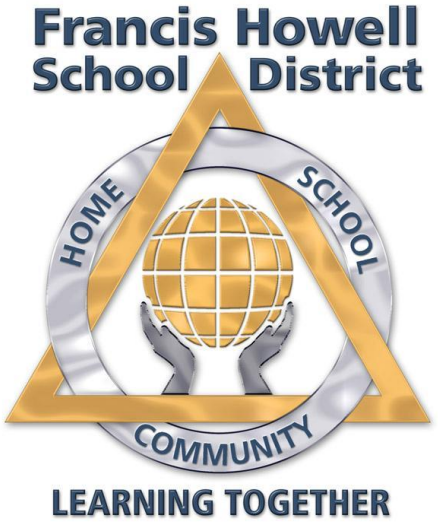
Earth Science 6

Curriculum



Board Approved:

Francis Howell School District

Mission Statement

The mission of the Francis Howell School District is to prepare students today for success tomorrow.

Vision Statement

Every student will graduate with college and career readiness skills.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement
- Operating safe and well-maintained facilities
- Providing a safe learning environment for all students
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing responsible citizens
- Operating as a professional learning community
- Making appropriate use of technology

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life. Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Earth Science 6th Grade Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Earth Science 6th Grade Course Description

This course is designed to have students explore the many facets of Earth science through the use of scientific inquiry, technology and hands-on activities. The course focuses on three main topics: study of Earth's surface and forces that change it, study of weather, climate and factors that affect them, and study of our solar system and interactions of objects in it. Scientific inquiry and the environment are embedded into each unit. Students are encouraged to ask questions, explore questions, and assess human activity on Earth's resources and systems.

Earth Science 6th Grade Curriculum Team

Curriculum Committee

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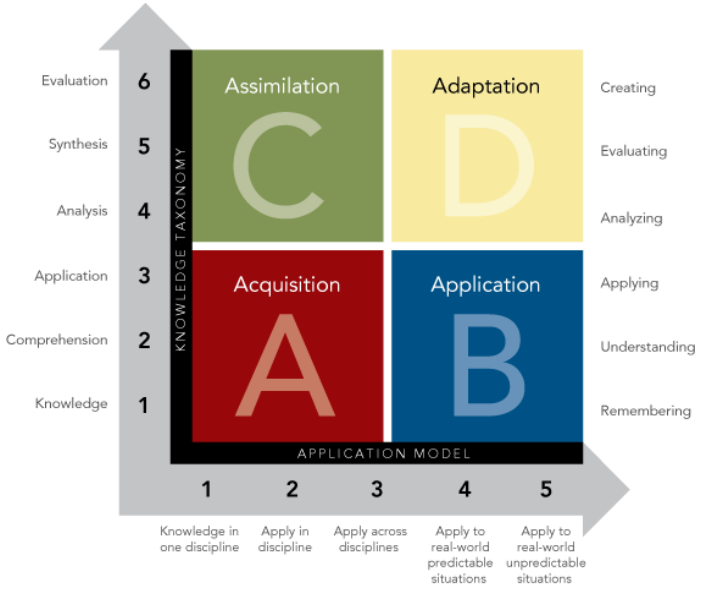
Curriculum Notes

All FHSD performance tasks and sample learning activities are aligned not only to understandings and standards, but also the Rigor and Relevance Framework and 21st Century Skills. Information on these two things is provided below or by clicking on the hyperlinks.

Rigor and Relevance Framework

The Rigor/Relevance Framework is a tool developed by the International Center to examine curriculum, instruction, and assessment along the two dimensions of higher standards and student achievement.



The Rigor/Relevance Framework has four quadrants.
Quadrant A represents simple recall and basic understanding of knowledge for its own sake. Examples of Quadrant A knowledge are knowing that the world is round and that Shakespeare wrote Hamlet.

Quadrant C represents more complex thinking but still knowledge for its own sake. Quadrant C embraces higher levels of knowledge, such as knowing how the U.S. political system works and analyzing the benefits and challenges of the cultural diversity of this nation versus other nations.

Quadrants B and D represent action or high degrees of application. Quadrant B would include knowing how to use math skills to make purchases and count change. The ability to access information in wide-area network systems and the ability to gather knowledge from a variety of sources to solve a complex problem in the workplace are types of Quadrant D knowledge.

A	B	C	D
Students gather and store bits of knowledge and information. Students are primarily expected to remember or understand this knowledge.	Students use acquired knowledge to solve problems, design solutions, and complete work. The highest level of application is to apply knowledge to new and unpredictable situations.	Students extend and refine their acquired knowledge to be able to use that knowledge automatically and routinely to analyze and solve problems and create solutions.	Students have the competence to think in complex ways.

21st Century Skills

These skills have been pared down from 18 skills to what are now called the 4Cs. The components include critical thinking, communication, collaboration, and creativity. Critical thinking is focused, careful analysis of something to better understand and includes skills such as arguing, classifying, comparing, and problem solving. Communication is the process of transferring a thought from one mind to others and receiving thoughts back and includes skills such as choosing a medium (and/or technology tool), speaking, listening, reading, writing, evaluating messages. Collaboration is working together with others to achieve a common goal and includes skills such as delegating, goal setting, resolving conflicts, team building, decision-making, and managing time. Creativity is expansive, open-ended invention and discovery of possibilities and includes skills such as brainstorming, creating, designing, imagining, improvising, and problem-solving.

Standards

If Missouri has changed the standard from NGSS, the code is a MO 6-8 LS code. If the MO standard and the NGSS standard are identical, the NGSS code has been used.

Standards aligned to this course can be found:

Science Standards

Missouri Science Standards 6-12

Next Generation Science Standards

Next Generation Science Standards

National Educational Technology Standards

http://www.iste.org/STANDARDS

Units & Standards Overview

Semester 1 **Semester 2**

Unit 1: History of Earth	**Unit 2:**Weather and Climate	**Unit 3:**Human Impact on the Environment	**Unit 4:**Space Systems
Evidence Statements 6-8 ESS2-1 **MS-ESS2-2** MS-ESS2-3 **MS-ESS1-4**	Evidence Statements MS-ESS2-2 **6-8 ESS2-5** MS-ESS2-6 MS-ESS3-5	Evidence Statements 6-8-ESS3-1 **6-8 ESS3-3** MS-ESS3-4 **6-8-ESS3-5**	Evidence Statements **6-8 ESS1-1** 6-8 ESS1-2 MS-ESS1-2 MS-ESS1-3
Disciplinary Core Ideas ESS2.B ESS2.A **ESS1.C** ISTE 1c ISTE 4c	Disciplinary Core Ideas **ESS2.C** **ESS2.D** ISTE 4b	Disciplinary Core Ideas **ESS3.D** ESS3.A ESS3.C ISTE 4b ISTE - 1a ISTE - 2b	Disciplinary Core Ideas **ESS1.B** ESS1.A ISTE - 3d ISTE - 1a ISTE - 1c
Science Engineering Practices: 2, 4, 6, 7, 8	Science Engineering Practices: 2,4, 6, 7	Science Engineering Practices: 1, 4, 6, 7, 8	Science Engineering Practices: 2
Cross Cutting Concepts: 1, 2, 3, 5	Cross Cutting Concepts: 1, 2, 4, 5	Cross Cutting Concepts: 2	Cross Cutting Concepts: 1,3, 6,
PE Assessment: Part 1: Earth's History Part 2: Fossils	PE Assessment: Part 1: Water Cycle Gizmo Part 2:	PE Assessment: Global Warming Research Project	PE Assessment: Great Seasons Debate

Course Map

	Unit Description	PE Summary	Evidence Statements Addressed in PE
Unit 1: History of Earth **9 weeks**	All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The Earth's surface is made up of moving plates, which is changed by both internal and external processes. Earth's surface is also affected by human activity. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved over time. Weathering agents and erosional processes slowly cause surface changes. Human activity cause changes as well. These changes in the Earth over time can be inferred through rock and fossil evidence, by relative dates.	This assessment includes plate tectonics, plate boundaries, land formations, surface weathering and erosion. Students will model landforms and processes of plate tectonics. Scale proportion and quantity is within the rate of weathering illustration. Students will explain why earthquakes and volcanoes form using cause and effect justifications. Students will explain convection currents in the mantle through connections of energy and matter. Students will use stability and change to explain surface changes due to plate movement, weathering, and erosion.	***MS-ESS2-2*** ***MS-ESS1-4*** ***DCI:ESS2.A*** ***ESS1.C*** ***SEP:6*** ***CCC: 3***
Unit 2: Water Planet **5 weeks**	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.	Students will model, draw and label the water cycle including: runoff, reservoir, collection, energy source, condensation, precipitation, transpiration and evaporation. Students will also trace the origins of water from the ocean to their homes.	**MS-ESS2-4** **ISTE 1c** ***DCI:* ESS2.C** ***SEP: 2, 7*** ***CCC: 4***
Unit 3: Weather and Climate **8 weeks**	Weather and climate are influenced by many different factors; both natural and man-made. These factors contribute to changes in ocean currents, weather, landform features and global warming. These interactions have shaped Earth's history and will determine its future. Weather can only be predicted probabilistically and contributes to the understanding of related geologic forces and the likelihood of future events.	Students will use models (weather map and weather station model) to predict future weather patterns. They will develop and use a seabreeze model to determine the cause and effect of areas of high and low pressure.	**MS-ESS2-5** ***DCI:* ESS2.D** ***SEP: 3*** ***CCC: 2, 4***

