Branchburg Township Public Schools

Office of Curriculum and Instruction

Grade 7 Science Curriculum

Adopted by the Board of Education October 2022

This curriculum is aligned with the 2020 New Jersey Student Learning Standards in Science

Curriculum Scope and Sequence			
Content Area	Science	**Course Title/Grade Level:**	Earth & Space Science Grade 7

Topic/Unit Name		Suggested Pacing (Days/Weeks)
Topic/Unit #1	Processes of ESS The Engineering Design Process/Climate Change	September-October September-June
Topic/Unit #2	Space Systems/Astronomy	November-January
Topic/Unit #3	Weather & Climate	January-March
Topic/Unit #4	Earth Systems	April - June

Topic/Unit 1 Title	Introduction to ESS The Engineering Design Process (Climate Change)	Approximate Pacing	September-October September-June

STANDARDS

Science Standards (NGSS)

Students will be able to...	Student will know…	Crosscutting Concepts
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.	**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) **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) **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)	**Patterns** Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **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-ESS1-3) **Energy and Matter** Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior. (MS-ESS2-1) **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)

	Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	**Stability and Change** For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.(MS-ESS3-1) **<u>Connections to Nature of Science</u>** **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)

Interdisciplinary Connections:

ELA/Literacy

- RI.7.1-Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- W.7.1.B-Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.

Example: Using “Earth is Getting Hotter” article about climate change, students begin to learn how to take facts/data from the text, cite these facts to support their ideas in written responses.

Mathematics	
● 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3) Example: Students compare and contrast scale models and evaluate the benefits and disadvantages of each model.	
Computer Science & Design Thinking:	**Career Readiness, Life Literacies, & Key Skills:**
● 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch) Example: Students will identify and evaluate/test models (physical, mathematical and conceptual models) to select the appropriate model to solve a real world problem (ex: weather). ● 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team Example: Students will investigate physical models in a collaborative team by discussing ways to improve on their own product designs (flying devices).	● 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential Example: Students identify multiple intelligences and apply them to the broad scope of science career choices. ● 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2) Example: After doing research on their flying devices, students will brainstorm ideas on how to create effective devices based on given criteria. ● 9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions) ● 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective ● 9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change ● 9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on climate change Example: Students research the causes of climate change, gathering data from multiple viewpoints, including evaluating solutions tried by scientists in the past. Students ensure their information is valid, coming from a reputable source.
UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS	
What factors interact and influence the Earth as a system?	

- Phenomenon: Photo that represents different spheres (biosphere, geosphere, atmosphere, hydrosphere) and how they interact with each other

How does climate change impact the Earth?

- Photos/videos of local New Jersey severe storm damage (before and after)

What is an invasive species and how do they impact society and the natural environmental system?

What is the design process and how can it be used to create solutions with technology to manipulate the natural world?

How do you stop an invasive species? How does the government support the removal of invasive species?

- Phenomenon: The lanternflies swarm on some trees but not others. Why is it those trees vs the others they are choosing to attach?

STUDENT LEARNING OBJECTIVES	
Key Knowledge	**Process/Skills/Procedures/Application of Key Knowledge**
Students will know: Astronomy, Oceanography, Meteorology, Geology, physical model, mathematical model, conceptual model, claim, evidence, reasoning, Engineering/design, weather, climate, prototype, variables **Specific to Spotted Lanternfly Eradication Design challenge:** phloem, deciduous, invasive, egg, instar, adult, sustainable, optimization	***Students will be able to:*** ● Evaluate different types of models ● Analyze data (graphs, charts, diagrams, tables, databases) to identify trends in climate change. ● Use patterns to identify cause and effect relationships ● Compare, contrast and evaluate websites for reliability to use for research and projects ● Generate multiple solutions to a real-world problem related to Spotted Lanternfly eradication ● Design and create a trap for Spotted Lanternflies under specific constraints using the engineering design process that addresses a real world problem.
ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	● Written Assessments (tests, quizzes, etc) ● Rubric-based assessments on Spotted Lanternfly engineering design process
Formative Assessments (Ongoing assessments during the learning period to guide instruction)	● Do Now ● Exit slips ● Discussion/conferencing/reflection throughout Spotted Lanternfly engineering project ● Group work/pair-share/independent work ● Homework

Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency,)	- Compare and contrast physical, mathematical and conceptual models as they apply to investigations - Identify and practice safe methods for lab investigations - Multiple Intelligences Activity - Students explore different types of intelligences and link them to science careers (LGBTQ+/Disabilities Mandate - talk about diverse individuals and give real life examples in the science world, ex: Richard Mankin) - Flying Device Activity (following the Engineering Design Process) - Sketches, physical prototypes, digital designs on Tinkercad during Spotted Lanternfly engineering project
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	Grade level benchmark assessment: Evidence based short response assessments.
RESOURCES	
Core instructional materials: - Rutgers Spotted Lanternfly EDP Folder - Pearson Elevate Science Textbook 2019 - Scientific Literature (ReadWorks, NewsELA, Science World, etc.) - Lab Investigations	
Supplemental materials: - Videos/EdPuzzles - Explore Learning Gizmos: Models in Science - Interactive websites such as Discovery Education - Nearpod	
Modifications for Learners	
See appendix	

