes

Cape May City Elementary School District Grade Grade 6 Science Curriculum **Unit V Overview**
Content Area: Science
Unit Title: Unit V **MS-ETS1: Engineering Design**
Target Course/Grade Level: 6
Unit Summary: Learning Goal *In this unit students will be able to:* ● define a simple design problem reflecting a need or a want that includes specified criteria ● compare multiple possible solutions to a problem based on how well each is likely to meet the criteria of solving the problem ● plan and carry out fair tests to identify aspects of a model or prototype that can be improved

Interdisciplinary Connections:	
Interdisciplinary Connections: ● Science, Technology, English / Language Arts, Health, Social Emotional Learning, Mathematics, Social Studies	
Career Readiness: Life Literacies and Key Skills Standards: ● Career Readiness, Life Literacies and Key Skills ● These include critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, and interpersonal communication and science. ● Incorporation of relevant technologies as tools as part of instruction (i.e. Chromebooks, Touch screen devices, manipulatives, certified assistive technologies for students with special needs, etc.) ● Developing effective communication ● Developing Independent Learning Strategies ● Incorporating Science, Technology, Engineering, and Mathematical themes into daily lessons	
Learning Targets: **MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	
Unit Activity	**Suggested Learning Activities**
V.	**Science and Engineering Practices**: 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. (MS-ETS1-1) Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **DCI:** ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS ETS1-2), (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS ETS1-3) Models of all kinds are important for testing solutions. (MS-ETS1-4) **Crosscutting Concepts:** Influence of Science, Engineering, and Technology on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

 **Lesson Plan Activity:**

Design and Test a Car!

Preview Video-Design and Test a Car!

Overview: Students will sort the different balloon car parts, including bottle caps for wheels, straws, plastic bottles, cardboard rectangles, balloons, wooden kabob skewers, or skinny and fat straws.Then each team will watch the video to build two different balloon cars, which they will test in two trials, recording distance, and time, for each car. Analysis of these experiments with models and their results will help them see and figure out what makes each car go faster and farther, and what can be changed to influence the characteristics and performance of the cars. A final balloon car will be built using the data from trials to help the students make a final design that will go farther and faster. When every team has a final design, the class should have a competition to see whose team car goes the farthest and the fastest. For some additional fun, students could create team names, and certificates could be awarded to each team for different areas of excellence.

Details of the project!

1: Identify the problem to be solved.-Define a simple problem that includes responding to a need or want.

- How can I make a balloon car go the fastest and the farthest?

2: Use scientific knowledge to generate design solutions.-Research the problem, collaborate with your team, and discuss multiple solutions.

In your journal show the following data:

- Show your research from the Internet and/or books about balloon car designs.
- Tell how you collaborated with others to do the research, Each team member should research at least one possible design.
- Explore researched and alternative ideas for a variety of balloon car designs as a team, and record the ideas.
- Choose three prototype balloon cars to create, and test. The team will need to agree on materials and designs for each prototype paper airplane.

3: Describe criteria and constraints and evaluate potential solutions-Your prototype will be developed from the data collected.

- A prototype needs to be built that matches criteria and constraints that you have brainstormed in your journal.
- Each prototype needs to be tested in two trials for distance and time.
- Design issues and changes needed should be addressed for each car , and recorded in your science journal.

4: Plan an Investigation-Create a plan for the investigation of the final model that describes different tests.

- Collect and record data of materials used,distance, and time, from the prototype trials in your journal.
- A new improved final should be created from the trial data.
- What data did you use to create the final model and why?
- Complete three data trials for distance, and time, with your new balloon car against your best prototype, and record the data.

5: Models/Pictures-Compare your prototype model, and your new model.

- Write a comparison of your best prototype model, and your final model in your journal.
- Include photos or drawn pictures of the process in your journal.

6: Conclusion-Your conclusion needs to address the following questions.

- Did your final solution/model solve the problem of engineering a car that went farther and fastest.

	• What data do you have to support your conclusion? • If you were going to continue this project, what new questions would you ask about solving a different problem for a balloon car.

