Great Meadows Regional School District
Science Curriculum
Grade 6

CURRICULUM GUIDE
Approved
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This curriculum may be modified through varying techniques, strategies and materials, as per an individual student's Individualized Education Plan (IEP).

Approved by the Great Meadows Board of Education
At the regular meeting held on August 22, 2017
And
Aligned with the New Jersey Student Learning Standards for Science

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Philosophy and Rationale

Science, engineering, and technology influence and permeate every aspect of modern life. Some knowledge of science and engineering is required to engage with the major public policy issues of today as well as to make informed everyday decisions, such as selecting among alternative medical treatments or determining how to invest public funds for water supply options. In addition, understanding science and the extraordinary insights it has produced can be meaningful and relevant on a personal level, opening new worlds to explore and offering lifelong opportunities for enriching people's lives. In these contexts, learning science is important for everyone, even those who eventually choose careers in fields other than science or engineering.
Source: NJ Student Learning Standards for Science.

Scope and Sequence

Unit 1 - Motion and Stability: Forces and Interactions with Mousetrap and Matchbox cars - 20 days

Content

- Identify balanced and unbalanced forces in a system.
- Calculate the net force and direction of motion in a system.
- Analyze the mass and acceleration of two colliding objects to predict the motion of the objects upon impact.
- Explain how and why energy forms change in a given system.
- Utilize proper units and frame of reference when recording and reporting data.

Practices

- Utilize proper units and frame of reference when recording and reporting data.
- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and principles.
- Construct arguments supported by evidence and scientific reasoning.

Unit 2 - Motion and Stability: Forces and Interactions with Electricity and Magnets - 18 days

Content

- Plan investigations to explore the effects of inertia, mass, and acceleration on an object's motion.
- Determine the factors that affect the strength of electric and magnetic forces.
- Conduct an investigation to provide evidence that forces exist between objects even though we can’t see them.
- Develop a model to describe how the arrangement of objects interacting at a distance affects the amount of potential energy stored in a system.

Practices

- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and principles.
- Construct arguments supported by evidence and scientific reasoning.

Unit 3 - Astronomy and Earth's Place in the Universe - 28 days

Content

- Describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- Describe the role of gravity in the motions within galaxies and solar systems.
- Determine scale properties of objects in the solar system.

Practices

- Develop and use a model to describe phenomena.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.

Unit 4 - Earth's Systems - Earth's Atmosphere and Air Pollution - 30 days

Content

- Describe that waves are reflected, absorbed or transmitted through materials.
- Identify and collect data related to human impacts on the environment.
- Propose and assess feasible solutions that can reduce human impacts.
- Identify and evaluate evidence of the factors that have caused the rise in global temperatures over the past century.
- Explain how unequal heating of the Earth's surfaces and the rotation of the Earth result in the development of local and global winds.
- Explain how global winds contribute to the continual recycling and redistribution of Earth's resources and materials.

Practices

- Ask questions to identify and clarify evidence of an argument.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Unit 5 - Earth's Systems - Oceans and Freshwater - 26 days

Content

- Describe how the amplitude of a wave is related to the energy in the wave.
- Describe that waves are reflected, absorbed or transmitted through materials.
- Describe the past movements of tectonic plates based on the distribution of fossils and rocks, continental shapes, and seafloor structures.
- Describe the cycling of water through Earth's systems and the role of energy from the sun and the force of gravity.
- Describe how unequal heating and Earth's rotation cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Analyze and interpret data on natural hazards to forecast catastrophic events and inform the development of technologies to mitigate their effects.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Practices

- Develop a model to describe phenomena and unobservable mechanisms.
- Ask questions to identify and clarify evidence of an argument.
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze and interpret data to provide evidence for phenomena.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Unit 6 - Earth's Systems - Weather - 18 days

Content

- Describe how the motions and complex interactions of air masses results in changes in weather conditions.
- Describe how unequal heating and Earth's rotation cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Practices

- Develop a model to describe phenomena and unobservable mechanisms.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.

- Construct arguments supported by evidence and scientific reasoning.

Unit 7 - Earth's Systems - Solar Cars and Alternative Fuels - 5 days

Content

- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Practices

- Develop a model to describe phenomena and unobservable mechanisms.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.
- 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.
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- 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.
- 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 8 - Earth's Systems - Geology - 19 days

Content

- Describe how the amplitude of a wave is related to the energy in the wave.
- Describe that waves are reflected, absorbed or transmitted through materials.
- Describe the past movements of tectonic plates based on the distribution of fossils and rocks, continental shapes, and seafloor structures.
- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Analyze and interpret data on natural hazards to forecast catastrophic events and inform the development of technologies to mitigate their

effects.
- Explain how the geologic time scale is used to organize Earth's 4.6 billion year old history.
- Describe the cycling of Earth's materials and the flow of energy that drives the process.
- Explain how geoscience processes have changed Earth's surface at varying time and spatial scales.