Topic/Unit 2 Title	Space Systems/Astronomy	Approximate Pacing	October-December

STANDARDS

Science Standards (NGSS)

Students will be able to...	Student will know…	Crosscutting Concepts
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*	**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 and 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) **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. (MS-ETS1-2), (MS-ETS1-3)	**Patterns** Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **Structure and Function** The way an object is shaped or structured determines many of its properties and functions. (MS-ESS 1-1, 1-2) **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

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.*] ● Analyze and interpret data to determine similarities and differences in findings. **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)	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)

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.		

Interdisciplinary Connections:
ELA/Literacy ● RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3) Example: Students will develop a model based on their lab data to demonstrate how the sunlight's angle affects Earth's temperature. ● SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS1- 1),(MS-ESS1-2),(MS-ESS1-3) Example: Students create presentations demonstrating their understanding of seasons, solstices, and/or eclipses. **Mathematics** ●7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-3) Example: Students learn the difference between mass and weight by calculating their mass and weight on different planets.

Computer Science & Design Thinking Standards:	**Career Readiness, Life Literacies, & Key Skills:**
● 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose Example: Students use a variety of tools to collect, use and transform data to synthesize their observations of the	● 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4). Example: Students create diagrams to explain what causes the phases of the moon ● 9.4.8.TL.3: Select appropriate tools to organize and present information digitally Example: Students will gather data on the cause of seasons and select a resource to present their findings.

world around them (Possible examples: seasons, phases of the moon, eclipses) ● 8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues ● 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital) Example: Students explore advances in technological devices that helped to change society's view on how the world exists (heliocentric model vs geocentric model)	
UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS	
How do Earth, the sun and the moon interact? ● Phenomenon: In New Jersey, there are more hours of daylight in summer than in winter. ● Phenomenon: Over the course of a month the fraction of the Moon that is visible changes gradually. ● Phenomenon: Total lunar eclipses have been much more frequent than total solar eclipses.	
STUDENT LEARNING OBJECTIVES	
Key Knowledge	**Process/Skills/Procedures/Application of Key Knowledge**
Students will know: axis, rotation, revolution, orbit, solstice, equinox, gravity, law of universal gravitation, inertia, phase, eclipse, ellipse, umbra, penumbra, force, mass, weight, Newton's First Law of Motion, solar, lunar, tilt	***Students will be able to:*** ● 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. ● Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. ● Analyze and interpret data to determine scale properties of objects in the solar system. ● Evaluate competing design solutions using a systematic scientific process to determine how well they meet the criteria and constraints of the problem.

	• Analyze data from tests to determine similarities and differences.
ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	• Written Assessments (tests, quizzes, etc)
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	• Do Now • Exit slips • Discussion • Group work/pair-share • Homework
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	• Develop and discuss a model to represent the scale of Earth, Sun, and Moon system (Students will investigate different astronomers and astronauts and report on their contributions to science - LGBTQ+/Disabilities Mandate, ex: Wanda Diaz Merced: a blind astronomer who is able to hear audio of a sunburst) • Create a model of the Earth - Moon system to explain moon phases • Create models to explain what causes Solar and Lunar Eclipses • Collect and analyze data to explore the relationship between angles of sunlight and temperature
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	• Grade level benchmark assessment: Evidence based short response assessments.
RESOURCES	
Core instructional materials: • Pearson Elevate Science Textbook 2019 • Scientific Literature (ReadWorks, NewsELA, Science World, etc.) • Lab Investigations: Sunlight Angle, Earth- Moon- Sun Data, The Water Cycle, Heat Transfer, Moon Phases, Day and Night, • Engineering: Designing a Flying Machine	

Supplemental materials:
Supplemental materials: ● Videos/EdPuzzle: Weight versus Mass, ● Explore Learning Gizmos: Seasons in 3D, Water Cycle,Weight and Mass ● Interactive websites such as Discovery Education ● Nearpod
Modifications for Learners
See appendix

Topic/Unit 3 Title	Weather and Climate	Approximate Pacing	January-March

STANDARDS

Science Standards (NGSS)

Students will be able to...	Student will know...	Crosscutting Concepts
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 results in changes in weather conditions *[Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory*	• 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) **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	**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-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,

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.]* • **ESS2.C, ESS2.D -** Use a model to explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country. *[Note: This SLO is based disciplinary core ideas found in the Framework. It is included as a scaffold to the following SLO.]* • **ESS2.C -** Explain how variations in density result from variations in temperature and salinity drive a global pattern of interconnected ocean currents. *[Note: This SLO is based on a disciplinary core idea found in the Framework. It is included as a scaffold to the following SLO.]* **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*	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.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)	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-ESS2-6) **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)

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-ESS3-2.** 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	**ESS3.D: Global Climate Change** ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5) **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)	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** *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) **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,

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-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures 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	**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. (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) **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)	natural resources, and economic conditions. (MS-ETS1-1)

global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.] **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.		