Gifted and Talented: Enrichment Links and Writing Prompts
Links: Define a Problem with Paul Andersen Developing Possible Solutions with Paul Andersen Optimizing the Design Solution with Paul Andersen Interdependence of Science, Engineering, and Technology with Paul Andersen Influence of STEAM on the World with Paul Andersen Concept Posters for the Classroom Solving a Problem with the Washington Monument **Writing Prompts:** Draw or write sentences to finish the prompts. "Create a simple design solution to a problem, be sure to say how it solves a need or a want in your life." "Why would you compare multiple possible solutions to a problem?" "Explain the steps of the engineering process."
At-Risk, Including ELL: Resources to Enhance Understanding
Books: STEAM Kids Book Series, Awesome Engineering Activities for Kids: 50+ Exciting STEAM Projects to Design and Build (Awesome STEAM Activities for Kids) Paperback –by Christina Schul, Famous STEM Inventors, by Sumita Mukherjee, The Bridge Will Not Be Gray by Dave Eggers, & Tucker Nichols **Video Links:** The Engineering Design Process Build a Catapult

Cape May City Elementary School District Grade 1 Science Curriculum **Evidence of Learning**
Specific Formative Assessments Utilized in Daily Lessons: • Suggested Formative Assessment • Daily independent practice • Peer Discussions • Student Portfolio • Reading/Writing Conferences • Self-Evaluations • Anecdotal Notes • Open-Ended Responses • Journal Entries • Reading Logs • Exit Tickets
Summative Assessment Utilized throughout Units: • Performance Task • Technology Task

Benchmarks:

- Quarterly Benchmarks Generated by the Teacher / Curriculum Committee

Modifications for English Language Learner's [ELL]

- Teacher tutoring
- Peer tutoring
- Online Resources
- Cooperative Learning Groups
- Modified Assignments
- Differentiated Instruction
- Response to Intervention (www.help4teachers.com)
- Provide additional examples and opportunities for additional problems for repetition with visuals and manipulatives
- Picture vocabulary
- Picture books
- Simplified language for understanding
- Reader's Theater
- Modify Homework, Assignments and Assessment (can be oral if necessary)
- Cooperative learning
- Retell stories using props
- Additional Center work focusing on alphabet and HFW
- Additional Phonemic Awareness teaching and practice
- Re-teach alphabet and alphabet sounds
- Sentence frames with word bank and pictures
- Songs
- Total Physical Response
- Picture word wall

Modifications for Special Education Students [IEPs]:

- Follow all IEP accommodations for each student as to meet each student's individual need
- For extra strategies please review list above in the ELL category for students who have IEPs
- Provide instructional brakes / practice chunking
- Circling back to original topic
- Lexile score modifications

Modifications for students with 504s:

- Adhere to the modifications of the 504
- For extra strategies please review list above in the ELL category for students who have IEPs
- Provide instructional brakes / practice chunking
- Circling back to original topic

- Lexile score modifications

Modifications Gifted and Talented Students:

- Advanced Lexile Resources
- Independent Study
- Advanced Assignments

Modifications At-Risk/Basic Skills:

- Teacher tutoring
- Supplemental / Pullout Teaching
- Peer tutoring
- Cooperative Learning Groups / Centers
- Modified Assignments
- Differentiated Instruction
- Response to Intervention (www.help4teachers.com)
- Provide additional examples and opportunities for additional problems for repetition with visuals and manipulatives
- Picture vocabulary
- Picture books
- Simplified language for understanding
- Reader's Theater
- Modify Homework, Assignments and Assessment (can be oral if necessary)
- Cooperative learning
- Retell stories using props
- Additional Center work focusing on alphabet and HFW
- Additional Phonemic Awareness teaching and practice
- Re-teach alphabet and alphabet sounds
- Sentence frames with word bank and pictures
- Songs
- Total Physical Response
- Picture word wall

Teacher Notes:

- **Career Readiness, Life Literacies, and Key Skills:** Rapid advancements in technology and subsequent changes in the economy have created opportunities for individuals to compete and connect on a global scale. In this increasingly diverse and complex world, the successful entrepreneur or employee must not only possess the requisite education for specific industry pathways but also employability skills necessary to collaborate with others and manage resources effectively in order to establish and maintain stability and independence. This document outlines concepts and skills necessary for New Jersey's students to thrive in an ever-changing world. Intended for integration throughout all K–12 academic and technical content areas, the New Jersey Student Learning Standards- Career Readiness, Life Literacies, and Key Skills (NJSLS-CLKS) provides the framework for students to learn the concepts, skills, and practices essential to the successful navigation of career exploration and preparation, personal finances and digital literacy that rewards innovation, creativity, and adaptation to change.

Project-based Learning Tasks:

- Ongoing student portfolio assessments [created by faculty] to monitor student progress.

