Grade 8 Science, Quarter 4, Unit 4.1

Processes that Shape the Earth

Overview

Number of instructional days: 20 (1 day = 45 minutes)

Content to be learned

- Explain the role of differential heating and convection on climate.
- Explain cause and effect relationships between global climate and energy transfer.
- Use evidence to make inferences and predictions about global climate issues.
- Use geological evidence to support the idea that the earth's crust/lithosphere is composed of plates that move.
- Cite evidence and develop a logical argument for plate movement using fossil evidence, layers of sedimentary rock, location of mineral deposits, and shape of the continents.
- Evaluate slow processes of weathering, erosion, mountain building, and sea floor spreading to determine how the earth has changed and will continue to change over time.

Science processes to be integrated

- Explain cause and effect relationships.
- Collect evidence to explain concepts.
- Make inferences and predictions based on evidence collected.
- Develop a logical argument citing evidence.
- Identify patterns of change.
- Participate in inquiry activities.
- Explain changes within systems.

Essential questions

- What is the effect of differential heating or convection on climate?
- How can information about global climate and energy transfer be used to make predictions about global issues?
- What evidence exists to support the idea that the earth's crust is composed of plates that move?
- What are some examples of how slow processes have changed and will continue to change the earth?

Written Curriculum

Grade Span Expectations

ESS1 - The earth and earth materials as we know them today have developed over long periods of time, through continual change processes.

ESS1 (5-8) SAE+ POC –4

Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate.

ESS1 (7-8)–4 Students demonstrate an understanding of processes and change over time within earth systems by …

4a explaining cause and effect relationships between global climate and energy transfer.

4b using evidence to make inferences or predictions about global climate issues.

ESS1 (5-8) INQ+ POC –1

Use geological evidence provided to support the idea that the Earth's crust/lithosphere is composed of plates that move.

ESS1 (7-8)–1 Students demonstrate an understanding of processes and change over time within earth systems by …

1a citing evidence and developing a logical argument for plate movement using fossil evidence, layers of sedimentary rock, location of mineral deposits, and shape of the continents.

ESS1 (5-8) POC –3

Explain how earth events (abruptly and over time) can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.

ESS1 (7-8)–3 Students demonstrate an understanding of processes and change over time within earth systems by …

3a evaluating slow processes (e.g. ~~weathering, erosion, mountain building~~, sea floor spreading) to determine how the earth has changed and will continue to change over time.

Clarifying the Standards

Prior Learning

In grades K–2, students demonstrated an understanding of processes and changes over time within earth systems by observing and recording seasonal and weather changes throughout the year.

Students investigated local landforms and how wind, water, or ice have shaped and reshaped them. Students also built and used models to simulate the effects of how wind and water shape and reshape the land and they identified sudden and gradual changes that affect the earth.

In grades 5–6, students explained how differential heating and convection affect earth's weather patterns. They described how differential heating of the oceans affects ocean currents, which in turn influence weather and climate. Students also explained the relationship between differential heating/convection and the production of winds. Students analyzed global patterns of atmospheric movements to explain effects on weather and predicted temperature and precipitation changes associated with the passing of various fronts.

Students identified and described the layers of the earth and plotted the location of volcanoes and earthquakes to explain the relationship between the location of these phenomena and faults.

In grade 7, students evaluated fast processes such as erosion, volcanoes, and earthquakes, to determine how the earth has changed and will continue to change over time. Students also investigated the effect of flowing water on landforms using stream tables and/or their local environment.

Current Learning

The instructional level for the content in this unit of study will be developmental and reinforcement. This unit of study focuses on plate movement, sea floor spreading, the relationship between global climate and energy transfer, and global climate issues.

Students explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate. They also explain how earth events (abruptly and over time) can bring about changes in earth's surface: landforms, ocean floor, rock features, or climate. Students focus on how these events in earth systems by look in terms of patterns of change over time.

Students use provided geological evidence to support the idea that the earth's crust/lithosphere is composed of plates that move. They collect evidence, making models/diagrams and explaining their findings cooperatively, in whole class discussions and in written form. Using evidence, they can now develop a logical argument for how the earth has changed over time. Evaluating sea floor spreading helps students demonstrate an understanding of the process of change over time. Through a series of inquiry experiences, students identify patterns within the geological evidence and develop logical arguments based on that evidence.

Future Learning

In high school, students will demonstrate an understanding of processes and change over time within earth systems by explaining how convection circulations of the mantle initiate the movement of the crustal plates which cause plate movement and seismic activity. Students will also explain how the physical and chemical processes of the earth alter the crust in various ways such as seafloor spreading or weathering.