Practices

- Develop a model to describe phenomena and unobservable mechanisms.
- Ask questions to identify and clarify evidence of an argument.
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze and interpret data to provide evidence for phenomena.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Unit 9 - Motion and Stability: Forces and Interactions with Rockets - 5 days

Content

- Apply Newton's Laws to solve problems involving the motion of two colliding objects.
- Plan investigations to explore the effects of inertia, mass and acceleration on an object's motion.
- Develop a model to describe how the arrangement of objects interacting at a distance affects the amount of potential energy stored in a system.

Practices

- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and principles.
- Construct arguments supported by evidence and scientific reasoning.

Mission Statement

The Great Meadows Regional School District will provide quality educational opportunities that ensure the individual success of all students within a safe and supportive environment and build lifelong learners who will meet society's challenges into and beyond the 21'st century. To that end, it is anticipated that all students will achieve The NJ Student Learning Standards at all grade levels.

Units

Unit 1 - Motion and Stability: Forces and Interactions with Mousetrap and Matchbox cars

Stage 1: Desired Results

Content Standards

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

Essential Questions

- How can we predict the motion of two colliding objects?
- How does the motion of an object change when the forces acting upon the object and the object's mass change?
- What happens to the potential energy stored in a system when the arrangement of the objects is changed?

Enduring Understandings

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength but opposite in direction to the force that the second object exerts on the first object (Newton's third law of equal and opposite forces).
- The motion of an object is determined by the sum of the forces acting on it. If total force is not equal to zero the object's motion will change.
- The greater the mass of an object, the greater the force required to achieve the same change in motion.
- For any given object, a greater force will cause a greater change in motion.
- Energy exists in various forms (i.e.: Potential, Kinetic, Chemical, etc.) and can be interchanged.

Knowledge and Skills (SWBAT)

- Identify balanced and unbalanced forces in a system.
- Calculate the net force and direction of motion in a system.
- Analyze the mass and acceleration of two colliding objects to predict the motion of the objects upon impact.
- Explain how and why energy forms change in a given system.
- Utilize proper units and frame of reference when recording and reporting data.
- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and

principles.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

In this unit, students will explore and identify various forms of energy interacting in a closed system such as a mousetrap car. They will develop an understanding that energy is neither created nor destroyed in a system, but rather energy forms are interchanged or converted. In addition, students will explore Newton's Laws of Motion using a matchbox car and ramp system. They will develop an understanding that forces occur in pairs, an object's motion is a result of the sum of forces acting upon it, and force is a function of an object's mass and acceleration. They will develop and use models to expand their understanding of system components and their interactions.

The unit will be introduced through student observation, online research, comparison and categorization of different types of energy including electromagnetic, sound, heat, mechanical, and nuclear. Students will use personal observation and media sources to explore energy types, where they are found, and how they are used.

Students will utilize their understanding of basic energy forms to explore how energy can be converted within a given system. In this unit the focus will be on the conversion between potential and kinetic energy as they use mechanical energy to move a lever arm to load a spring on a mousetrap car. They will explore how the potential energy in the system changes when the fulcrum or point of force is changed in the mousetrap car system.

Student learning will progress as students utilize their understanding of potential and kinetic energy and apply it to a matchbox car and ramp system. In this lab, students will plan an experiment to explore the effects of changing various components of the system such as car mass and ramp height. They will identify the type of energy in the system when a car is placed on the top of a ramp, released, and hits/reacts to a stationary object. Students will begin to identify the presence of balanced and unbalanced forces, predict net force and motion in a system and eventually complete mathematical calculations to confirm predictions. They will observe and identify Newton's Laws of Motion and begin to predict and explain how the matchbox car motion and force changes as various components of the system (ramp height, car mass) are changed. Finally, students will utilize their understanding of energy transformations and Newton's Laws of Motion to predict how objects in other types of systems will react/move when

unbalanced forces are introduced.

Cross curricular connections:

Mathematics - Students will utilize mathematics to collect data related to object mass, speed, and ramp distances. They will understand the importance of accurately recording numerical values as well as proper units of measure. Students will display mathematical data in a variety of ways such as tables, graphs, and diagrams. In addition, students will calculate averages and net forces.