Unit 4: Human Impact on the Environment **5 weeks**	Human activities and behaviors are major factors in the current rise in Earth's mean surface temperature. Humans depend on Earth's renewable and nonrenewable resources, and as the human population increases, so does the limitation of resources.	Students will do a research project and create a presentation (google slides, PowerPoint, Prezi, etc.) on the repercussions of global warming and climate change on a specific region of the country. Students will analyze and interpret diagrams and graphs of a key impact of global warming on their region. They will also suggest possible solutions to address the key impact.	**6-8-ESS3-5** **MS-ETS1-1** **ISTE 4b** **ISTE 6a** **ISTE 6c** **ISTE 6d** **ISTE 2c** **ISTE 3b** **ISTE 3c** **ISTE 3d** ***DCI:* ESS3.D** **ETS1.A** ***SEP:1, 3, 6, 7, 8*** ***CCC: 2***
Unit 5: Space Systems **9 weeks**	The patterns of the apparent motion of the sun, the moon, stars, and planets can be observed, described, predicted and explained by scale models. The solar system consists of the sun, and a collection of other objects, held in orbit around the sun by gravity. Our solar system is one of many galaxies in our universe.	Students will use the the Great Seasons Debate activity as a culminating assessment following a series of lessons that addresses what factors actually cause seasons and which are commonly held misconceptions. Students first examine 3 claims about what causes seasons, look for patterns in the data, and predict which are accurate. Students are then challenged to collect and analyze data using an online interactive model that either provides evidence to support their predictions about each claim or proves it to be a misconception. Literacy, note taking and argumentative elements are an essential part of the process and interwoven into final R.A.F.T. product where students produce a draft of an e-mail addressed to their teacher identifying whether each claim is factual or a misconception using data and notes to justify their position on each.	**6-8 ESS1-1** **ISTE 4c** **DCI: ESS1.B** **SEP: 2** **CCC: 1**

Unit 1: History of Earth

Content Area: Science	Course: 6th Grade Earth Science	UNIT: History of Earth

Unit Description:	Unit Timeline:
This unit is divided into two parts. Part 1 (Earth's History): All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. The Earth's surface is made up of moving plates, which is changed by both internal and external processes. Earth's surface is also affected by human activity. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved over time. Weathering agents and erosional processes slowly cause surface changes. Human activity cause changes as well. Part 2 (Fossils): These changes in the Earth over time can be inferred through rock and fossil evidence, by relative dates.	9 weeks

DESIRED Results

Transfer Goal (Science and Engineering Practices) - ***Students will be able to independently use their learning to……***

1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematical and computational thinking.
6. Construct explanations and design solutions.
7. Engage in argument from evidence.
8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How do Earth's major systems interact?
- How do people reconstruct and date events in Earth's planetary history?
- How do natural hazards affect individuals and societies?
- Why do the continents move, and what causes earthquakes and volcanoes?
- How do people reconstruct and date events in Earth's planetary history?

Phenomena to ground the unit:
German Candle Carousel (Watch from 47 seconds on)
Mud Volcanoes
Volcano from space
Geyser before it erupts
Seashell in mountain 2
Seashells in mountain video clip

Standards Addressed		
Students who demonstrate understanding can: 6-8 ESS2-1 Develop and use a model to illustrate that energy from the Earth's interior drives convection which cycles Earth's crust leading to melting, crystallization, weathering and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building and active volcanic chains. [Clarification Statement: The emphasis is on large-scale cycling resulting from plate tectonics that includes changes in rock types through erosion, heat and pressure.] Linked to NGSS: MS-ESS2-1 **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. [Clarification statement: Examples of data include similarities or 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.] **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 history. [Clarification statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative age of major events in Earth's history. Examples of Earth's major events could range from being very recent such as the last Ice Age or the earliest fossils of *Homo sapiens* to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.]**		
Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
Part 1: History of Earth		
ESS2.A 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.[evolving standard] Know the theory that continental drift and plate	**Construct an argument using evidence that geoscience processes have changed the Earth's surface at varying times and spatial scales. This evidence should include:** **-The slow and large-scale motion of the Earth's plates and the results of that motion.** **-Surface weathering, erosion, movement,**	**Scale, proportion, quantity to explain the rate of weathering and erosion on different aged mountain ranges.**

tectonics are driven by the convection currents in the mantle. Know the processes that shape Earth's features are gradual and occur over millions of years. Know timescales for each identified geoscience process.	**and the deposition of sediment ranging from large to microscopic scales (e.g.; sediment consisting of boulders and microscopic grains of sand, raindrops dissolving microscopic amounts of minerals).** Explain the theory that continental drift and plate tectonics are driven by the convection currents in the mantle. Explain that the processes that shape Earth's features are gradual and occur over millions of years. Identify corresponding timescales for each identified geoscience process. Engage in an argument from evidence to support the theory of continental drift. (e.g., climate, fossils, rocks, coast lines, and/or glacial evidence).	
ESS2.B 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.	Obtain, evaluate, and communicate information to support the theory of continental drift.	Patterns:Students will observe the commonalities of rocks and fossils found on various continents to support the theory of continental drift. Students will use the patterns within these observations to justify that the continents have moved great distances, collided, and spread apart.
ESS2.A 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	**Explain the process of sea-floor spreading.** **Explain how convection currents cause movement at plate boundaries.**	**Energy and matter flows, cycles and conservation to explain convection and density differences in the mantle that drives plate movement.**

matter that cycles produce chemical and physical changes in Earth's materials and living organisms. **Know the process of sea-floor spreading.** **Know how convection currents cause movement at plate boundaries.** **Know how mountain ranges, mid-ocean ridges, and rift valleys are formed by tectonic plate motion based on evidence.**	**Identify landforms created at each plate boundary.** **Explain how mountain ranges, mid-ocean ridges, and rift valleys are formed by tectonic plate motion based on evidence.**	**Cause and effect to explain how mountain ranges, mid-ocean ridges, and rift valleys are formed by tectonic plate motion.**
Part 2: Fossils		
ESS1.C Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.	**Develop and use a model to identify landforms and processes of plate tectonics.**	**Patterns to explain how older rock is found near continents and newer rock is found near mid-ocean ridges due to sea floor spreading.**
ESS3.B 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. Know that the plates move through convection and this movement causes earthquakes, volcanoes, and can be affected by weathering and erosion.	Construct an explanation based on evidence that the plates move through convection and this movement causes earthquakes, volcanoes, and can be affected by weathering and erosion.	Cause and effect to explain how earthquakes and volcanoes are caused by tectonic plate motion.
ESS1.C 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. Know that events in the Earth's 4.6 billion year-old history are organized relative to one	**Construct a scientific explanation based on evidence from rock strata and fossils for how the geologic time scale is used to organize Earth's history. This explanation should include:** - **types and order of rock strata** - **the fossil record**	**Patterns of fossils and geologic features to interpret the relative ages of rock layers.**

another using the geologic time scale.	- **identification of and evidence of major events in the Earth's history (e.g.; volcanic eruptions, asteroid impacts, etc.)** **Analyze and interpret data of fossils and geologic features to explain relative ages of rock layers.**	
ISTE Standards		
ISTE 1c	Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.	
ISTE 4c	Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.	

Unit 1 (Earth's History): Assessment

EVIDENCE of LEARNING			
Understanding ***3- Scale Proportion and Quantity***	Standards ***MS-ESS2-2*** ***ESS2.A*** ***ESS2.C*** ***6- Construct Explanations***	**Unit 1:** *This is a two part assessment, given during different class periods.* **Performance Assessment Part 1 - Earth's History**: *Earth's History PE* **Description of Performance Task:** Students will complete a CER (Claim evidence reasoning) to answer the questions "Which mountain range is older?" when given two images of the Sierra Nevada and Appalachian mountain ranges. Students might explain how energy flows and how matter that cycles produces physical changes in Earth's materials including plate tectonics, plate boundaries, land formations, surface weathering and erosion. Students will model landforms and processes of plate tectonics. **Teacher will assess:** ● Students claim, evidence, and reasoning on how geoscience processes have changed Earth's surface at varying time and spatial scales. **Performance:** **Mastery:**Students will show that they really understand when they support a claim that the Appalachian mountain range was formed earlier than the Sierra Nevadas based on the evidence of jagged edges. The jagged edges imply that they have been exposed to less weathering agents (wind, rain, ice, snow...etc.) for less time. The Appalachian mountains are more rounded due to their repeated exposure to weathering agents for a longer period of time. **Scoring Guide:** **Earth's History PE Scoring Guide**	**R/R Quadrant 21 Century** *#1- A* *#2-C* *#3-A* *#4-D* *#5-D* *#6-D* Critical thinking
1-Patterns ***3- Scale, proportion, and quantity***	***MS-ESS1-4*** ***ESS1.C*** ***6- Construct Explanations***	**Performance Assessment Part 2 - Fossils:** *Fossils PE* **Description of Performance Task:** Students will be given a diagram of 2 different sites and will use fossils and geologic features to interpret the relative ages of rock layers. Students will use patterns of index fossils and rock strata to explain how weathering and erosion has changed earth's surface over long periods of time. **Teacher will assess:**	**R/R Quadrant 21 Century** B Critical thinking

		● Students identify and describe the evidence necessary for constructing the explanation, including: ○ types and order of rock strata ○ the fossil record ○ identification of and evidence for major event(s) in the Earth's history (e.g., volcanic eruptions, asteroid impacts, etc.). ● Students use multiple valid and reliable sources of evidence, which may include students' own experiments. **Performance Mastery:** Students will show that they really understand when they… achieve Mastery 70% Near Mastery 65% **Scoring Guide:Fossils PE Scoring Guide**	

Unit 1 (Earth's History): Suggested Activities

LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
1- Patterns **3- Scale, Proportion and Quantity**	**ESS2.A** ESS2.B 5-Engage in an argument from evidence 8-Obtain, evaluate, and communicate information ISTE 1c	**1. Lesson**: Continental Drift Explore Learning Website **Objective:** Students will... ● know the names of major landmasses. ● understand and be able to explain the theory of continental drift. ● understand how to fit the landmasses together to form an ancient supercontinent called Pangaea. ● be able to use several types of evidence (fossils, rocks, glaciers) to revise their model of Pangaea. **Learning activity:** Students will use the Building Pangaea Student Exploration to explore the fit of the continents that inspired the theories of continental drift and plate tectonics. As students are working, teacher will ask the following questions: 1. Based on the first map you made (activity A, looking at the fit of coastlines only) do you think there is strong evidence that the continents have moved? 2. Based on the second map (activity B, including fossil and rock evidence), how well do the landmasses fit together this time? How are your maps different? 3. At the time, most scientists did not agree with Wegener's theory. If you were one of those scientists, how would you have explained some of the following things: a. The fit of the coastlines of Africa and South America. b. Fossils of animals and plants that are found on opposite sides of large oceans. (After discussing this question, point out that the most popular explanation during Wegener's time was that ancient land bridges used to connect continents across oceans.) 4. Evidence of north-moving glaciers in tropical southern India.	Cues, Questions, and Advance organizers Non-linguistic representations Generating and Testing Hypotheses	D Critical Thinking

