Unit 6.4 Plate Tectonics & Rock Cycling

Content Area: **Science**
Course(s): **Science 6**
Time Period: **Marking Period 4**
Length: **MP 4**
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Essential Questions

What causes Earth's surface to change?

Lesson 1 What is causing Mt. Everest and other mountains to move, grow, or shrink.

Lesson 2 How are earthquakes related to where mountains are located?

Lesson 3 How does what we find on and below Earth's surface compare in different places?

Lesson 4 What is happening to Earths' surface and the material below it during an earthquake?

Lesson 5 How does plate movement affect the land around mountains such as Mt. Everest?

Lesson 6 How could plate movement help us explain how Mt. Everest and other locations are changing in elevation?

Lesson 7 What happens at mountains where we see volcanic activity?

Lesson 8 What is occurring at locations where two plates are moving away from each other?

Lesson 9 What causes mountains to change?

lesson 10 Where were Africa and South America in the past?

Lesson 11 Where were the other plates located in the distant past?

Lesson 12 Where did mountains that aren't at plate boundaries today, like the Appalachians and Urals, come from?

Lesson 13 What causes mountains to shrink in elevation?

Lesson 14 How is there an exposed marine fossil on Mt. Everest? And, what other remaining questions from our Driving Question Board can we now answer?

Big Ideas

Unit Summary and Storyline

Mountains move! And there are ocean fossils on top of Mt. Everest! In this plate tectonics and rock cycling unit, students come to see that the Earth is much more active and alive than they have thought before. The unit launches with documentation of a 2015 Himalayan earthquake that shifted Mt. Everest suddenly to the

southwest direction. Students also discover that Mt. Everest is steadily moving to the northeast every year and getting taller as well. Students wonder what could cause an entire mountain to move during an earthquake.

Students investigate other locations that are known to have earthquakes and they notice landforms, such as mountains and ridges that correspond to earthquake patterns. They read texts, explore earthquake and landform patterns using a data visualization tool, and study GPS data at these locations. Students develop an Earth model and study mantle convection motion to explain how Earth's surface could move from processes below the surface. From this, students develop models to explain different ways plates collide and spread apart, ultimately explaining how Mt. Everest could move all the time in one direction, and also suddenly, in a backward motion, during an earthquake. The unit ends with students using what they have figured out about uplift and erosion to explain how a fossil was found at Mt. Everest without having to dig for it.

Anchoring Phenomenon

For the anchoring phenomenon, students read text about how Mt. Everest has increased in elevation over time and analyze data cards about 5 other mountains around the world looking for evidence of other mountains changing as well. This phenomenon around the tallest mountain changing in height is confounding and supports students in beginning to think about how other places on Earth's surface might be changing as well.

Each OpenScied unit's anchoring phenomenon is chosen from a group of possible phenomena after analyzing student interest survey results and consulting with several external advisory panels. The Mt. Everest, and other mountain cases analyzed in this unit were chosen for the following reasons:

- Mt. Everest, as the tallest mountain above sea level, is familiar to students and surprising to read that a mountain can change in height. In addition, the most recent height was determined when scientists from Nepal and China agreed to share data for more accuracy. This was added to the initial article students read to support the Nature of Science ideas that more data leads to more accuracy.
- Students' experience with mountains changing over time is mostly limited so a set of 5 other mountain cases are also part of the anchoring lesson to provide students with additional information about whether mountains change. The addition of these data cards helps students begin making connections to changes in the land around the places they live and visit.

Cross-Curricular Integration

Language Arts Companion Standards:

WHST 6-8.1 Write arguments focused on *discipline-specific content*.

WHST 6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

RST 6-8.1 Cite specific textual evidence to support analysis of science and technical texts.

RST 6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

RST 6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a

text.

RST6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Activity:

Pyramid of Energy: What is the process of energy flow from the sun through tertiary consumers? Based on your background knowledge and evidence from your research about the energy pyramid, could an ecosystem survive when inverted? In an essay, explain the flow of energy in the pyramid. Explain the effects of inverting the ecosystem. Defend your position related to ecosystem survival. Use research and credible evidence to support your claim and opinion.

Diversity Integration

Objective: Students will complete a graphic organizer on a Scientist from a diverse background or protected class.