English Language Arts/Literacy - Students will utilize ELA skills through online research of energy forms, the recording of data and observations in a lab journal, and through the writing of a formal science lab report. Students will identify ways to elaborate and clarify their written expression through the use of sketches, pictures, and other visual presentations.

21st Century Skills -

- Critical thinking and Problem Solving
- Communication and Collaboration through lab reports and small group activities
- Information and Media Literacy
- Classroom Computers and Laptops for research, data collection, and lab reports

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 20 days

Resources:

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites

- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 2 - Motion and Stability: Forces and Interactions with Electricity and Magnets

Stage 1: Desired Results

Content Standards

- **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.
- **MS-PS2-3**. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- **MS-PS3-5**. 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.
- **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.

Essential Questions

- How can we demonstrate that force fields exist between objects even though we can't see them?
- What are the factors that affect the strength of electric and magnetic forces?

Enduring Understandings

- Forces that act at a distance can be explained by fields that extend through space and can be mapped by their effect on other objects.
- Electric and magnetic forces can be attractive or repulsive and their sizes depend on the magnitude of the charges, currents, or magnetic strength and on the distances between the interacting objects.

Knowledge and Skills (SWBAT)

- Determine the factors that affect the strength of electric and magnetic forces.
- Conduct an investigation to provide evidence that forces exist between objects even though we can't see them.
- Develop a model to describe how the arrangement of objects interacting at a distance affects the amount of potential energy stored in a system.
- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and principles.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

In this unit, students will use hands on exploration activities to investigate electric and magnetic forces. They will understand that electricity occurs naturally and can be man-made. Using electrical circuit kits, they will develop an understanding that electric currents are created when electrons move from one atom to another along a path called a circuit. The flow of the electrons can be controlled by the use of conductors, insulators, and switches, and the energy can be stored (potential) for later use. The electric force depends upon the magnitude of the electron current (flow), the distance the current travels, and the sizes of the objects being operated.

Using simple magnets, students will gain an understanding that magnetic forces result when the electrons in an object align and spin in the same direction to create magnetic domains and magnetic poles. When electrons move, they create a force field around the object that can be detected through space and mapped by its effect on another object. These fields can be attractive or repulsive. The size of the force field depends upon the magnitude of the magnetic strength and the distances between the interacting magnets or objects.

Cross curricular connections:

Mathematics - Students will use mathematics to collect, organize, and compare data related to the distances through which electric and magnetic forces can act upon other objects. They will display data in a variety of ways such as tables, graphs and diagrams.

English Language Arts/Literacy - Students will utilize ELA skills through the recording of data and observations in a lab journal or note packet. They will have opportunities to express their understanding of concepts and explain results through short constructed responses.

21st Century Skills -

- Critical thinking and Problem Solving
- Communication and Collaboration through lab reports and small group activities
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 18 days

Resources:

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 3 - Astronomy and Earth's Place in the Universe

Stage 1: Desired Results

Content Standards

- **MS-ESS1-1** Develop and use a model or the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- **MS-ESS1-2** Develop and use a model to describe the role of gravity in the motions within the galaxies and solar system.
- **MS-ESS1-3** Analyze and interpret data to determine scale properties of objects in the solar system.

Essential Questions

- How can models be used to represent, explain and predict solar system related phenomena such as Earth-sun-moon cycles, comets, planet positions, etc.?

- How can current models be used by scientists to represent, explain and predict space related phenomena that occur outside our solar system and beyond our current ability to measure and observe?

Enduring Understandings

- Patterns of the apparent motion of the sun, moon and stars in the sky can be observed, described, predicted, and explained with models.
- Earth and its solar system are part of the Milky Way galaxy which is one of many galaxies in the universe.
- The solar system consists of the sun and a collection of planets, their moons, and asteroids that are held in orbits around the sun by its gravitational pull on them.
- The model of the solar system explains eclipses of the sun and moon.
- Earth is tilted on its axis as it rotates and revolves around the sun. The seasons are a result of this tilt and result from the differing intensities of sunlight received by different parts of the earth at different times of the year.
- The solar system appears to have formed from a disk of dust and gas pulled together by gravity.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Use models to describe and explain the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- Describe the role of gravity in the motions within galaxies and solar systems.
- Determine scale properties of objects in the solar system.
- Develop and use a model to describe space related phenomena.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

The field of astronomy and space exploration has expanded significantly as new tools and models have been invented and developed. However, there is an infinite amount of knowledge still to be discovered. By understanding how and why our Earth-sun-moon cycles occur, students can begin to apply these concepts to movements of other objects in the solar system and then to the universe. In this unit, students will utilize their prior knowledge of Earth-sun-moon cycles to explore, revise and expand their knowledge of cycles that exist in the solar system, Milky Way galaxy and our universe.