5-Energy and Matter 2-Cause and Effect **3- Scale, Proportion and Quantity**	**ESS2.C** 2- Use a Model ISTE 1c	**2. Lesson**: Convection Currents-Sawdust/Raisin Demo **Objective**: Students will be able to use a model to explain how convection in the mantle causes plate movement. **Learning activity:** Teacher will use a hot plate, a beaker of water, and sawdust to model convection currents through a fluid and how it relates to the movement of magma in the Earth's mantle. Students will then answer Convection Demonstration Questions to explain how this demonstration models convection currents in the mantle and supports Wegener's theory of continental drift.	*Non - linguistic representations*	C Critical Thinking
1-Patterns **3- Scale, Proportion and Quantity**	**ESS2.A** **ESS2.C** 2- Develop and Use a Model ISTE 1c	**3. Lesson:** Sea-Floor Spreading Modeling **Objective:** Students will be able to explain sea-floor spreading using a model. . **Learning Activity:** In this activity students build a paper model of how the sea-floor spreading occurs. This model demonstrates how mid-ocean ridges are formed, rock recycles in the mantle, and new oceanic crust is created. Students will then reflect on what was demonstrated with the model by answering the **Sea Floor Spreading Model - Student Questions**. **Check for Understanding:** **Sea Floor Spreading Model Directions Option 1** **Sea Floor Spreading Model Directions Option 2** **Sea Floor Spreading Model - Student Questions**	Non-linguistic representations Cues, Questions, and Advance organizers	C Creativity
2- Cause and Effect **3- Scale, Proportion and Quantity** 4- Systems & Systems Model	ESS2.B 2- Develop and use a model ISTE 1c	**4. Lesson:** Graham Cracker Lab **Objective:** Students will explain plate boundary movement with magma using a physical model. **Learning Activity:** Graham Cracker Lab Activity and Questions In this activity students model the movement of sea-floor spreading along plate boundaries. This model demonstrates how plate boundaries move and the effects of magma. This represents convergent, divergent, and transform plate boundaries and where the magma comes through at those boundaries.	Cues, Questions, and Advance organizers Non-linguistic representations Similarities and Differences	B Critical Thinking
2-Cause and	ESS3.B	**5. Lesson:** Natural Hazards	Cooperative	D

effect	**6- Construct explanations** ISTE 4c	**Objective:** Students will be able to describe several methods that engineers use to predict, minimize, or eliminate the effects of natural hazards. **Learning Activity:** Students will use the cooperative learning structure Think-Pair-Share to evaluate the placement of natural disaster prevention devices. Individually, students use the Save Our City - student activity to evaluate the placement of natural disaster prevention devices within a location. Using their understanding of natural hazards, correct placement will be determined based on optimal effectiveness of the devices. Some of these devices include a tsunami buoy, a volcano monitor, doppler radar, and a water gauge. Then, students will pair with their shoulder partners to critique the sample key given. After their conversation with their partner, students will revise their original work. Then, as a group of four, students will share out their revised natural disaster prevention device placements.	learning Cues, Questions, and Advance organizers Non-linguistic representations	Creativity, Collaboration Communication, Critical Thinking
1- Patterns **3- Scale, Proportion and Quantity**	**ESS1.C** **6- Construct explanations** 4- Analyze and interpret data ISTE 4c	**6. Lesson:** Law of Superposition **Objective:** Students will be able to identify the positions of rock layers and fossils to determine the relative age of rocks. **Learning Activities:** Part 1- **Cookie Monster student activity** Students will use the Cookie Monster student activity to determine the order of a sequence of events. Then, students will apply their understanding of sequencing events to determine a sequence of hypothetical geological events and their relative age. Part 2- **Who's on First Superposition Activity** In this activity, students will use the Who's on First Superposition sorting cards to complete a sequencing activity. This activity gives students an understanding of sequencing events. Then, students use the fossil pictures printed on "rock layer cards" to sequence the rock layers. Sequencing the rock layers will demonstrate how paleontologists use fossils to give relative dates to rock strata. Part 3- Students will complete the **Law of Superposition Student Questions**.	Non-linguistic Identifying similarities and differences Cues, questions, advance organizers	D Critical Thinking

UNIT 1: (HISTORY OF EARTH) RESOURCES

Teacher Resources:

Online textbook: http://www.connected.mcgraw-hill.com
ClassZone contains a number of animations and ways to visualize various events related to Earth Science, including the rock cycle.
sedimentary rock formation-
http://www.classzone.com/books/earth_science/terc/content/visualizations/es0605/es0605page01.cfm?chaper_no=visualization
erosion- http://www.classzone.com/books/earth_science/terc/content/visualizations/es1205/es1205page01.cfm?chapter_no=visualization
rock cycle-http://www.rocksandminerals.com/rockcycle.htm
Mineral Society rock cycle: http://minsocam.org/MSA/K12/rkcycle/rkcycleindx.html
Youtube.com: WE WILL ROCK YOU! (The Rock Cycle) https://www.youtube.com/watch?v=r68iEwYdbh4
Youtube.com Rock Cycle Foldable https://www.youtube.com/watch?v=CD0xaUqsuG8
http://www.bbc.co.uk/schools/gcsebitesize/science/21c_pre_2011/earth_and_space/continentaldriftact.shtml
Gizmos (Plate Tectonics, Building Pangea, Mineral Identification, Rock Cycle, Rock Classification) http://www.explorelearning.com
United Streaming- Greatest Discoveries with Bill Nye: Earth Science http://drive.unitedstreaming.com
United Streaming- Natural Disasters http://drive.unitedstreaming.com
Brainpop: (Plate Tectonics, Earthquakes, Volcanoes, Mountains, Ocean Floor, Rock Cycle, Types of Rocks, Mineral Identification)
Bill Nye: Erosion, Weathering, Rock Cycle
Drone footage of New Zealand fault post earthquake:
https://www.yahoo.com/movies/video/drone-video-captures-impact-zealand-132806086.html
Seashells in mountains https://www.learner.org/series/modules/express/pages/scimod_32.html
3D model of earthquakes (time lapse): https://sos.noaa.gov/Datasets/view-movie.html?video=earthquakes_2001-2015_400
Earthquakes and plates activity: http://oceanexplorer.noaa.gov/edu/learning/player/lesson01/l1la2.htm
NOAA Natural Hazard map:
https://maps.ngdc.noaa.gov/viewers/hazards/?layers=2&extent=-180,70,180,-70
Earthquake STEM: http://assets.pearsonschool.com/asset_mgr/current/201315/STEMSample_6_8_BuildingForEarthquakes.pdf
St Charles County Earthquake prep: http://www.sccmo.org/700/Earthquake
PBS activities History of Earth
Geologic time *http://ninenet.pbslearningmedia.org/resource/ssecgoodthinking13/good-thinking-time-its-like-so-deep/*
Weathering and erosion resources http://science-class.net/archive/science-class/Geology/weathering_erosion.htm · Weathering and Erosion Resources
Science court video fossils Science Court Video Fossils
Soil Soil Resources
Getting into the fossil record activity http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/index.html
weathering and erosion song https://www.youtube.com/watch?v=0PMsdoi-XP4

fossils, geologic time www.brainpop.com
Interactive erosion site www.kineticcity.com/mindgames/warper/
Plate tectonics resources (Wegner puzzle) Wegner Puzzle
Continental Drift resources http://sepuplhs.org/pdfs/lAES_Continental_Drift.pdf

Student Resources:
Online textbook: http://www.connected.mcgraw-hill.com
Mineral Society (NSTA recommended): Easy for kids to use and understand to get basics about rock types and how each forms.
Science court – fossils, soil Science Court Science Court

Vocabulary:
Plate tectonics– the theory that explains how large pieces of the Earth's outermost layer, called tectonic plates, move and change shape.
Convergent boundary – the boundary formed by the collision of two lithospheric plates.
Divergent boundary –the boundary between two tectonic plates that are moving away from each other.
Transform boundary—the boundary between two tectonic plates that are sliding past each other horizontally.
Fault—a break in a body of rock along which one block slides relative to another.
Magma—molten rock.
Convection currents—current in Earth's mantle that transfers heat in Earth's interior and is the driving force for plate tectonics.
Folding—the bending of rock layers due to stress.
Seismic waves—waves of energy that travel through the Earth and away from an earthquake in all directions.
Trench—a long, narrow, steep-sided depression where one crustal plate sinks beneath another.
Subduction—where oceanic and continental plates collide, the oceanic plate plunges beneath the less dense continental plate. As the plate descends, molten rock forms and rises toward the surface, creating volcanoes.
Mid ocean ridge—the area in an ocean basin where new ocean floor is formed.
Rift valley—a valley that forms when continental plates pull apart.
Density—measurement of the mass of an object divided by its volume. (D = m÷v)
Matter—anything that has mass and takes up space.
Mass—the amount of matter in an object.
Minerals—a naturally occurring inorganic solid that has a definite chemical composition and an orderly internal atomic structure.
Rock cycle—the series of processes in which a rock forms, changes from one type to another, is destroyed, and forms again by geological processes.
Igneous rock—rock formed when magma or lava cools and hardens.
Metamorphic rock—rock forms when heat, pressure, or fluids act on igneous, sedimentary, or other metamorphic rock to change its form or composition.
Sedimentary rock—rock forms when sediments are compacted and cemented together or when minerals form from solutions.
Intrusive igneous rock—rock formed from the slow cooling and solidification of magma beneath the Earth's surface.
Extrusive igneous rock—rock that forms as a result of volcanic activity that cools quickly at or near the Earth's surface.

Fossil- the preserved remains or evidence of past living organisms
Relative age- the age of rocks and geologic features compared with other nearby rocks and features
Absolute age – the numerical age, in years, of a rock or object.
Soil – a mixture of weathered rock, rock fragments, decayed organic matter, water, and air
Law of superposition – the principle that in undisturbed rock layers, the oldest rocks are on the bottom
Index Fossils- remains of species that existed on Earth for a relatively short period of time, were abundant and widespread geographically, and can be used to assign the ages of rock layers.