Activity:

1. Students are to make a copy of the graphic organizer that they are to complete on the scientists.
2. They will then need to complete the organizer by doing research on the person and their field of science that the scientists work in.
3. After finding information about the scientist, they will then need to write a paragraph on the person and explain to us "Why is this scientist famous? What have they done in their lifetime to help out the world?"

Science and Society

Thomas Malthus

Essays on the Principle of Population

Rachel Carson

American biologist and environmentalist

John Muir

Naturalist

CSDT Technology Integration

8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.

8.1.8.DA.5 Test, analyze .and refine computational models

Activity:

SWBAT complete a web-based research project on 2 different biomes that make up the Earth's ecosystems and create a Google Slide presentation that they will present to the class.

Enduring Understandings

Next Generation Standards

MS. Human Impacts/Interdependent Relationships in Ecosystems

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

MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their impact.

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Disciplinary Core Ideas

ESS3.A: Natural Resources

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable

over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

ESS3.B: Natural Hazards

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)

ESS3.C: Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But Changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS- ESS3-3),(MS-ESS3-4)

LS2.A: Interdependent Relationships in Ecosystems

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually Beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (MS-LS2-5)

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)

Crosscutting Concepts

Patterns

Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Cause and Effect

Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)

Cause and effect relationships may be used to predict phenomena in natural or designed systems.

(MS-ESS3-1), (MS-ESS3-4)

Stability and Change

Small changes in one part of a system might cause large changes in another part. (MS-LS2-4)

Focus Areas

Populations and Communities

- An organism gets the things it needs to live, grow and reproduce from its environment.
- Biotic and abiotic factors make up a habitat.
- The levels of organization in an ecosystem are organism, population, and community.
- Populations can change in size when new members join the population or when members leave the population.
- Some limiting factors for populations are weather conditions, space, food, and water.
- Every organism has a variety of adaptations that are suited to its specific living conditions and help it survive.
- Two major types of interactions among organisms are competition and predation.
- The three main types of symbiotic relationships are mutualism, commensalism, and parasitism.
- Unlike primary succession, secondary succession occurs in a place where an ecosystem currently exists.

Ecosystems and Biomes

- Each of the organisms in an ecosystem fills the energy role of producer, consumer, or decomposer.
- Energy moves through an ecosystem when one organism eats another.
- The most energy is available at the producer level of the pyramid. As energy moves up the pyramid, each level has less energy available than the level below.
- The processes of evaporation, condensation, and precipitation make up the water cycle.
- The processes by which carbon and oxygen are recycled are linked. Producers, consumers, and decomposers play roles in recycling both.
- Nitrogen moves from the air into the soil, into living things, and back into the air or soil.
- The six major biomes are desert, rainforest, grassland, deciduous forest, boreal forest and tundra.
- There are two types of aquatic, or water-based, ecosystems: freshwater ecosystems and marine (or saltwater) ecosystems.
- Continental drift, wind, water, and living things are all means of distributing species. Other factors, such as physical barriers, competition and climate can limit species dispersal.

Resources and Living Things

- Environmental issues fall into three main categories: Resource use, population growth, and pollution.
- To balance opinions, decision makers weigh the cost and benefits of a proposal.
- Natural resources include organisms, water, sunlight, minerals, and oil.
- Humans depend on Earth's natural resources for survival and for development.
- Biodiversity has both economic value and ecological value within an ecosystem.
- Factors that affect biodiversity include climate, area, niche diversity, genetic diversity, and extinction.

- Biodiversity can be negatively or positively affected by the actions of humans.

Service Learning

Community Issue: Students will choose between one of these issues to research, create a presentation on how they can help with this issue in Milltown, and then make a pamphlet to be posted.

Focus Areas:

- **Pre-Reflection:**
  - Students in their groups, will look over the list of types of projects they can do their project on.
  - They will talk about what they already know about the environment and how they can help it. Using their previous knowledge, they will choose the best project for their group.
- **Research:**
  - Students will research their topic. They will brainstorm and come up with a concept map of how they want to create their presentation Google Slides and their pamphlet in Google Docs.
- **Presentation & Pamphlet:**
  - Students will take all of their research on their chosen topic and create a presentation in Google Slides. This presentation will be presented to the class.
  - Students will also come up with a pamphlet summarizing their presentations that can be shared on Parent Square to help bring awareness to the Milltown Community.
- **Reflection:**
  - Students will then reflect (in their science journals?) on how they think their project went, and how they will use the suggestions they provided to help the environment.