In addition students will continue to construct and revise their explanations of universal phenomena. They will analyze existing models to identify cause and effect relationships and begin to understand that models can be used to represent systems and their interactions. Using images and data from NASA telescopes and probes, students will analyze data to explore and debate evidence to answer questions such as

- Is the "Big Bang" theory a valid scientific theory? What evidence supports the theory? What questions still need to be addressed?
- Are there other universal theories? What evidence supports those theories?
- How do we know that the universe continues to expand?
- Why isn't our solar system expanding as well?
- How do we know the properties of planets and stars even though we can't sample them?
- How do we know what exists beyond our own solar system? Our galaxy? Our universe?

Finally, students will analyze and interpret planetary and stellar data to compare objects in space. They will develop scale models to help them to understand the relative sizes of various objects in the solar system and galaxy. They will gain an understanding that scale models provide a valuable tools for the study of systems that are too large or too small to physically observe.

As students begin to see patterns that are common to our Earth-sun-moon system, our solar system and our galaxy, they can begin to understand relationships and and construct deeper explanations of our planet's place in the vast universe.

Cross curricular connections:

Mathematics - Students will use mathematics to organize and compare planetary and stellar data to develop appropriate units of scale and create scale models of planetary objects.

English Language Arts/Literacy - Students will utilize ELA skills through class discussions. They will have opportunities to express their understanding of concepts and explain results through short constructed responses.

21st Century Skills -

- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities and class discussions.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their

understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 28 days

Resources

Suggested resources will include but are not limited to the following:
- District approved science textbook
- Assessments
- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 4 - Earth's Systems - Earth's Atmosphere and Air Pollution

Stage 1: Desired Results

Content Standards
- **MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed or transmitted through various materials.
- **MS-ESS2-1**. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.
- **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.
- **MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

- **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.

Essential Questions

- What factors have contributed to global warming over the past century?
- How can human impacts on the atmosphere be monitored and minimized?
- How do wind borne materials travel around the Earth to result in the redistribution of resources?

Enduring Understandings

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- When light shines on an object it can be reflected, absorbed or transmitted through the object depending upon the object's material and the frequency or color of the light.
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. Changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies are engineered otherwise.
- Human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean temperature. 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.
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The 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.
- The planet's systems interact over scales from microscopic to global in size, they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Describe that waves are reflected, absorbed or transmitted through materials.
- Identify and collect data related to human impacts on the environment.
- Propose and assess feasible solutions that can reduce human impacts.
- Identify and evaluate evidence of the factors that have caused the rise in global temperatures over the past century.
- Explain how unequal heating of the Earth's surfaces and the rotation of the Earth result in the development of local and global winds.
- Explain how global winds contribute to the continual recycling and redistribution of Earth's resources and materials.
- Ask questions to identify and clarify evidence of an argument.

- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

Students will begin the unit of study by viewing a video that traces the melting of the Glaciers in Glacier National Park from 1913 through 2015 and discusses the effects observed on local plant and animal populations. They will compare the phenomena in Glacier National park with global climate change events such as melting ice caps to form a hypothesis of why these events are occurring. In the early part of the unit, students will explore the greenhouse effect and the concept of radiation balance as it occurs naturally in Earth's environment. They will come to understand that the Earth's natural radiation balance has changed resulting in the rise of global temperatures.

In addition, students will compare global temperature trends to timelines of technological advances and explore societal changes to develop cause/effect relationship. Through a variety of hands-on activities, they will analyze the CO_2 production of various common vehicles to investigate how the use of fossil fuels for transportation influences air pollution. They will also investigate the differences in human populations around the world, per capita energy consumption, per capita CO_2 production and per capita income for a variety of countries. Students will develop arguments based on data to explain how these factors contribute to the process of global warming.

Next, using comparative data, students will perform an analysis of various alternative fuels based on cost of production, CO_2 production, environmental impacts, production by-products (positive and negative), and safety considerations. They will then be challenged to determine the "best" alternative fuel source and write a persuasive essay using data to defend their choice.