Unit 2: Weather and Climate

Content Area: Science	Course: 6th Grade Earth Science	UNIT: Weather and Climate

Unit Description:	Unit Timeline:
Weather and climate are influenced by many different factors; both natural and man-made. These factors contribute to changes in ocean currents, weather, landform features and global warming. These interactions have shaped Earth's history and will determine its future. Weather can only be predicted probabilistically and contributes to the understanding of related geologic forces and the likelihood of future events.	9 weeks

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematical and computational thinking.
6. Construct explanations and design solutions.
7. Engage in an argument from evidence.
8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How do Earth's major systems interact?
- How do the properties and movements of water shape Earth's surface and affect its systems?
- How do people model and predict the effects of human activities on Earth's climate?
- What regulates weather and climate?

Phenomenon to ground this unit: Path of river changing over time
Bubble Freeze
Turbidity In Water
Snowtrees
Snowdonuts
Dead Sea Thing

Standards Addressed
Students who demonstrate understanding can: **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.]** **6-8 ESS2-5 Research, collect, and analyze 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 possible ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).]Linked to NGSS: MS-ESS2-5** MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding,the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] 6-8 ESS3-5 Analyze evidence of the factors that have caused the change 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 global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.]Linked to NGSS:MS-ESS3-5

Disciplinary Core Ideas Students will know...	Science and Engineering Practice Students will be able to...	Cross Cutting Concepts Students will understand...
ESS2.C Global movements of water and its changes in form are propelled by sunlight and gravity. **Understand that the Sun's energy and gravity change the movement of Earth's water.**	**Construct an explanation to describe that the Sun's energy and gravity change the movement of Earth's water.** **Develop a model in which they identify the relevant components: Water (liquid, solid, and in the atmosphere), Energy in the form of**	**Cause and effect to show that Earth receives energy from the Sun which powers movement of global waters.** **Energy and matter cycles, flows and is conserved. The Sun's energy causes Earth's water to cycle and change states.**

	sunlight, Gravity, Atmosphere, Landforms, Pants and other living things.	
ESS2.C Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **Know that the transfer of energy between water and its environment drives the phase changes that drive water cycling through evaporation, transpiration, condensation, crystallization, and precipitation.** **Know how gravity interacts with water in different phases and locations to drive water cycling between the Earth's surface and the atmosphere.** **Know the path water takes from the ocean to their home.**	**Design and develop a model of the water cycle.** **Students use the model to describe that the transfer of energy between water and its environment drives the phase changes that drive water cycling through evaporation, transpiration, condensation, crystallization, and precipitation.** **Students use the model to describe how gravity interacts with water in different phases and locations to drive water cycling between the Earth's surface and the atmosphere.** **Construct an explanation to describe the path water takes from the ocean to their home.**	**Energy and matter cycles, flows and is conserved. The Sun's energy causes Earth's water to cycle and change states.** **Systems and System models to create, label, and trace water through the water cycle.** **Scale, proportion and quantity to show that the water cycle is dependent on the Sun's energy. The unequal heating of Earth influences the water cycle.**
ESS2.C 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.	Collect, analyze, and interpret data to provide evidence for how the motions and complex interactions of air masses results in change in weather conditions.	System models to show how cold fronts and warm fronts are formed due to air masses coming together. Students will illustrate on maps the types of weather that will be associated with the different types of fronts.

Unit 2: Assessment

EVIDENCE of LEARNING			
Understanding ***4 - Systems & System Models***	Standards **MS-ESS2-4** **ESS2.C** **2- Develop and use models** **7 - Engage in an argument from evidence** ISTE 1c	**Unit 2 Part 1: Performance Assessment (Water Cycle)**: Water Planet PE **Description of Assessment:** Students will model, draw and label the water cycle. Including runoff, reservoir, collection, energy source, condensation, precipitation, transpiration and evaporation. Students will also trace the origins of water from the ocean to their homes. **Teacher will assess:** 1. Student will model the water cycle and label all of the terms listed above appropriately within the system. 2. Student will describe the pathway that water takes from the ocean to their faucet at home using the steps of the water cycle. **Performance:** **Mastery:** Students will show that they really understand when they… Mastery: 70% Near Mastery: 65% **Scoring Guide: Water Planet PE Scoring Guide**	**R/R Quadrant** **21 Century** C Critical thinking
Understanding **2- Cause and Effect** **4-Systems and System Models**	Standards **6-8 ESS2-5** **ESS2.D**	**Unit 2 Part 2: Performance Assessment Weather Performance Event** : **Description of Performance Task:** Weather and Climate Performance Event Students will use a graph and a chart to predict future weather patterns. **Teacher will assess:** Students identify and describe the evidence necessary for constructing the explanation, including: i. Patterns in weather conditions in a specific area ii. The relationship between the distribution and movement of air masses and land forms (land breeze/sea breeze) iii. The relationship between large scale weather patterns and the location or movement of air masses, including patterns that develop between air masses (characteristics of cold and warm fronts)	**#1-6 A** **#7-12 B** **#13-19 D** *Critical thinking*

		Students use multiple valid and reliable sources of evidence, which may include students' own experiments. **Performance:** **Mastery:** *Students will show that they really understand when they…* achieve Mastery 70% Near Mastery 65% **Scoring Guide: Unit 3 Weather PE Scoring Guide**	

Unit 2 (Water Planet): Sample Activities

LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
2 -Cause and effect **3 -Scale, Proportion & Quantity** **4 -Systems & System Models** 5 -Energy and Matter	**ESS2.C** **2- Develop and Use Models** 3- Plan and carry out investigations **6- Construct explanations and design solutions** ISTE 1c ISTE 3d	**1. Lesson**: **Water Cycle Gizmo** **Water Cycle Gizmo Answer Key** **Objective**: Students will be able to explain the path of water as it travels through the water cycle. **Activity:** Students will trace the path of a drop of water through the water cycle, explain how water evaporates from Earth's surface, condenses into clouds, and then precipitates back to Earth's surface. Students will also describe the different paths that water can travel on Earth's surface and compare the amounts of water in different reservoirs (oceans, ice, soil, etc).	Cues, Questions, and Advance organizers Non-linguistic representation	B Critical Thinking
1-Patterns **4 -Systems & System Models**	**ESS2.C** **2- Developing and Using Models**	**2. Lesson**: Rain Card Sort Activity **Objective**: Students will be able to: ● Identify the order of events that leads to the formation of precipitation. ● Create a model of the water cycle using information from the card sort activity. **Activity:** Before completing the card sort, students will explore and online interactive site; working cooperatively to trace the droplet of water through the water cycle. NASA Kids water droplet Students will then be provided with a list of statement cards. When put in the correct order, they will be able to trace the steps and processes in the water cycle that result in the production of precipitation (rain). Students will also predict how amounts of water vapor in the air affect the formation of rain.	Cooperative learning Cues, Questions, and Advance organizers Non-linguistic representations Assigning Homework and Providing Practice	*C* *Creativity, Collaboration, Communication, Critical Thinking*

		Check for understanding: The teacher will check in with each group for understanding and review (as a whole class) the answers as part of a follow up discussion.		
5- Energy and Matter	**ESS2.C** **2- Developing and Using Models**	**3. Lesson**: Water Droplet's Adventure **Objective**: Students will create a story about a water droplet by tracing its path through the different ocean currents. **Activity:** Students will be researching ocean currents and creating a short story, a news documentary or a poem that describes a water droplet's adventure - being carried by an ocean current of their choice. (Taken from Ch 16 Lesson 3 of the textbook)	Non-linguistic representation	C Creativity, Communication Critical Thinking
5- Energy and Matter	**ESS2.C** **ESS2.D** ISTE 3d	**4. Lesson:** Atmospheric Soundings (This lesson will be completed over multiple days) **Objective:** Students will be able to graph and analyze data in order to make claims about the relationship of changes in pressure, temperature, wind speed and dew point in Earth's atmosphere. **Activity:** Students will examine air temperature, dew point, wind speed and air pressure data collected by radiosonde. They will access real time data sets and create graphs using Microsoft Excel (or similar spreadsheet software).	Non-linguistic representations	A Critical Thinking
4- Systems and System Models	MS-ESS 2-6 ESS2.C **6- Construct explanations**	**5. Lesson: Density and salinity mini lab** **How does salinity affect the density of water? (mini-lab Pg 565 of Glencoe textbook)** **Objective:** Students will understand how salinity affects the density of water. **Activity:** In this mini-lab, students will investigate how much salt needs to be added to freshwater to make it dense enough to float an egg. They will start with a hard-boiled egg in a beaker with 1,000 mL of water. They will then add salt in increments of 10 grams, stir and observe the egg's position.	Providing Practice Cues and Questions Non-linguistic representation Identifying Similarities and Differences	D Critical Thinking

		Students will use their understandings of how salinity affects density and discuss how this may or may not influence the water cycle.	Generating and Testing Hypotheses	
4- Systems and System Models	**ESS2.C** ISTE 1c ISTE 3d 6- Construct an explanation	**6. Freezing Salt Water Gizmo** **Freezing Salt Water Gizmo Student Exploration** **Freezing Salt Water Gizmo Answer Key** **Objective:** Students will … ● Be able to describe at a molecular level what happens when water freezes and melts. ● Understand that the freezing point of water is the same temperature as the melting point of ice. ● Be able to explore how adding salt to water changes its freezing and melting points. ● Be able to explain why salt is used on icy walkways and roads. **Activity:** This Gizmo allows students to explore the effect that salt has on the melting point of ice. Students will determine how salt concentrations affect freezing and melting points, and discover that salt lowers the melting point of ice.	Non-linguistic representations Summarizing and note taking Providing Practice Identifying Similarities and Differences Generating and Testing Hypotheses	B Critical Thinking
4- Systems and System Models	**ESS2.C** 6- Construct an explanation 7- Engage in argument from evidence	**7. Lesson:** Ocean Currents **Objective**: Students will be able to identify the names of major ocean currents, their location, and in what direction they flow. **Activity:** Rubber Ducky Activity Students will work in groups to plot points on a map using data from a table. Students will analyze the route of the rubber duckies in the Pacific Ocean to determine which ocean currents carried the toys. Students will then predict a possible path for the rubber duckies to reach New England and defend their decision.	Cues, Questions, and Advance organizers Non-linguistic representations Identifying Similarities and Differences	D Collaboration Communication Critical Thinking