Vocabulary:

- In-text vocabulary should be incorporated into every unit. Word journals, vocabulary walls, and/or various other activities should be utilized by the instructor to teach vocabulary.
- Story, key details, retell, describe, main topic, rhyming words, syllables, story elements, character, setting, question, question words, front cover, back cover, title page, narrative, favorite, informational text, rules, connection, discuss, conversation, information, illustrator, author, illustrate, picture

The Research Process:

- The research process must be integrated within each course curriculum. Student will be provided with opportunities to investigate issues from thematic units of study. As the NJSLS indicate, students will develop proficiency with MLA or APA format as applicable.
- https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/general_format.html
- https://owl.purdue.edu/owl/research_and_citation/mla_style/mla_formatting_and_style_guide/mla_formatting_and_style_guide.html

Technology:

- Students must engage in technology applications integrated throughout the curriculum, though technology provided by us in their individual classroom, and in our technology centered classrooms.
- BrainPop
- Time for Kids Magazine online
- Scholastic Magazine online
- Google Earth
- Nationalgeographic.com

- **Resources:**
- Ancillary resources and materials used to deliver instruction are included below:
- Learning New Jersey Model Curriculum
- ThinkCentral
- Achieve3000
- Reading A-Z.com
- Abcmouse .com
- EnchantedLearning,Com
- Sing Along Songs
- Scholastic.com
- Bilingualplanet.com
- Frog street
- Press.com
- 122 teachme.com
- Starfall
- www.teacherspayteachers.com
- www.udl.org
- http://www.state.nj.us/education/aps/cccs/ss/
- www.macmillanmh.com –downloadable graphic organizers

- **Career Education & Resources:**
- **NJDOE CTE (https://www.nj.gov/education/cte/)**
- Careers are Everywhere Workbook (https://lmci.state.tx.us/shared/careersareeverywhere.asp)
- Career Bingo (http://www.breitlinks.com/careers/career_pdfs/careerbingo.pdf)
- Vocational Information Center / Career Exploration Guides and Resources for Younger Students (http://www.khake.com/pageGrade 64.html)

Differentiation Strategies

Differentiation strategies can require varied amounts of preparation time. High-prep strategies often require a teacher to both create multiple pathways to process information/demonstrate learning and to assign students to those pathways. Hence, more ongoing monitoring and assessment is often required. In contrast, low-prep strategies might require a teacher to strategically create process and product choices for students, but students are allowed to choose which option to pursue given their learning profile or readiness level. Also, a low-prep strategy might be focused on a discrete skill (such as vocabulary words), so there are fewer details to consider. Most teachers find that integration of one to two new low-prep strategies and one high-prep strategy each quarter is a reasonable goal.

Low Prep Strategies	
Varied journal prompts, spelling or vocabulary lists	Students are given a choice of different journal prompts, spelling lists or vocabulary lists depending on level of proficiency/assessment results.
Anchor activities	Anchor activities provide meaningful options for students when they are not actively engaged in classroom activities (e.g., when they finish early, are waiting for further directions, are stumped, first enter class, or when the teacher is working with other students). Anchors should be directly related to the current learning goals.
Choices of books	Different textbooks or novels (often at different levels) that students are allowed to choose from for content study or for literature circles.
Choices of review activities	Different review or extension activities are made available to students during a specific section of the class (such as at the beginning or end of the period).
Homework options	Students are provided with choices about the assignments they complete as homework. Or, students are directed to specific homework based on student needs.
Student-teacher goal setting	The teacher and student work together to develop individual learning goals for the student.
Flexible grouping	Students might be instructed as a whole group, in small groups of various permutations (homogeneous or heterogeneous by skill or interest), in pairs or individual. Any small groups or pairs change over time based on assessment data.
Varied computer programs	The computer is used as an additional center in the classroom, and students are directed to specific websites or software that allows them to work on skills at their level.