Finally, students will read about and discuss the phenomenon of the yearly transfer of millions of tons of dust from the Sahara Desert to the Amazon Basin. They will make predictions about the various forces that drive the movement of the dust. They will then investigate the roles of local convection cells and global wind patterns to develop a model to explain the phenomenon.

Cross curricular connections:

Mathematics - Students will utilize mathematics to interpret and construct graphs, compare data, and calculate CO_2 values.

English Language Arts/Literacy - Students will utilize ELA skills to discuss ideas and concepts, express their thoughts and opinions, and develop written arguments to support a claim to thesis.

21st Century Skills -

- Global awareness and Environmental literacy through the discussion of human impacts as related to societal values and lifestyles
- Creativity and Innovation through the development of a method to monitor and minimize human impacts on the atmosphere
- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities, class discussions, and short constructed responses.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.
- Social and Cross-Cultural Skills as students learn about the differences in societal values and lifestyles.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 30 days

Resources

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites

- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 5 - Earth's Systems - Oceans and Freshwater

Stage 1: Desired Results

Content Standards

- **MS-PS4-1** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in the wave.
- **MS-PS4-2** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- **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.
- **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.
- **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.
- **MS-ESS3-1** Construct a scientific explanation based on evidence for how uneven distribution of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- **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.
- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.
- **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.

Essential Questions

- What is the role of the oceans and freshwater bodies in the distribution and cycling of Earth's energy and matter?
- How can human impacts on Earth's oceans and freshwater bodies be monitored and minimized?

Enduring Understandings

- A simple wave has a repeating pattern with a specific wavelength, frequency and amplitude.
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The 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.

- The planet's systems interact over scales from microscopic to global in size, they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- 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 in local weather patterns and global climate patterns.
- Global movements of water and its changes are propelled by sunlight and gravity.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- 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 the ocean currents.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Describe how the amplitude of a wave is related to the energy in the wave.
- Describe that waves are reflected, absorbed or transmitted through materials.
- Describe the past movements of tectonic plates based on the distribution of fossils and rocks, continental shapes, and seafloor structures.
- Describe the cycling of water through Earth's systems and the role of energy from the sun and the force of gravity.
- Describe how unequal heating and Earth's rotation cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Analyze and interpret data on natural hazards to forecast catastrophic events and inform the development of technologies to mitigate their effects.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- Develop a model to describe phenomena and unobservable mechanisms.
- Ask questions to identify and clarify evidence of an argument.
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze and interpret data to provide evidence for phenomena.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab

reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

As an introductory activity students will read a true story about bath toys that fell off a container ship and washed up on beaches around the world. Using a world map, they identify, locate, and record the dates and places where the toys were found. Finally, they develop a written hypothesis about how the rubber toys made their way to the various locations identified.

As the investigation continues, students develop an understanding that the large ocean circulations affecting the Pacific ocean mimic major wind and weather patterns. They begin by creating and observing wave and riffle patterns and motions of objects in a tub. They plot possible current patterns on their map and organize meteorological data to determine how well wind patterns match their predictions. After a lecture/discussion to learn more about currents winds and weather patterns, they finish up with a discussion that takes them back to the question about the toys' movements.

In addition, students develop an understanding of waves and tides and their motion through discussion, demonstration, and hands-on investigation. They demonstrate wave motion in containers. They use their knowledge to consider whether waves or tides could account for the movement of the bath toys to their final locations.

Students will then engage in a variety of hands-on demonstrations and experiments that will help them to understand thermohaline circulation in the ocean. They begin with an introductory activity that helps them to review or arrive at a definition of density, then go on to demonstrate the effects of temperature and salinity on density and design their own experiment to simulate ocean mixing. They experiment further with hot and cold water as they consider the effects of tropical and polar climates on ocean currents, and end by writing conclusions to summarize their learning.

Finally, students discuss and synthesize all of their experiences in the unit. With the help of an animation and a video, they develop a basic understanding of the global thermohaline "conveyor belt" that contributes to the recycling and redistribution of Earth's materials and resources.

Students will then contrast the characteristics and statistics of salt water to those of fresh water. They will compare composition, global availability and usability of both types of water. Students will investigate and focus on the availability of accessible, usable freshwater to develop an understanding of freshwater as a valuable and limited resource. Students will brainstorm ways to protect, conserve, and refresh freshwater sources on the Earth.

Cross curricular connections:

Mathematics - Students will utilize mathematics in their analysis of data tables and graphs representing ocean currents, global wind patterns and weather patterns.