Activity:

- **Athletic Shoe Recycling:** Learn about the resources needed to create athletic shoes, and the amount of landfill space used to dispose of them. Create a campaign to recycle athletic shoes at your school.
- **Biking Clinic:** Use the internet and other resources to gather information about bike safety, investigating the health benefits of biking, and the energy savings of bicycle transportation. Create a pamphlet on bike safety for local youth and community members.
- **Computer Recycling:** Investigate the different types of materials used to build computers and how these materials can be either disposed of or recycled. Develop a brochure to encourage community members to recycle old electronics and where to bring them.
- **Create a Rain Garden:** Study the benefits of rain gardens and the scientific principles which support their use. Create a brochure to help your community create a rain garden at your school, using native trees and shrubs.
- **Hiking Guide for Students:** Using research from the internet, the library, and interviews with experts, gather information about local hikes. Learn from experts what to bring along on a hike. Create an informational brochure or website to share with the community.
- **Ladybugs for Natural Pest Control:** Learn alternative methods of pest control and the different impacts that these methods have on the environment. Create a brochure to demonstrate how everyone

in town can do this and not use harmful pesticides.

- **Making Enviro-Friendly Cleaners:** Learn about the chemicals contained in traditional cleansers and their impacts on humans and the environment. Research alternative methods of cleaning. Produce environmentally friendly cleansers show Milltown how you make them in videos or pamphlets so they can make the cleaners.
- **Saving Water:** Research and study water needs and usage in the community. Learn about conservation strategies from the water bureau. Design and publish a water-saving tip sheet to distribute to parents and community residents, and create a coloring book illustrating the tips for the community's youngest residents.
- **Sustainable Gardening:** Learn how traditional gardening methods can have a negative impact on water quality and other environmental indicators. Research alternative methods and train community members in sustainable gardening by creating a "How To" pamphlet.

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2)

Constructing Explanations and Designing Solutions

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)
- Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)
- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

Engaging in Argument from Evidence

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2- 5)

Climate Change

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

- Activity: Students will be able to develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Students will be assessed by creating a visual diagram illustrating the cycling of matter and flow of energy within an ecosystem, labeling key components accurately.

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

- Activity: Students will be able to develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Students will be assessed by creating a visual diagram illustrating the cycling of matter and flow of energy within an ecosystem, labeling key components accurately.

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

- Activity: Students will be able to develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Students will include human activities in this process as well as how it effects other aspects of the process. Students will be assessed by creating a visual diagram illustrating the cycling of matter and flow of energy within an ecosystem, labeling key components accurately.

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

- Activity: Analyze and interpret data on natural hazards to forecast future catastrophic events and explain how this information can be used to develop technologies that mitigate their effects. Create a digital or physical map of a specific region, plotting historical natural hazards and using this data to forecast potential future events. Write a short report explaining their predictions and suggesting at least two technologies or strategies to mitigate the effects of these potential hazards. The report should include at least one relevant percentage or statistical data point to support their analysis.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

- Activity: Design a scientific method for monitoring and minimizing a specific human impact on the environment, considering both positive and negative effects on different living things. Create a detailed poster presentation that outlines their designed method for monitoring and minimizing a chosen human impact on the environment. The poster should include (1) Identification of a specific human activity affecting the environment. (2) Description of positive and negative impacts on different living things. (3) A step-by-step scientific method for monitoring the impact. (4) Proposed solutions for minimizing negative effects. (5) Use of integers and rational numbers to quantify environmental changes.

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.

- Activity: Construct an evidence-based argument explaining how increases in human population and per-capita consumption of natural resources impact Earth's systems, including both negative and positive effects on different living things. Create a poster presentation that: (1) Identifies a specific human activity impacting Earth's systems. (2) Explains how this activity relates to population growth or resource consumption. (3) Describe at least one negative and one positive impact on different living

things. (4) Provides evidence from reliable sources to support their claims. (5) Proposes a solution or mitigation strategy from negative impacts.

Resources

Savvas Interactive Science - Ecology and Environment 2016

Scientific Inquiry

MS-LS2-1 (5.3.8.C.1) *Human Population Growth*, p. 10-12
MS-LS2-2 (5.3.8.C-D) *Ecosystem Food Chains*, p. 43-46