Additional Research Findings

"At this level, students are able to complete most of their understanding of the main features of the physical and biological factors that shape the face of the earth. This understanding will still be descriptive because the theory of plate tectonics will not be encountered formally until high school. Of course, students should see as great a variety of landforms and soils as possible. "

"It is especially important that students come to understand how sedimentary rock is formed periodically, embedding plant and animal remains and leaving a record of the sequence in which the plants and animals appeared and disappeared. Besides the relative age of the rock layers, the absolute age of those remains is central to the argument that there has been enough time for evolution of species. The process of

sedimentation is understandable and observable. But imagining the span of geologic time will be difficult for students." (p. 73)

"Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or that are too vast to be changed deliberately, or that are potentially dangerous. Students should have many opportunities to learn how conceptual models can be used." (*Benchmarks for Science Literacy,* p. 26)

"Students of all ages may hold the view that the world was always as it is now, or that any changes that have occurred must have been sudden and comprehensive." (*Atlas of Science Literacy,* p. 50)

"… learning about plates and their movement should wait until after students have developed ideas about change and the earth's landforms…" (*Atlas of Science Literacy,* p. 52)

Notes About Resources and Materials

Suggested websites:

- Geologic time — http://www.uky.edu/KGS/education/geologictimescale.pdf
- General earth science website — http://earthguide.ucsd.edu/
- Pangaea reconstruction — http://earthguide.ucsd.edu/earthguide/diagrams/plate_reconstruction/platereconstruction.html
- Climate change animation — http://www.scotese.com/paleocli.htm
- Climate change lab — http://www.billsclimatelab.org/
- http://library.thinkquest.org/17457/platetectonics/4.php
- Evidence for climate change — http://climate.nasa.gov/evidence/

Textbooks:

Inside Earth

- pp. 28–32 Drifting continents
- pp. 33–39 Sea-floor spreading
- pp. 40–41 Sea-floor spreading

Weather and Climate [4a and 4b]

- pp. 42–45 Energy in the Atmosphere
- pp. 110–118 What Causes Climate?
- pp. 134–138 Long-Term Changes in Climate
- pp. 139–142 Global Changes in the Atmosphere
- pp. 132–133 "Cool Climate Graphs" Lab

Grade 8 Science, Quarter 4, Unit 4.2

Space Science

Overview

Number of instructional days: 20 (1 day = 45 minutes)

Content to be learned

- Explain how the regular and predictable motion of the earth and sun causes the day/night cycle.
- Explain how the regular and predictable motion of the sun and earth causes seasons.
- Explain how the regular and predictable motion of the earth and moon causes tides.
- Explain how the regular and predictable motion of the sun and earth causes a year.
- Describe the relationship between distance and the gravitational force between objects.
- Explain that the sun's gravitational pull holds the earth and other planets in their orbits.
- Explain how the planet's gravitational pull keeps their moons in orbit.

Science processes to be integrated

- Use diagrams and physical models.
- Describe cause and effect relationships.
- Identify patterns of change.
- Evaluate changes within systems.

Essential questions

- How does the revolution of earth around the sun and the rotation of earth on its axis cause day/night, year, and seasons?
- How does the relationship between the positions of the earth, sun, and moon result in tidal patterns that we observe on earth?
- Why do the earth and other planets remain in orbit around the sun (and moons remain in orbit around planets)?
- How do mass and distance between objects in space affect the gravitational force between these objects?

Written Curriculum

Grade Span Expectations

ESS2 - The earth is part of a solar system, made up of distinct parts that have temporal and spatial interrelationships.

ESS2 (5-8) SAE+ POC –8

Explain temporal or positional relationships between or among the Earth, sun, and moon (e.g., night/day, seasons, year, tides) or how gravitational force affects objects in the solar system (e.g., moons, tides, orbits, satellites).

ESS2 (7-8) -8 Students demonstrate an understanding of temporal or positional relationships between or among the Earth, sun, and moon by …

8b explaining night/day, seasons, year, and tides as a result of the regular and predictable motion of the Earth, sun, and moon.

8d describing the relationship between mass and the gravitational force between objects.

8e describing the relationship between distance and the gravitational force between objects.

8f explaining that the sun's gravitational pull holds the Earth and other planets in their orbits, just as the planet's gravitational pull keeps their moons in orbit.

Clarifying the Standards

Prior Learning

In grades K–2, students observed that the sun can only be seen in the daytime, but the moon can be seen sometimes at night and sometimes during the day. They also observed that the sun and moon appear to move slowly across the sky and observed that the moon looks slightly different from day to day.

In grades 3–4, students reinforced their learning from grades K–2 and added observations that the stars appear to move slowly across the sky. Students added to their observations of the moon by observing that while the moon looks slightly different from day to day, it looks the same again in about four weeks. Students also recognized that the rotation of the earth on its axis every 24 hours produces the day/night cycle.

In grades 5–6, students identified and compared the size, location, distances, and movement of the objects in our solar system. Students explained night/day, seasons, year, and tides as a result of the regular and predictable motion of the earth, sun, and moon. Students also used models of the earth, sun, and moon to recreate the phases of the moon.