English Language Arts/Literacy - Students will utilize ELA skills to discuss ideas and concepts, express their thoughts and opinions, and develop written arguments to support a claim to thesis.

21st Century Skills -

- Global awareness and Environmental literacy through the discussion of human impacts as related to societal values and lifestyles
- Creativity and Innovation through the development of a method to monitor and minimize human impacts on oceans and freshwater bodies
- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities, class discussions, and short constructed responses.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources through the use of Google Classroom and various websites/online resources.
- Social and Cross-Cultural Skills as students learn about the differences in societal values and lifestyles.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 26 days

Resources

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments

- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 6 - Earth's Systems - Weather

Stage 1: Desired Results

Content Standards

- **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.
- **MS-ESS2-5** Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
- **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.
- **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.

Essential Questions

- How do the water cycle, the unequal heating of Earth's surfaces, and Earth's rotation act together to result in changing weather conditions?
- How can knowledge of meteorological conditions be interpreted and utilized to to forecast catastrophic events and inform the development of technologies to mitigate their effects?

Enduring Understandings

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The 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.
- The planet's systems interact over scales from microscopic to global in size, they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- 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 in local weather patterns and global climate patterns.
- Global movements of water and its changes are propelled by sunlight and gravity.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.

- Because these patterns are so complex, weather can only be predicted probabilistically.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Describe how the motions and complex interactions of air masses results in changes in weather conditions.
- Describe how unequal heating and Earth's rotation cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- Develop a model to describe phenomena and unobservable mechanisms.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response,quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

Students will begin the unit by viewing a video discussing the difference between weather and climate. They will record vocabulary related to both topics to compare and contrast in a follow-up discuss to develop working definitions of weather and climate. They will be able to discuss the factors that determine local weather, those that determine climate, and how climate and Earth's biomes are related.

They will continue the unit by reviewing concepts from previous units such as layers of the atmosphere, convection cells, and wind formation. Building on this prior knowledge, students will expand their understanding of concepts and develop new weather related knowledge. Through hands on demonstrations, interactive websites, and videos, students will investigate the role of the atmosphere in the water cycle, explain how clouds form and explain why clouds express different characteristics. They will explore the role of unequal heating in the formation of pressure differentials and how these differences result in various wind formations, weather fronts and the types of weather conditions that are associated with each. Students will explore the role of unequal heating, pressure gradients and relative humidity in the formation of phenomena such as tornadoes and hurricanes.

Finally, students will explore how scientists utilize their knowledge of atmospheric conditions such as air pressure, relative humidity, and global wind patterns to predict

weather. They will learn to use interactive weather maps to track weather patterns and make predictions about future weather conditions. They will discuss the conditions that make weather forecasting an imperfect science and discuss ideas to improve the reliability of weather forecasting.

Cross curricular connections:

Mathematics - Students will compare temperature and air pressure data to draw conclusions about the relationship between unequal heating, air pressure gradients, and weather patterns.

English Language Arts/Literacy - Students will use ELA skills to extract information from weather maps and weather pages to determine current weather conditions and future weather conditions for various locations around the world.

21st Century Skills -

- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities and class discussions.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 18 days

Resources

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites

- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 7 - Earth's Systems - Solar Cars and Alternative Fuels

Stage 1: Desired Results

Content Standards

- **MS-ESS3-**1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

- **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.

- **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 criteria and constraints of the problem.

- **MS-ETS1-3** Analyze data from tests to determine similarities and differences among several 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 optimal design can be achieved.

Essential Questions

- How do scientists use the engineering design process to imagine, invent and innovate solutions to problems and challenges?

Enduring Understandings

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the design solution will be successful. Specifications of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.
- A solution needs to be tested, 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.
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

- Although one design may not perform 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.
- 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 an optimal solution.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Explain how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- Develop a model to describe phenomena and unobservable mechanisms.
- Analyze and interpret data to determine similarities and differences in findings.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.
- 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.
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- 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.
- 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.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

Students will begin this unit by reviewing the concepts learned in the Atmosphere and Air Pollution unit. They will recall the primary causes of global air pollution and its effect on the environment. They will also discuss the societal values that influence the use of fossil fuels and the increase in carbon dioxide production leading to global warming. Students will also review the various alternate fuels sources focusing on solar energy.

Students will engage in the engineering design process to research, plan, build, test, and modify a working solar car. Using the written DAPIC format, students will use criteria provided by the sponsor, TransOptions Corporation, to identify requirements and constraints. They will use online and printed articles as well as hands-on activities to research key factors such as solar panel functioning, gear ratios, aerodynamics, and weight. They will then design and build a working solar car which they will test and optimize. Finally, they will analyze their design and their results to explain how they further improve their design.