UNIT RESOURCES

Teacher Resources:

Greenhouse Effect Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=372
Water Cycle Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=435
Water Pollution Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=445
What is Groundwater? https://www.youtube.com/watch?v=oNWAerr_xEE
Brainpop: Greenhouse Effect http://www.brainpop.com
Online Textbook http://www.connected.mcgraw-hill.com
Water to ice experiment https://www.stevespanglerscience.com/lab/experiments/instant-freeze-soda-ice/
Water freezing point experiment Water freezing point experiment
Bill Nye Weathering, Erosion
Weathering and Erosion Discovery Education Discovery Education Erosion and Weathering
Land Breeze and Sea Breeze Land Breeze and Sea Breeze
Water cycle resources https://pmm.nasa.gov/education/water-cycle
Greenhouse Gas Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=372
A Tour of the Water cycle https://pmm.nasa.gov/education/videos/tour-water-cycle
Water cycle "molecule man" https://pmm.nasa.gov/education/videos/water-cycle-featuring-molecule-man
Observing a raindrop through the water cycle Classzone
Phases of water Gizmo Phases of water Gizmo
USGS Water Cycle School https://water.usgs.gov/edu/watercycle-kids-adv.html
Water Cycle activities and labs http://science-class.net/hydrology/water_cycle/water_cycle.htm
Weather maps https://www.wunderground.com/maps/
Weather forecasts http://www.noaa.gov/
Weather forecasts http://www.weather.gov
Seasons 3D Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=463
Seasons Around The World Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=465
Coastal Winds and Clouds Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=438
Hurricane Motion Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=427
Weather Map Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=430
Brain Pop: Earth's Atmosphere http://www.brainpop.com
Brain Pop: Wind http://www.brainpop.com
Brain Pop: Weather http://www.brainpop.com
Brain Pop: Greenhouse Effect http://www.brainpop.com
Brain Pop: Ozone Layer http://www.brainpop.com

Brain Pop: Global Warming http://www.brainpop.com
Online textbook: http://www.connected.mcgraw-hill.com
Ozone and pollution video
https://app.discoveryeducation.com/learn/videos/E3203C99-D00E-42EE-8836-5B9BB6E7FDFE?hasLocalHost=false
Wonders of weather video
https://app.discoveryeducation.com/learn/videos/B353D56F-A218-43DD-A8DD-1F8582CB6259?hasLocalHost=false
Meteorology is weather video
https://app.discoveryeducation.com/learn/videos/73DEB013-4387-45A2-AB28-360DEC83C565?hasLocalHost=false
National Weather Service lessons on Atmosphere, Ocean, Global Circulation, Meteorology
http://www.srh.noaa.gov/jetstream/append/lessonplans.html

Student Resources:
Online textbook http://www.connected.mcgraw-hill.com
Greenhouse Effect Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=372
Water Cycle Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=435
Water Pollution Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=445
What is Groundwater? https://www.youtube.com/watch?v=oNWAerr_xEE
USGS Water Cycle School https://water.usgs.gov/edu/watercycle-kids-adv.html
Water Cycle activities and labs http://science-class.net/hydrology/water_cycle/water_cycle.htm
Weather maps https://www.wunderground.com/maps/
Weather forecasts http://www.noaa.gov/
Weather forecasts http://www.weather.gov
Weather Map Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=430
Seasons 3D Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=463
Seasons Around The World Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=465
Coastal Winds and Clouds Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=438
Hurricane Motion Gizmo https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=427
Online textbook: http://www.connected.mcgraw-hill.com

Vocabulary:
Weathering – the mechanical and chemical processes that change Earth's surface over time
Erosion- the moving of weathered material, or sediment, from one location to another
Greenhouse effect- the natural process that occurs when certain gases in the atmosphere absorb and reradiate thermal energy from the Sun (pg 771)
Climate Change-a large scale, long term shift in the planet's weather patterns or average temperatures.

Global Warming - a slow increase in average temperature worldwide
Gyre- (JI ur)- a large circular system of ocean currents (pg. 582)
Water cycle - the series of natural processes by which water continually moves throughout the hydrosphere
Current- movement within a fluid
Temperature- is a measure of the internal energy of a system.
Salinity- a measure of the mass of dissolved salts in a mass of water. (pg.565)
Density - measure of the mass of an object divided by its volume (d=m÷ v)
Atmosphere– a thin layer of air that forms a protective covering around the planet.
Ozone layer– a layer in the atmosphere with a high level of ozone which absorbs harmful radiation from the sun.
Radiation – energy transferred by waves or rays.
Conduction –transfer of energy that occurs when molecules bump into each other.
Convection—transfer of heat by the flow of material.
Condensation—process by which water vapor changes to a liquid.
Evaporation—the process by which a liquid changes to gaseous or vapor form.
Transpiration—process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere.
Respiration- the process in which the cells of an organism obtain energy by combining oxygen and glucose, resulting in the release of carbon dioxide, water, and ATP (the currency of energy in cells).
Precipitation—water falling from clouds—including rain, snow, sleet, and hail—whose form is determined by air temperature
Coriolis effect - the effect of the Earth's rotation on the direction of winds and currents

- **Atmosphere**– a thin layer of air that forms a protective covering around the planet.
- **Ozone layer**– a layer in the atmosphere with a high level of ozone which absorbs harmful radiation from the sun.
- **Radiation** – energy transferred by waves or rays.
- **Conduction** –transfer of energy that occurs when molecules bump into each other.
- **Convection**—transfer of heat by the flow of material.
- **Condensation**—process by which water vapor changes to a liquid.
- **Evaporation**—the process by which a liquid changes to gaseous or vapor form.
- **Transpiration**—process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere.
- **Precipitation**—water falling from clouds—including rain, snow, sleet, and hail—whose form is determined by air temperature.
- **Dew point**—temperature at which air is saturated and condensation forms.
- **Humidity**—the amount of water vapor held in the air.
- **Relative humidity**—the measure of the amount of moisture held in the air compared with the amount it can hold at a given temperature; can range from 0 percent to 100 percent.
- **Barometric pressure**—the weight of the air above the earth.
- **Isobars**—lines drawn on a weather map that connect points having equal atmospheric pressure; also indicate the location of high- and low-pressure areas and can show wind speed.
- **Temperature**—a measure of the warmth or coldness of an object or substance.
- **Land breeze**—movement of air from land to sea at night, created when cooler, denser air from the land forces up warmer air over the sea.

· **Sea breeze**—movement of air from sea to land during the day when cooler air from above the water moves over the land, forcing the heated, less dense air above the land to rise.
· **Weather**—the state of the atmosphere at a specific time and place, determined by factors including air pressure, amount of moisture in the air, temperature, wind, and precipitation.
· **Climate**—average weather pattern in an area over a long period of time; can be classified by temperature, humidity, precipitation, and vegetation.
· **Air mass**—large body of air that has the same characteristics of temperature and moisture content as the part of Earth's surface over which it formed.
· **Front**—boundary between two air masses with different temperatures, density, or moisture; can be cold, warm, occluded, and stationary

Unit 3: Human Impact on the Environment

Content Area: Science	Course: 6th Grade Earth Science	UNIT: Human Impact on the Environment

Unit Description:	Unit Timeline:
Human activities and behaviors are major factors in the current rise in Earth's mean surface temperature. Humans depend on Earth's renewable and nonrenewable resources, and as the human population increases, so does the limitation of resources.	5 weeks

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematical and computational thinking.
6. Construct explanations and design solutions.
7. Engage in an argument from evidence.
8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How do people model and predict the effects of human activities on Earth's climate?
- How do humans depend on Earth's resources?
- How do humans change the planet?

Phenomena to ground the unit:
Climate Change
Earth's Climate Change

Standards Addressed
Students who demonstrate understanding can: 6-8-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 and human activity. [Clarification statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions 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).]Linked to NGSS MS-ESS3-1 **6-8-ESS3-3: Analyze data to define the relationship for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of data 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.] Linked to NGSS 3-3** 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 consequence 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.] 6-8-ESS3-5 Analyze evidence of the factors that have caused the change 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 global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities play in causing the rise in global temperatures.] Linked to NGSS MS-ESS3-5 **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.** 6-8.ESS3.C.2 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).] Linked to NGSS MS-ESS3-2		
Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
ESS3.D 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 decision and activities.	Analyze and interpret data to construct an argument based on evidence of the factors that have caused the change in global temperatures over the past century. Students formulate questions that would identify and clarify: - Relevant ways in which natural processes and/or human activities may have affected the patterns of change in global temperatures over the past century. - The influence of natural processes and/or human activities on gradual or sudden change in global temperatures in natural systems (e.g.; glaciers and arctic ice, and plant and animal seasonal movements and life cycle activities). - The influence of natural processes and/or human activities on changes in the concentration of carbon dioxide and other greenhouse gases in the atmosphere over the past century. Analyze evidence for: - Patterns in data that connect natural processes and human activities to changes in global temperatures over	Cause and Effect to explain relationships between human population and consumption of natural resources. Cause and Effect to identify ways that humans have altered the environment. Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

	the past century. - Patterns in data that connect the changes in natural processes and/or human activities related to greenhouse gas production to changes in the concentrations of carbon dioxide and other greenhouse gases in the atmosphere. Obtain, evaluate, and communicate information about this problem and the solution designed.	
ESS3.A Humans depend on Earth's land, ocean, atmosphere, biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. Know that the Earth's resources are formed as a result of past and current geologic processes. The environment or conditions that formed the resources are specific to certain areas and/or times on Earth, thus identifying why those resources are found only in those specific places/periods Know that as resources are used, they are depleted from the sources until they can be replenished, mainly through geologic processes Know that because many resources continue	Construct a scientific explanation based on evidence for how the uneven distribution of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Student explanations should include: - The Earth's resources are formed as a result of past and current geologic processes - The environment or conditions that formed the resources are specific to certain areas and/or times on Earth, thus identifying why those resources are found only in those specific places/periods - As resources are used, they are depleted from the sources until they can be replenished, mainly through geologic processes - Because many resources continue to be formed in the same ways that they were in the past, and because the amount of time required to form those resources (e.g., minerals, fossil fuels)	Cause and effect relationships between the limitations the Earth's resources and time it takes to replenish resources. The uneven distribution of natural resources is a result of past and current geoscience processes.