In grade 7, students created and used models of the earth, sun and moon system to show rotation and revolution. They also used a model of the earth, sun, and moon to recreate the phases of the moon.

Current Learning

The instructional level for this unit of study is primarily reinforcement. The study of night/day, seasons, year, and tides are a repeat of the standard in grades 5–6. Therefore, at this grade level, students will focus on demonstrating an understanding of temporal or positional relationships between or among the earth, sun, and moon.

Students at this level are also focused on how gravitational force affects objects in the solar system. Universal gravitation, which is introduced in grades 6–8, is a very abstract idea and is especially hard to grasp because gravitational forces between objects such as soda cans, pencils, and people are not noticeable. Students will examine the differences between the gravitational pull of very large objects and smaller objects in the solar system. For example, they can compare the gravitational pull of the sun compared to the gravitational pull of the earth in order to explain why earth orbits the sun instead of the other way around.

Students will also need to compare the gravitational pull of objects based on their relative distance from each other. They use models to represent the temporal and positional relationship between the earth, sun, moon, and planets by moving around the classroom, modeling the motion of these objects. The learning for this unit unifies dispersant ideas such as gravity, tides, seasons, and day/night into a connected earth, sun, moon system.

Future Learning

In high school, students will demonstrate an understanding of forces and motion by using Newton's laws of motion. They will demonstrate an understanding of forces and motion by explaining through words, charts, diagrams, and models the effects of distance and the amount of mass on the gravitational force between objects. They will explain components of the universe, and various theories regarding the universe.

Additional Research Findings

According to *Benchmarks for Science Literacy*:

"Students can now consolidate their prior knowledge of the earth (as a planet) by adding more details (especially about climate), getting a firmer grasp of the geometry involved in explaining the seasons and phases of the moon, improving their ability to handle scale, and shifting their frame of reference away from the earth when needed."

Gravity, earlier thought of as acting toward the ground, can by now be thought of as acting toward the center of the spherical earth and reaching indefinitely into space.

The cause of the seasons is a subtle combination of global and orbital geometry and of the effects of radiation at different angles. Students can learn part of the story at this grade level, but a complete picture cannot be expected until later." (p. 68)

Earth is the only body in the solar system that appears able to support life. The other planets have compositions and conditions very different from the earth. Everything on or anywhere near the earth is pulled toward the earth's center by gravitational force. The moon's orbit around the earth once in about 28 days changes what part of the moon is lit by the sun and how much of that part can be seen from the earth—the phases of the moon. (p. 69)

"Every object exerts gravitational force on every other object. The force depends on how much mass the objects have and on how far apart they are. The force is hard to detect unless at least one of the objects

has a lot of mass. The sun's gravitational pull holds the earth and other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them." Page 95

According to *Making Sense of Secondary Science*:

"… a lack of understanding of the relative size and relative distance apart of the earth, sun, and moon. Most pupils drew three [circles] of the same size or between half or double each other's diameter, and the sun and moon were drawn within one to four earth diameters away from the earth. These misconceptions … may be compounded, or indeed caused, by the, models used in the classroom or by the diagrams in books, which do not use the true scale for the size and distance." (p. 171)

According to the *Atlas for Science Literacy*:

"Students cannot accept that gravity is center-directed if they do not know the earth is spherical. Nor can they believe in a spherical earth without some knowledge of gravity to account for why people on the 'bottom' do not fall off. Students are likely to say many things that sound right even though their ideas may be very far off base. For example, they may say that the earth is spherical, but believe that people live on a flat place on top or inside of it—or believe that the round earth is 'up there' like other planets, while people live down here. Research suggests teaching the concepts of spherical earth, space, and gravity in close connection to each other. Students of all ages may hold misconceptions about the magnitude of the earth's gravitational force." (p. 42)

"Explanations of the day-night cycle, the phases of the moon, and the seasons are very challenging for students. To understand these phenomena, students should first master the idea of a spherical earth, itself a challenging task. Similarly, students must understand the concept of 'light reflection' and how the moon gets its light from the sun before they can understand the phases of the moon. Finally, students may not be able to understand explanations of any of these phenomena before they reasonably understand the relative size, motion, and distance of the sun, moon, and the earth. Student ideas about the shape of the earth are closely related to their ideas about gravity and the direction of "down". (p. 44)

Notes About Resources and Materials

- Lab activity about gravity – http://sciencespot.net/Media/gravlab.pdf
- http://msteacher.org/epubs/science/science7/animators.aspx
- http://www.wliw.org/edonline/ntti/resources/lessons/gravity/index.html

Textbooks

- Astronomy – 8b
- Night and day – p. 15
- Year – pp. 15–17
- 21 seasons – p. 18
- Tides – pp. 32–34
- Seasons (skills lab) – pp. 22 – 23