Cross curricular connections:

Mathematics - Students will use mathematics to weigh and measure various components of their car.

English Language Arts/Literacy - Students will utilize ELA skills to produce a written report (DAPIC) outlining and recording their engineering process.

21st Century Skills -

- Global awareness and Environmental literacy through the discussion of human impacts as related to societal values and lifestyles
- Creativity and Innovation through the development a working solar car
- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities, class discussions, and short constructed responses.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources. th
- Flexibility and Adaptability through teamwork
- Initiative and Self-Direction as a member of a team
- Productivity and Accountability for assigned team role
- Social and Cross-Cultural Skills as students learn about the differences in societal values and lifestyles.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social

or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 5 days

Resources

Suggested resources will include but are not limited to the following:
- District approved science textbook
- Assessments
- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 8 - Earth's Systems - Geology

Stage 1: Desired Results

Content Standards
- **MS-PS4-1**. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- **MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- **MS-ESS1-4.** Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
- **MS-ESS2-1.** Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- **MS-ESS2-2.** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **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.
- **MS-ESS3-1.** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- **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.

Essential Questions
- How do plate tectonics and related geoscience processes explain and support the changes in Earth's surface over time, the cycling of Earth's matter, and the uneven distribution of Earth's resources?
- How does the distribution of fossils and rocks, continental shapes, and seafloor structures provide evidence of past plate movements?

Enduring Understandings

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The 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.
- The planet's systems interact over scales from microscopic to global in size, they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
- 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.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Describe how the amplitude of a wave is related to the energy in the wave.
- Describe that waves are reflected, absorbed or transmitted through materials.
- Describe the past movements of tectonic plates based on the distribution of fossils and rocks, continental shapes, and seafloor structures.
- Explain how the uneven distribution of Earth's mineral, energy, and groundwater sources are a result of past and current geoscience processes.
- Analyze and interpret data on natural hazards to forecast catastrophic events and inform the development of technologies to mitigate their effects.
- Explain how the geologic time scale is used to organize Earth's 4.6 billion year old history.
- Describe the cycling of Earth's materials and the flow of energy that drives the process.
- Explain how geoscience processes have changed Earth's surface at varying time and spatial scales.
- Develop a model to describe phenomena and unobservable mechanisms.
- Ask questions to identify and clarify evidence of an argument.
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze and interpret data to provide evidence for phenomena.
- Construct a scientific explanation based on valid and reliable evidence obtained from a variety of sources and interpretations of theories and laws that govern the natural world.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

Students will begin the unit by viewing a video: Earth Science: History of the Earth to act as a springboard for eliciting questions about Earth's geological history, Earth's ever changing structure, the rock cycle and the use of rocks and fossils in understanding Earth's history, and phenomena such as earthquakes, volcanoes, continental drift, and tsunamis.

Students will then use online interactive websites, videos, and games to investigate various concepts. Through the activities, students will gain an understanding of the difference between rocks and minerals, and how Earth's processes create and transform rocks and Earth formations. They will learn how the continuous process of weathering, erosion and deposition results in the redistribution of materials and the formation of sedimentary layers that can be analyzed to provide clues and evidence about Earth's geological timeline.

In addition, students will utilize online resources to explore plate tectonic theory and the role of plate movement in the formation of continents, land features and oceanic structures. They will gain an understanding of how fossil records, rocks, continental positions and shapes, and seafloor structures provide evidence of past plate movements and how scientists can use the past to predict the future.

Finally, they will use the interactive online resources to investigate the development of earthquakes and volcanoes. They will develop a model to explain how the movement of tectonic plates creates wave movements that result in the formation of earthquakes. They will also develop a model of how tectonic plate movement creates openings in the Earth's layers that allow for the formation of different types of volcanoes.

Finally, they will gather earthquake and volcano data to compare and contrast locations and characteristics to explain the relationship between these phenomena. They will then investigate scientific tools used to predict earthquakes and monitor volcanoes to gain an understanding of the limits of these tools.

Cross curricular connections:

Mathematics - students will collect and compare data related to earthquakes and volcanoes and plot locations and magnitudes on a map.

English Language Arts/Literacy - Students will use ELA skills to read and extract information from online and text resources.