to be formed in the same ways that they were in the past, and because the amount of time required to form those resources (e.g., minerals, fossil fuels) is much longer than timescales of human lifetimes, these resources are limited to current and near-future generations. Some resources (e.g. groundwater) can be replenished on human timescales and are limited based on distribution.	is much longer than timescales of human lifetimes, these resources are limited to current and near-future generations. Some resources (e.g. groundwater) can be replenished on human timescales and are limited based on distribution.	
ESS3.C 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.	**Given a problem related to human impact on the environment, students use scientific information and principles to generate a design solution that:** **- addresses the results of the particular human activity.** **- incorporates technologies that can be used to monitor and minimize negative effects that human activities have on the environment.** **Identify relationships between human activity and negative environmental impact based on scientific principles, and distinguish between causal and correlational relationships to facilitate the design of the solution.** **Design a solution for minimizing human impact on the environment.**	**The uneven distribution of natural resources is a result of past and current geoscience processes.**

ESS3.C 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.	**Define and quantify criteria and constraints for their designed solution including:** **-individual or societal needs and desires** **- constraints imposed by economic conditions (e.g., costs of building and maintaining the solution)**	**The uneven distribution of natural resources is a result of past and current geoscience processes.**
ETS1.A 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.	**Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.** **Students will describe how well the solution meets the criteria and constraints for the solution, including monitoring or minimizing a human impact on the causal relationship between relevant scientific principles about the processes that occur in, as well as among, Earth systems and the human impact on the environment.** **Students identify limitations of the use of technologies employed by the solution.**	
ISTE Standards		
ISTE 4b	Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.	
ISTE 2c	Demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.	
ISTE 3b	Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.	

ISTE 3c	Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
ISTE 3d	Build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
ISTE 6a	Choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
ISTE 6c	Communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
ISTE 6d	Publish or present content that customizes the message and medium for their intended audiences.

Unit 3: Assessment

EVIDENCE of LEARNING			
Understanding 2-Cause and Effect 7-Stability and change	Standards **ESS3.C** **6-8 ESS3-3** **MS-ETS1-1** *1- Ask questions and define problems.* *4-Analyze and interpret data* *6- Construct explanations and design solutions* *7- Engage in an argument from evidence* *8- Obtain, evaluate, and communicate information* ISTE 4b ISTE 6a ISTE 6c ISTE 6d ISTE 2c ISTE 3b ISTE 3c ISTE 3d	**Unit Performance Assessment**: **Description of Performance Task:** Students will use the engineering design process to create a way to monitor and minimize human impact on the environment. Students will use the process of engineering design to create a way to minimize and monitor this issue of choice. Engineering Process: a. Define the problem and resources available b. Brainstorm solutions c. Develop a plan d. Test your plan e. Improve the plan f. Analyze the plan and use it Possible ideas: https://www.youtube.com/watch?v=5o_NVuMXcZU https://www.youtube.com/watch?v=hQp7Kp477Wg Students will split into small groups (or work individually) to design a way to monitor and minimize human impacts on the environment. Students will design a method to monitor and minimize human impact they see around their school, home, or town. They could also think bigger and design something that would monitor and minimize in their state or country. They will need to use the information they have collected. a. Allow students to define a problem in respect to human impacts and the environment and resources available: 1. What is the problem? How have others approached it? 2. What are your constraints? 3. Prompt the students with questions that relate to defining the problem. a. Once they have identified a problem, students should do additional research on the topic they choose. They should evaluate their sources to be reliable sources. b. In groups or individually, ask students to brainstorm solutions: 1. What are some solutions? Brainstorm ideas. Choose the best one. c. Develop a plan:	**R/R Quadrant** **21 Century** C 4C- critical thinking communication

		1. Draw a diagram or write out your plan. Make lists of materials you will need. 2. Give students the opportunity to develop a plan. Be sure they create a template or drawing for collecting their "monitor" data and have ideas about how they will minimize. But they should know that those ideas can change depending on their data collection. d. Test your plan: During this step, allow students to complete an inside-outside circle activity so peers can share their designs with each other and provide feedback and suggestions. 1. Follow your plan and test it or begin monitoring. 2. Discuss ways of testing their design. This might include sharing the design/plan with classmates and getting suggestions. e. Improve the plan: 1. What worked? What didn't? What could work better? Modify your plan to make it better. 2. Test it out again. 3. Get feedback from students and based on that feedback ask the students to make some modifications of their plan. f. Analyze the plan and use it: 1. Ask students to write up a description for their plan that includes some reasons why they think it is important. Students will use the Design Project Guide to record the steps of their design process. Students create a presentation (google slides, PowerPoint, Prezi, etc.) detailing their design process, why they choose this problem, why it is a problem, why it needs to be solved, and how they would monitor its effect. **Teacher will assess:** 1. The student's attention to detail in following the design process. 2. The student's content understanding in what causes the problem. 3. The student's reflection on their design effectiveness and the method for monitoring the effectiveness. **Performance:** **Mastery:** *Students will show that they really understand when they…* 1. Identify the causes of one problem	

		2. Design a solution to address the problem (Whether the design is effective or not) 3. Revise their design based on feedback 4. Develop a method to monitor the effectiveness of the design **Scoring Guide:** **Engineering Design Project Rubric**	

Unit 3: Sample Activities

SAMPLE LEARNING PLAN				
Pre-assessment: Pre-assessment worksheet Pre-assessment scoring guide				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
2-Cause and Effect 7-Stability and change	ESS3.A **ESS3.C** 6-Construct explanation based and design solutions ISTE- 4b	**Lesson 1**: PBS Water Conservation **Objective**: Students will be able to identify sources of fresh water available for consumption on earth and the methods that can be used to purify and conserve it. **Activity:** Students will investigate the availability of freshwater on Earth. Teachers can either demonstrate or have student groups use 2 liter bottles of colored water to model the percentage of freshwater available. Students will also use the global interactive to answer questions and discuss where water comes from. They will investigate how much water is used per day and how to manage our water supply. After completing the lesson and watching the multimedia resources, students will write an article or an editorial discussing their ideas about either the importance of conserving water and techniques for reducing water use at home or positive and negative effects of dams and techniques that big cities can implement to eliminate the need for dams.	Cues, Questions, and Advance organizers Non-linguistic representations Identifying Similarities and Differences	C *Creativity* *Collaboration* *Communication*

2-Cause and Effect **7-Stability and change**	**ESS3.C** 6-Construct explanation based and design solutions 7- Engage in Argument from Evidence *ISTE - 1a*	**Lesson 2**: Minimizing Human Impact through Recycling **Objective**: Students will understand that biodegradable materials are those capable of disintegrating easily in nature. Discarded materials made up of biodegradable materials take up less room in a landfill. **Activity:** Students will work in groups to design a product that can be made with only biodegradable materials. **Check for understanding:** Students can make models of their inventions or draw detailed diagrams explaining how and where their products would be used. Groups can create marketing campaigns to convince other people to purchase their environmentally friendly product. Discussion questions and extensions are also included in the lesson plan.	Non-linguistic representations	B *Creativity,* *Collaboration,* *Communication* *Critical Thinking*
1- Patterns **7- Stability and change**	**ESS3.D** **ISTE 3b** **1- Ask questions** 4- Analyze and interpret data	**Lesson 3**: Indicators Around the World (Two days) **Objective**: The students will be able to define the difference between climate and weather. **Activity: Day 1:** Using Lesson 1 from Climate Consideration In small groups, students will receive a piece of the Global Land and Ocean Temperature Anomalies graph. Define anomalies for students and explain that this graph shows the temperature change from average. Have a discussion about how to ask good clarifying questions with your students. A clarifying question does not provide new information, but expands on understanding the information that is already presented. In their journals, ask students to list questions they should ask when clarifying evidence. Clarifying questions could include: a. Who collected this data? b. When was it collected? c. Does it represent what it's supposed to? d. Who funded the research? Allow students a few minutes to look at the graph. Ask students to come up with 3 questions they can ask to help clarify the evidence before them and 3 things they notice about the evidence. Ask students to write their responses	Non-linguistic representations Identifying Similarities and Differences Cues & Questions	B Collaboration Communication Critical Thinking

		on sticky notes. Groups will share their responses with the class. Help students understand the importance of asking clarifying questions to ensure they are using sound evidence. Share the paragraph about the graph with the students and bring up the source website if needed. Other discussion questions to ask your students: a. What do you notice about this ~25 year segment? b. What conclusion about temperature can you draw from your 25-year segment? c. What do you think is causing the changes in your segment? d. Based on your segment, what do you think the next 20 years will look like? e. Did your questions lead you to a deeper understanding of the graph? f. What do you still have questions about? Ask students to bring their graph segment to the front of the room and put them together. This is the Global Land and Ocean Temperature Anomalies graph. It shows the average temperature for each year starting in 1880 until 2015. Once the graph is together, students will be able to see that the temperature is in fact increasing. Remind students that this graph shows average temperature (some places may get colder one year, but overall the temperatures are increasing). a. Lead a discussion about looking at this graph as a whole, instead of in pieces. Why is it important to look at change over time (years, decades, centuries)? For homework, students will interview an older person about weather and climate. Students should ask the adult about what they remember about weather when they were young. **Day 2:** Students share their interview responses from their homework in their groups. Within their groups, ask the teams to identify if there were any similarities or differences in their interview responses. Also ask if these stories constitute reliable evidence and why or why not? What would make them more reliable?		