Interdisciplinary Connections:
ELA/Literacy ● W.7.1.B-Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text. Example: Students compare and contrast claims on how water circulates in the ocean and how this affects weather.

● SL.7.1-Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. Example: In groups, students discuss and present about Black inventors and their inventions. **Mathematics** ● MP.2 Reason abstractly and quantitatively. (MS-ESS2-5),(MS-ESS3-5) Example: Students analyze data from data tables representing changes in temperature (air, water, land - sea breeze, land breeze).	
Computer Science & Design Thinking Standards:	**Career Readiness, Life Literacies, & Key Skills:**
● 8.1.8.DA.5: Test, analyze, and refine computational models Example: Students will test, analyze and refine weather maps to predict the weather. ● 8.1.8.DA.6: Analyze climate change computational models and propose refinements Example: In the Greenhouse Effect gizmo, students simulate how different amounts of Greenhouse gasses affect the environment.	● 9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8). Example: Students will research different models for climate changes and synthesize the reasoning for global temperature changes. ● 9.4.8.GCA.1: Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a) Example: Students will explore diverse scientists and communicate their contributions to society.
UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS	
How does the sun's energy affect Earth's atmosphere? ● Phenomenon: Students observe the phenomenon of a severely damaged house and then relate their observations to the probable cause of a weather event. What factors affect Earth's climate? ● Phenomenon: Students observe image of Mt. Kilimanjaro, Africa, where there's snow at the peak & vegetation without snow at the base.	
STUDENT LEARNING OBJECTIVES	
Key Knowledge	**Process/Skills/Procedures/Application of Key Knowledge**

Students will know:	Students will be able to:
current, Coriolis Effect, climate, weather, atmosphere, water vapor, density, air pressure, barometer, altitude,salinity, troposphere, stratosphere, mesosphere, thermosphere, conduction, convection, radiation, condensation, evaporation, precipitation, heat transfer, wind, local wind, sea breeze, land breeze, global wind, latitude, global warming, greenhouse effect, carbon dioxide	• Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. • Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. • Explain how variation in density caused by differences in temperature and salinity drives a global pattern of interconnected ocean currents. • Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine climates. • Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	• Written Assessments (tests, quizzes, etc)
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	• Do Now • Exit slips • Discussion • Group work/pair-share • Homework
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	• Analyze ocean currents - (surface and deep currents) • Compare and contrast layers of the atmosphere • Develop a model to represent the water cycle • Investigate and explain altitude’s effect on air pressure, temperature, and density • Develop a model to represent how radiation, conduction and convection work together to heat the troposphere • Develop and use models to show how the unequal heating of Earth’s surface create local and global winds

	• Catastrophic events research project • Black History Month Project - Students research and report on engineers and scientists that have made an impact on the science world (**Amistad Mandate**).
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	• Grade level benchmark assessment: Evidence based short response assessments.

RESOURCES
Core instructional materials: • Pearson Elevated Science Interactive Workbook • Scientific Literature (ReadWorks, NewsELA, Science World, etc.) • Lab Investigations: The Water Cycle, How does Wind move?, Ocean Circulation and Convection, Tea Bag Rocket, Does Air have Mass?, Air Pressure and Altitude
Supplemental materials: • Videos/EdPuzzle: Heat Transfer, The Water Cycle, Hurricanes, Heat Transfer in the Atmosphere • Explore Learning Gizmos: Coastal Wind, Seasons in 3D, Hurricane Motion, Water Cycle, Weight and Mass, Conventions and Conduction • Interactive websites such as Discovery Education • Nearpod
Modifications for Learners
See appendix

Topic/Unit 4 Title	Earth Systems	Approximate Pacing	April-June

STANDARDS		
Science Standards (NGSS)		
Students will be able to…	**Student will know…**	**Crosscutting Concepts**
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).] **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	**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) **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)	**Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) **Structure and Function** The way an object is shaped or structured determines many of its properties and functions.(MS-ESS2-2) **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

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-ESS3-1.** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2) **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) 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.B: Plate Tectonics and Large-Scale System Interactions** Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, 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)

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-ESS3-4.** 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).]	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.C: Human Impacts on Earth Systems** 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)	

Interdisciplinary Connections:
ELA/Literacy ● RI.7.1-Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. Example: Students will read scientific literature about plate tectonics, earthquakes, volcanoes, etc. and use textual evidence to support their analysis of the text.