Multiple Intelligence or Learning Style options	Students select activities or are assigned an activity that is designed for learning a specific area of content through their strong intelligence (verbal-linguistic, interpersonal, musical, etc.)
Varying scaffolding of same organizer	Provide graphic organizers that require students to complete various amounts of information. Some will be more filled out (by the teacher) than others.
Think-Pair-Share by readiness, interest, and/or learning profile	Students are placed in predetermined pairs, asked to think about a question for a specific amount of time, then are asked to share their answers first with their partner and then with the whole group.
Mini workshops to re-teach or extend skills	A short, specific lesson with a student or group of students that focuses on one area of interest or reinforcement of a specific skill.
Orbitals	Students conduct independent investigations generally lasting 3-Grade 6 weeks. The investigations "orbit" or revolve around some facet of the curriculum.
Games to practice mastery of information and skill	Use games as a way to review and reinforce concepts. Include questions and tasks that are on a variety of cognitive levels.
Multiple levels of questions	Teachers vary the sorts of questions posed to different students based on their ability to handle them. Varying questions is an excellent way to build the confidence (and motivation) of students who are reluctant to contribute to class discourse. Note: Most teachers would probably admit that without even thinking about it they tend to address particular types of questions to particular students. In some cases, such tendencies may need to be corrected. (For example, a teacher may be unknowingly addressing all of the more challenging questions to one student, thereby inhibiting other students' learning and fostering class resentment of that student.)
High Prep Strategies	
Cubing	Designed to help students think about a topic or idea from many different angles or perspectives. The tasks are placed on the six sides of a cube and use commands that help support thinking (justify, describe, evaluate, connect, etc.). The students complete the task on the side that ends face up, either independently or in homogenous groups.
Tiered assignment/ product	The content and objective are the same, but the process and/or the products that students must create to demonstrate mastery are varied according to the students' readiness level.
Independent studies	Students choose a topic of interest that they are curious about and wants to discover new information on. Research is done from questions developed by the student and/or teacher. The researcher produces a product to share learning with classmates.

4MAT	Teachers plan instruction for each of four learning preferences over the course of several days on a given topic. Some lessons focus on mastery, some on understanding, some on personal involvement, and some on synthesis. Each learner has a chance to approach the topic through preferred modes and to strengthen weaker areas
Jigsaw	Students are grouped based on their reading proficiency and each group is given an appropriate text on a specific aspect of a topic (the economic, political and social impact of the Civil War, for example). Students later get into heterogeneous groups to share their findings with their peers, who have read about different areas of study from source texts on their own reading levels. The jigsaw technique allows you to tackle the same subject with all of your students while discreetly providing them the different tools they need to get there.
Multiple texts	The teacher obtains or creates a variety of texts at different reading levels to assign strategically to students.
Alternative assessments	After completing a learning experience via the same content or process, the student may have a choice of products to show what has been learned. This differentiation creates possibilities for students who excel in different modalities over others (verbal versus visual).
Modified Assessments	Assessments can be modified in a variety of ways – for example by formatting the document differently (e.g. more space between questions) or by using different types of questions (matching vs. open ended) or by asking only the truly essential questions.
Learning contracts or Personal Agendas	A contract is a negotiated agreement between teacher and student that may have a mix of requirements and choice based on skills and understandings considered important by the teacher. A personal agenda could be quite similar, as it would list the tasks the teacher wants each student to accomplish in a given day/lesson/unit. Both Learning contracts and personal agendas will likely vary between students within a classroom.
Compacting	This strategy begins with a student assessment to determine level of knowledge or skill already attained (i.e. pretest). Students who demonstrate proficiency before the unit even begins are given the opportunity to work at a higher level (either independently or in a group).
Literature circles	Flexible grouping of students who engage in different studies of a piece of literature. Groups can be heterogeneous and homogeneous.
Learning Centers	A station (or simply a collection of materials) that students might use independently to explore topics or practice skills. Centers allow individual or groups of students to work at their own pace. Students are constantly reassessed to determine which centers are appropriate for students at a particular time, and to plan activities at those centers to build the most pressing skills.

Tic-Tac-Toe Choice Board (sometimes called "Think-Tac-Toe"	The tic-tac-toe choice board is a strategy that enables students to choose multiple tasks to practice a skill, or demonstrate and extend understanding of a process or concept. From the board, students choose (or teacher assigns) three adjacent or diagonal. To design a tic-tac-toe board: - Identify the outcomes and instructional focus - Design 9 different tasks - Use assessment data to determine student levels - Arrange the tasks on a tic-tac-toe board either randomly, in rows according to level of difficulty, or you may want to select one critical task to place in the center of the board for all students to complete.

Curriculum Development Resources/Instructional Materials:

List or Link Ancillary Resources and Curriculum Materials Here:

- New Jersey Student Learning Standards (https://www.nj.gov/education/cccs/)
  - NJSLS Science (https://www.nj.gov/education/modelcurriculum/sci//)

Board of Education Approved Text(s)

Scholastic Magazine

National Geographic for Kids

Time Magazine for Kids

STEMScopes

Reading A to Z