		Students should journal about the weather today being as detailed as possible. Then, ask students to describe the climate where they live in their journals. Have students share their thoughts with a partner. After talking with their partner, students may want to change their answer. Ask a few groups to share their answers with the class. Define weather and climate to your students. **Weather:** the atmospheric conditions of a specific place at a specific point in time, the minute-by-minute variable condition of the atmosphere on a local scale **Climate:** how the atmosphere "behaves" over relatively long periods of time (months, years), the description of an area's average weather conditions and the extent to which those conditions vary over long time intervals The difference between weather and climate is a measure of time. Weather is what you wear each day. Climate is the clothes you have in your closet. Show the following video: Weather vs. Climate Have students look back at the Global Land and Ocean Temperature Anomalies graph and ask students, "how would you describe the difference in global temperatures in 1909 and 1998? Can you describe the weather of those two years? why or why not? 1. Ask: What are the indicators that show us the global temperature is rising? Measurements from scientists, citizens, and students like yourselves can show us that temperatures around the world are going up. In this activity, students look at how measurements are made and draw conclusions about the global temperature after looking at multiple lines of evidence. 2. Ask students "Besides looking at a thermometer, what are things you see that indicate changes in temperature?" (i.e. ice out early on lakes, less ice cover on lakes, sea level rise because of melting glaciers) Make a list of the board. 3. Split class into 6 or 12 small groups. Give each group 1-2 figures from the Temperature Indicators Figures Set and give each student a worksheet. 4. Each group will study their figure(s), discover what indicators are shown, and answer questions on a provided worksheet to help clarify and ensure the		

		evidence is reliable. 5. After students have studied the figures they will present what they found to the class. Hang figures in classroom for students to reference throughout the unit. Note: Teachers may decide to share the explanatory information given in the Temperature Indicators Figure Set Descriptions with students after they have made their own interpretations.		
2- Cause and effect **7- Stability and change**	ESS3.D **ESS3.C** **2- Develop and use models** **6- Construct explanations**	**Lesson 4**: The Greenhouse Effect Game **Objective**: Students will understand the impact of human impacts and the greenhouse effect on the Earth's temperature. **Activity:** Using Lesson 2 from Climate Consideration as a guide. Show students the following video about carbon dioxide, the greenhouse effect, and heat trapping gasses http://www.climategen.org/ngconline Teacher Instructions: This activity is about making a model of the atmosphere and facilitating discussion. Students will illustrate a diagram of the greenhouse effect throughout the game. In the student's drawings there will need to be arrows representing where light, heat, energy, etc. are coming from. As a teacher, these are things you should not instruct your students to do, but highlight as you review their work and as they improve their diagrams after each round of game play. "How did you show movement? Heat? Light? Amount?" Encourage them, "I like how you used arrows to show direction/amount/etc." The game will work best with 15-30 students. Read about the set-up and background information here. 1. Have students each make two notecards. One says HEAT and the other LIGHT. 2. Before going outside, have students draw a diagram of the greenhouse effect in their journals. Be sure they label what they draw, even if it is only a few things. They need to bring their journals outside to draw after each round of the game. 3. Take students outside to play the game. Explain that the smaller circle represents the Earth and the larger one represents Earth's atmosphere. Have students place their 'heat' cards in a pile on the Earth. Explain to students that	Non-linguistic representations Cues & Questions	B Collaboration Communication Critical Thinking

		the size to atmosphere is not to scale. In real life the Earth's diameter is 7,917 miles and the atmosphere reaches about 800 miles above the Earth. A good analogy would be a peach. The flesh would represent the earth and the skin would represent the atmosphere. Instructions on playing the game as well as follow-up questions can be found here. Summary: Have a discussion about how energy from the sun gets trapped in the Earth's atmosphere. Discuss how human actions, particularly burning fossil fuels, can enhance the greenhouse effect by putting more CO_2 into the atmosphere. This increase in CO_2 which is increasing global temperature is referred to as climate change. The game should demonstrate that when you increase the amount of CO2, more heat gets trapped (illustrated by the students that were tagged in the atmosphere) and the Earth warms up. The action cards demonstrate how even small-scale actions can affect the amount of greenhouse gas that we emit to the atmosphere. The game can be a springboard into a variety of other explorations such as researching alternative energy sources, discussing sustainable lifestyles, and examining the different choices humans can make. a. How was this game like the atmosphere/not like the atmosphere? b. What makes the game an accurate or inaccurate model of the atmosphere? c. How did your diagram change throughout the game? What did you learn during the game? d. How did you show things moving around? How did you show quantity? How did you show that light changes to heat?		
1- Patterns **7-Stability and change** 2- Cause and effect	ESS3.D **ESS3.C** 7- Engage in an argument from evidence 4- Analyze and interpret data	**Lesson 5**: Looking into the causes **Objective**: Students will be able to support their claim about climate change using evidence and reasoning. **Activity:** Using Lesson 2 from Climate Consideration as a guide. Introduction: When asked about climate change, most people are able to give an opinion such as, "I believe...". This activity is going to help students get	Non-linguistic representations Cues & Questions	B Critical Thinking Communication Collaboration

		away from saying “I believe...” and instead say, “Based on the data...”. To accomplish this change of thinking students will be using an argumentation strategy known as Claim, Evidence, Reasoning 1. Students will be working in small groups to read figures from various sources to help answer this question: What is causing the global average temperature on Earth to increase? Based on what they know already, students will make a claim, collect evidence, and build an argument based on their analysis of the figures. a. Put students in groups of 3-4. Hand out a set of Evidence Figures for each group and a Claim, Evidence, Reasoning worksheet for each student. In their groups, students will study each figure and write a brief summary statement of what is being shown. What is the main concept or point being conveyed by the figure? Be sure to use the example format for your answers. b . Using the information you summarized, make a claim that answers the question: What is causing the global average temperature on Earth to increase? (Ex: Global temperatures have risen over the past century because there are more hot air balloons.) c. Give evidence to support your claim. Provide scientific data from the figures and data you were given. Include specific pieces of data. Students will also think about data they feel is missing. d. Give reasoning to explain why your evidence supports your claim. Why is your evidence important? Describe what it means that Earth’s temperature is rising and why your evidence allowed you to determine that the Earth is warming because of those reasons. e. After giving evidence and reasoning, would you revise your claim? Is there more info that you need? Write a statement about how you would revise your claim.Note: Teachers may decide to share the explanatory information given in the Evidence Figure Set Descriptions with students after they have made their own interpretations. 2. When students are finished with their worksheets, put students into groups		

		of five (5). Pass out the Discussion Diamond worksheet. Use the discussion diamond worksheet. In the center each student should write, "What is causing a rise in global temperatures?" Each partner will present their claim and then the rest of the group will write the claim and the lines of evidence provided in one triangle. Students should develop two clarifying questions based on their notes and ask the presenter. By the end of the presentations, students will each have a summary of the claims and evidence. 3. Students should discuss using similar or different evidence and if/how other group members use of evidence altered their own claim. Conclusion: Show the Separating Human and Natural Influences on Climate figure . In their notebooks, ask students to write their interpretation of the figure. What do each of the lines/colors mean? What are the contributing factors to those lines? Thinking about the other figures you reviewed, what connections can you make to this figure? Bring out the list of items that were discussed in the introduction activity. a. Figure Description: Observed global average changes (black line), model simulations using only changes in natural factors (solar and volcanic) in green, and model simulations with the addition of human-induced emissions (blue). Climate changes since 1950 cannot be explained by natural factors or variability, and can only be explained by human factors. 3. Invite groups to share their explanation of the figure and the connections they made.		
2-Develop and use a Model 7-Stability and	**ESS3.C** ESS3.D 1- Ask Questions and	**Lesson 6**: Local Impact of Climate Change **Objective**: The student will create a short documentary-style film about environmental changes in their community. **Activity:** Students will work in a small group to explore the topic of climate	Cooperative learning Non-linguistic representations Summarizing	D Creativity, Collaboration, Communication Critical Thinking

Change	Define Problems 4- Analyze and Interpret Data 7- Engage in Argument from Evidence 8- Obtain, evaluate and communicate information ISTE-1b, 2b	change as it applies to their local environment. The final product will be a short film/video. Through the process of filmmaking, the students will gain a deeper understanding of climate science and strengthen their ability to collaborate with their peers. **Check for understanding:** The teacher will guide students through the process of sharing a story through film. Once a group has chosen their topic, the students build a concept map to organize their thoughts. Each group will share their first draft concept map with another group. Groups will engage in peer feedback. Students will then produce a script based on feedback they received on their concept map. The students will create a storyboard based on the script. Before producing the film, students will individually write a short constructive response to a content-based prompt. The teacher can use these informal assessments to guide instruction. The final product can be assessed on: main idea/purpose, scientific content, organization, film and creativity.	and note taking	

UNIT RESOURCES

Teacher Resources:

- Ameren UE - energy efficiency kit - Bridget Murphy
- Planetary Heroes lesson - https://betterlesson.com/lesson/638035/planetary-heroes
- The Great Pacific Garbage Patch lesson - https://betterlesson.com/lesson/631903/the-great-pacific-garbage-patch
- Who Speaks for the Trees lesson https://betterlesson.com/lesson/638613/who-speaks-for-the-trees
- https://www.cocorahs.org/
- http://nca2014.globalchange.gov/report/appendices/climate-science-supplement
- https://www.climate.gov/teaching/national-climate-assessment-resources-educators/2014-national-climate-assessment-resources
- Middle Level Energy Series by National Science Teachers' Association, 1995
- Water in the News by Yael Calhoun, 2007
- Alternative Energy Sources (Science at the Edge Series) by Sally Morgan, 2009
- Investigation Air: Organizing, Analyzing, and Interpreting Information About the Quality of Air by National Science Teachers' Association, 1998
- McGraw-Hill Professional Development http://mhpdonline.com
- http://www.epa.gov/epahome/state/htm
- http://www.epa.gov

Student Resources:

This may include:

- *Earth Science Day Book*
- Online textbook: http://www.connected.mcgraw-hill.com
- Fossil Fuel (Energy Essentials Series) by Nigel Saunders and Steven Chapman, 2004
- Energy Technology (New Technology Series) by Chris Oxlade, 2008
- Using Nuclear Energy (Why Science Matters Series) by John Townsend, 2009
- American Museum of Natural History Science Bulletins http://www.amnh.org/sciencebulletins
- http://nationalatlas.gov/articles/people/a_energy.html
- www.nrcs.usda.gov
- http://www.amnh.org/exhibitions/climatechange/?section=making_a_difference&page=community_planning

Vocabulary

biodegradable- Capable of being broken down especially into innocuous products by the action of living things.

landfill- A system of trash and garbage disposal in which the waste is buried between layers of earth to build up low-lying land.
recycle- To process in order to regain material for human use.
nonrenewable resources- a natural resource that is being used up faster than it can be replaced by natural processes.
renewable resources-a natural resource that can be replenished by natural processes in a relatively short period of time.
fossil fuels- a natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
nuclear energy- energy stored in and released from the nucleus of an atom.
solar energy-energy from the sun.
wind energy- energy generated from the movement of air
hydroelectric power- electricity produced by flowing water
geothermal energy- thermal energy from Earth's interior
biomass energy- energy produced by burning organic matter, such as wood, food scraps, and alcohol
deforestation- the clearing of trees or forests to be used for non-forest use.
acid rain- rainfall made acidic by atmospheric pollution (burning of fossil fuels) and causes environmental harm

Unit 4: Space Systems

Content Area: Science	Course: 6th Grade Earth Science I	UNIT: Space Systems

Unit Description:	Unit Timeline:
The patterns of the apparent motion of the sun, the moon, stars, and planets can be observed, described, predicted and explained by scale models. The solar system consists of the sun and a collection of other objects, held in orbit around the sun by gravity. Our solar system is one of many galaxies in our universe.	9 weeks

DESIRED Results
Transfer Goal - ***Students will be able to independently use their learning to……*** 1. Ask questions and define problems. 2. Develop and use models. 3. Plan and carry out investigations. 4. Analyze and interpret data. 5. Use mathematical and computational thinking. 6. Construct explanations and design solutions. 7. Engage in an argument from evidence. 8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How do Earth's major systems interact?
- What are the predictable patterns caused by Earth's movement in the solar system?
- What is the universe, and what goes on in stars?