21st Century Skills -

- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities and class discussions.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 19 days

Resources

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

Unit 9 - Motion and Stability: Forces and Interactions with Rockets

Stage 1: Desired Results

Content Standards

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

Essential Questions

- How has our understanding of the laws of motion influenced technological advances?

Enduring Understandings

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength but opposite in direction to the force that the second object exerts on the first object (Newton's third law of equal and opposite forces).
- The motion of an object is determined by the sum of the forces acting on it. If total force is not equal to zero the object's motion will change.
- The greater the mass of an object, the greater the force required to achieve the same change in motion.
- For any given object, a greater force will cause a greater change in motion.
- Energy exists in various forms (i.e.: Potential, Kinetic, Chemical, etc.) and can be interchanged.
- Humans can apply patterns observed in nature to create and improve technology.

Knowledge and Skills (SWBAT embedded course proficiencies)

- Apply Newton's Laws to solve problems involving the motion of two colliding objects.
- Plan investigations to explore the effects of inertia, mass and acceleration on an object's motion.
- Develop a model to describe how the arrangement of objects interacting at a distance affects the amount of potential energy stored in a system.
- Ask questions and define problems.
- Plan and carry out investigations identifying independent and dependent variables and controls, necessary tools, and adequate data collection procedures.
- Construct explanations and design solutions by applying scientific ideas and principles.
- Construct arguments supported by evidence and scientific reasoning.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self-assessment)

Formative: informal observation, discussion (large group and partner share), lab reports, quick writes, short constructed response, quizzes.

Summative: written lab summaries/explanations, practical based unit tests, mid-year and year-end grade level assessment.

Stage 3: Learning Plan

Students will begin this unit by reviewing the concepts learned in the Astronomy and Earth's Place in the Universe unit. They will discuss the history of space exploration and the role of Newton's Laws of Motion in space flight. Students will learn about the "Space Race" between various nations and the united efforts underway today.

Students will engage in the engineering design process to research, plan, build, and launch a working rocket. They will use online and printed articles as well as hands-on activities to research key factors such as Newton's Laws, components of rockets, aerodynamics, and weight. They will then follow written directions and diagrams to build a working rocket which they will launch. Finally, they will analyze their design and their results to explain how they could have improved their design.

Cross curricular connections:

Mathematics - Students will use mathematics to weigh and measure various components of their rocket.

English Language Arts/Literacy - Students will utilize ELA skills to produce a written report (DAPIC) outlining and recording their engineering process.

21st Century Skills -

- Global awareness through the discussion of different societal impacts and contributions as related to space exploration
- Creativity and Innovation through the development a working rocket
- Critical thinking and Problem Solving
- Communication and Collaboration through small group activities, class discussions, and short constructed responses.
- Information and media literacy through the use of various online sources.
- Classroom computers/laptops through use of Google Classroom and various websites and online resources.
- Flexibility and Adaptability through teamwork
- Initiative and Self-Direction as a member of a team
- Productivity and Accountability for assigned team role
- Social and Cross-Cultural Skills as students learn about the differences in societal values and lifestyles.

Modifications

- Structure lessons around questions that are authentic/phenomena based, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a phenomena-based, social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Time Allotment: 5 days

Resources

Suggested resources will include but are not limited to the following:

- District approved science textbook
- Assessments
- Websites
- Videos
- Nonfiction/fiction sources
- Laboratory investigations
- STEM/STEAM activities

New Jersey Student Learning Standards

http://www.state.nj.us/education/cccs/

Integration of 21st Century Theme(s)

The following websites are sources for the following 21st Century Themes and Skills:
http://www.nj.gov/education/code/current/title6a/chap8.pdf
http://www.p21.org/about-us/p21-framework .
http://www.state.nj.us/education/cccs/standards/9/index.html

21st Century Interdisciplinary Themes (into core subjects)
- **Global Awareness**
- **Financial, Economic, Business and Entrepreneurial Literacy**
- **Civic Literacy**
- **Health Literacy**
- **Environmental Literacy**

Learning and Innovation Skills
- **Creativity and Innovation**
- **Critical Thinking and Problem Solving**
- **Communication and Collaboration**

Information, Media and Technology Skills
- **Information Literacy**
- **Media Literacy**
- **ICT (Information, Communications and Technology) Literacy**

Life and Career Skills
- **Flexibility and Adaptability**
- **Initiative and Self-Direction**
- **Social and Cross-Cultural Skills**
- **Productivity and Accountability**
- **Leadership and Responsibility**

Integration of Digital Tools
- **Classroom computers/laptops**
- **Technology Lab**
- **FM system**
- **Other software programs**