● RI.7.4-Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone. Example: As students read scientific literature about plate tectonics, earthquakes, volcanoes, etc., they will generate, categorize and apply new vocabulary. **Mathematics** ● 7SP.C.5: Understand that the probability of a chance event is a number between zero and one that expresses the likelihood of the event occurring. Example: Students use their knowledge of plate tectonics to estimate/predict the likelihood of geologic events (earthquakes, volcanoes, tsunamis, etc) occurring in a given location.

Computer Science & Design Thinking Standards:	**Career Readiness, Life Literacies, & Key Skills:**
● 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies Example: Students will explore the effects new technology has on the environment (The Lorax Project, recycle city game) ● 8.2.8.NT.3: Examine a system, consider how each part relates to other parts, and redesign it for another purpose Example: Students will examine how plate tectonics are related to the rock cycle, volcanoes and earthquakes.	● 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1) Example: Students will debate how human choice affects the environment (short term/long term effects, ex: deforestation, water pollution, air pollution, plastic pollution). ● 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2) Example: Students learn about Alfred Wegener and the challenges he went through when he presented his ideas about Pangaea/movement of plates.

UNIT/TOPIC ESSENTIAL QUESTIONS AND ENDURING OBJECTIVES/UNDERSTANDINGS
How do moving plates change Earth's crust? What drives the cycling of Earth's materials? ● Phenomenon: Video clip of an island being formed by a powerful geologic process How do we learn about Earth's 4.6 billion year history? ● Phenomenon: Image of aquatic fossils found in high elevation location
STUDENT LEARNING OBJECTIVES

Key Knowledge	Process/Skills/Procedures/Application of Key Knowledge
Students will know: system, energy, atmosphere, geosphere, hydrosphere, biosphere, constructive forces, destructive forces, feedback, pressure, crust, oceanic crust, continental crust, mantle, lithosphere, asthenosphere, outer core, inner core, convection, density, convection current, seafloor spreading, mid-ocean ridges, deep-ocean trenches, subduction, plate tectonics, plates, divergent boundaries, convergent boundaries, transform boundaries, fault, rift valley, volcano, lava, magma, igneous, sedimentary, metamorphic, erosion, weathering, fossil	***Students will be able to:*** ● Develop a model to explain the cause and effect of moving plates and how they change Earth's crust. ● Construct explanations about how the transfer of heat energy drives the motion/cycling of matter. ● Analyze how the stability of natural systems is affected by changes over time and processes at different scales. ● Use a model to explain the differences between constructive and destructive forces. ● Identify and explain how the different parts of the Earth system interact (geosphere, biosphere, hydrosphere, atmosphere).

ASSESSMENT OF LEARNING	
Summative Assessment (Assessment at the end of the learning period)	● Written Assessments (tests, quizzes, etc)
Formative Assessments (Ongoing assessments during the learning period to inform instruction)	● Do Nows ● Exit slips ● Discussion ● Group work/pair-share ● Homework
Alternative Assessments (Any learning activity or assessment that asks students to *perform* to demonstrate their knowledge, understanding and proficiency)	● Analyze ocean currents - (surface/ deep currents) ● Compare and contrast layers of the atmosphere ● Develop a model to represent the water cycle ● Investigate and explain altitude's effect on air pressure, temperature, and density ● Develop a model to represent how radiation, conduction and convection work together to heat the troposphere ● Develop and use models to show how the unequal heating of Earth's surface create local and global winds

	• Catastrophic events research project (**Amistad** - how different groups of people are affected by catastrophic events) • The Lorax Project - Students will investigate the effects humans have on our environment. (**Holocaust Mandate** - make connection from the holocaust and the genocide of people to deforestation)
Benchmark Assessments (used to establish baseline achievement data and measure progress towards grade level standards; given 2-3 X per year)	Grade level benchmark assessment: Evidence based short response assessments.

RESOURCES
Core instructional materials: • Pearson Elevated Science Interactive Workbook • Scientific Literature (ReadWorks, NewsELA, Science World, etc.) • Lab Investigations: What is your Carbon Footprint (**GW**), Plastic Pollution, Pangea Puzzle, Convection in the Mantle, The Ring of fire and Volcanoes, Plate tectonics and Boundary, Continental Drift,
Supplemental materials: • Explore Learning Gizmos Greenhouse Effect (online simulations) - Climate Change **(GW),** Water Pollution, The Rock Cycle, • videos/EdPuzzle: Alfred Wegner, The Puzzle of the Continents, Continental Drift • Interactive Websites such as Discovery Education • NearPod • Disabilities Don't Stop These Experts from Science and Tech article/video- class Jigsaw

Modifications for Learners
See appendix