Phenomena:
Transit of Mercury

Solar Eclipse totality

Dung Beetles Use Snapshots of Milky Way as GPS

https://sites.google.com/site/sciencephenomena/

Standards Addressed		
Students who demonstrate understanding can: 6-8 ESS1-1 Develop and use a model of the Earth-sun-moon system to explain the cyclic patterns of lunar phases and eclipses of the sun and moon. [Clarification Statement: Examples of models can be physical, graphical, or conceptual and should emphasize relative positions and distances.] Linked to NGSS: MS-ESS1-1 **6-8-ESS1-2: Develop and use a model of the Earth-sun system to explain the cyclical pattern of seasons, which includes the Earth's tilt and directional angle of sunlight on different areas of Earth across the year. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]Linked to NGSS: MS-ESS1-1** 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 or conceptual.] MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.[Clarification Statement: 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.]		
Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
ESS1.A Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.(Rotation/Revolution)	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.	Patterns observed from their model to provide causal accounts for events, including: Moon phases, eclipses, and seasons.
ESS1.B This model of the solar system can explain eclipses of the Sun and the Moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	**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.**	**Patterns observed from their model to provide causal accounts for events, including: Moon phases, eclipses, and seasons.**
ESS1.B The solar system consists of the Sun	Develop a model in which they identify the	The structure of the solar system, structure of

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.	relevant components of the solar systems including gravity, the Sun, planets, moons, and asteroids.	the galaxy, structure of the universe), students develop a model in which they identify the relevant functions of the system.
ESS1.A Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.	Develop a model of the Milky Way galaxy, demonstrating how it is a collection of stars (including our Sun) and their associated systems.	Galaxies are collections of stars; they vary in shape and size. The Milky Way is a spiral galaxy that contains our solar system.
ESS1.B The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	Describe the relationships and interactions between components of the solar system, including gravity and the orbital motion of objects in our solar system.	The patterns of motion of the objects in the solar system can be described and predicted on the basis of observations and an understanding of gravity.

Unit 4: Assessment

EVIDENCE of LEARNING			
Understanding 1- Patterns	Standards **6-8 ESS1-1** **ESS1.B** 2- Develop and use models ISTE 4c	**Unit Performance Assessment**: **Description of Performance Task:** Great Seasons Debate Students will use the the Great Seasons Debate activity as a culminating assessment following a series of lessons that addresses what factors actually cause seasons and which are commonly held misconceptions. Students first examine 3 claims about what causes seasons, look for patterns in the data, and predict which are accurate. Students are then challenged to collect and analyze data using an online interactive model that either provides evidence to support their predictions about each claim or proves it to be a misconception. Literacy, note taking and argumentative elements are an essential part of the process and interwoven into final R.A.F.T. product where students produce a draft of an e-mail addressed to their teacher identifying whether each claim is factual or a misconception using data and notes to justify their position on each. **Teacher will assess:** ● Claim has been identified. ● Justification of the claim ● Adequate notes ● Final product is organized, legible, and complete **Performance:** **Mastery:** · Accurate content information · Application of Literacy Standards · Completion using R.A.F.T. format · Personalization and creativity **Scoring Guide:** **Great Seasons Debate Scoring Guide**	**R/R Quadrant** **21 Century** *D* *Critical thinking* *Communication*

Unit 4: Suggested Activities

LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
1- Patterns	**ESS1.B** 2-Develop and Use a Model ISTE-3d	**1. Lesson**: Seasons: SAS Curriculum Pathways Student worksheet **Objective**: Students will calculate the mean distance between the Earth and the Sun for each of the four seasons. Using data, students will explain whether or not the mean distance between Earth and the Sun explains our seasons. **Activity:** Students will use the model on the website to record the distance between Earth and the Sun on the first day of each calendar month. Students will calculate the mean distance for each of the four seasons. Students will look for patterns in the data to explain whether the distance between Earth and the Sun is the reason for the seasons.	Non-linguistic representations Assigning Homework and Providing Practice	B Critical Thinking
1- Patterns 6- Structure and function	ESS1.A 2-Develop and use a model to describe moon phases. ISTE-1c	**2. Lesson**: Phases of the Moon Gizmo Phases of the Moon Gizmo Student Exploration Phases of the Moon Gizmo Student Exploration Answer Key **Objective**: Students will be able to develop and use a model to describe moon phases. **Activity:** Students will observe the 8 moon phases as it revolves around the Earth using an interactive model. Students will answer analytical questions and complete a diagram of the phases.	Cues, Questions, and Advance organizers Non-linguistic representations Identifying Similarities and Differences	B Critical Thinking
6- Structure and function	2- Develop and use a model	3. **Lesson**: Rules of Gravity Poster **Objective**: Students will use the rules of gravity and orbital motion to create a poster that models these rules.	*Non-linguistic representations* *Identifying*	A Creativity

	ISTE-1a	**Check for understanding:** **Rules of Gravity Poster Scoring Guide** Students should model that all objects that have mass have a gravitational force, the force of gravitation changes with distance, and the amount of gravitation force is affected by mass.	*Similarities and Differences*	
3-Scale, Proportion, and Quantity 6- Structure and function	2-Develop and Use a Model ISTE-1c	**Lesson 4**: Solar System Number Line **Objective**: Students will develop a scaled model of the solar system. Models will include data which explains objects features, composition, and locations within the solar system. **Activity:** The students will use a folding pattern on a long strip of paper to model the accurate representation of the planets orbits. Students will also include the asteroids, comets, and meteors in their model. This helps students understand the vastness and wonder of the solar system.	*cooperative learning* *Cues, Questions, and Advance organizers* *Non-linguistic representations* *Identifying Similarities and Differences*	*B* *Creativity,* *Collaboration, Communication,* *Critical Thinking*

UNIT RESOURCES
Teacher Resources: • **Seasons Brainpop http://www.brainpop.com** • **Leap Year Brainpop http://www.brainpop.com** • **Solstice & Equinox Brainpop http://www.brainpop.com** • **Moon Brainpop http://www.brainpop.com** • **Moon Phases Brainpop http://www.brainpop.com** • **Solar System Brainpop http://www.brainpop.com** • **Bill Nye A Reason for the Seasons** • **Discovery Education Bill Nye Greatest Discoveries with Bill Nye: Astronomy https://app.discoveryeducation.com/learn/videos/04744e86-ba58-4dd9-be32-32baad2e8c1d?hasLocalHost=false** • **Discovery Education A Spin Around the Solar System: How the Solar System Works https://app.discoveryeducation.com/learn/videos/be531185-9c5b-442b-bb55-bfab42203bc8?hasLocalHost=false** • **Discovery Education A Spin Around the Solar System: Moon Dance https://app.discoveryeducation.com/learn/videos/1d050d7c-c8e5-4703-91e8-3d17ee231387?hasLocalHost=false** • **Gravity/ Orbits simulations https://phet.colorado.edu/en/simulation/gravity-and-orbits** •
Student Resources: • **Seasons Brainpop http://www.brainpop.com** • **Leap Year Brainpop http://www.brainpop.com** • **Solstice & Equinox Brainpop http://www.brainpop.com** • **Moon Brainpop http://www.brainpop.com** • **Moon Phases Brainpop http://www.brainpop.com** • **Solar System Brainpop http://www.brainpop.com** • **Gravity/ Orbits simulations https://phet.colorado.edu/en/simulation/gravity-and-orbits** •
Vocabulary: · **Rotation**– the Earth spinning on its axis. · **Revolution** – Earth's yearlong elliptical orbit around the sun. · **Orbit**– curved path followed by a satellite as it revolves around an object. · **Ellipse**—elongated, closed curve that describes Earth's yearlong orbit around the Sun. · **Day**—the time for one complete rotation of Earth on its axis.

- **Year**—the time for one complete revolution around the Sun
- **Axis**—imaginary vertical line around which Earth spins.
- **Solstice**—twice-yearly point at which the Sun reaches its greatest distance north or south of the equator.
- **Moon phase**—change in appearance of the Moon as viewed from the Earth, due to the relative positions of the Moon, Earth, and Sun.
- **Equinox**—the two days of the year on which neither hemisphere is tilted toward or away from the sun.
- **Lunar eclipse**—occurs when Earth's shadow falls on the Moon.
- **Solar eclipse**—occurs when the Moon passes directly between the Sun and Earth and casts a shadow over part of Earth.
- **Waxing**—describes phases following a new moon, as more of the Moon's lighted side becomes visible.
- **Waning**—describes phases that occur after a full moon, as the visible lighted side of the Moon grows smaller.
- **Gravity**—a force that pulls objects toward each other.
- **Astronomical unit**—the mean distance between the Earth and the sun.
- **Light year**—the distance that light travels in one year, about 9.5 million million (trillion) kilometers.
- **Satellite**—an object that revolves around another object in space.
- **Asteroid**—Rocky objects revolving around the sun that are too small and numerous to be considered planets.
- **Meteoroid**—a chunk of rock or dust in space.
- **Comets**—a loose collection of ice, dust and small rocky particles, typically with a long, narrow orbit of the sun.