Grade 7 Science, Quarter 3, Unit 3.1

Space Science

Overview

Number of instructional days: 20 (1 day = 50 minutes)

Content to be learned

- Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about our solar system.
- Identify how technological advances made by scientists and cultures have contributed to our understanding of the earth as part of the solar system.
- Demonstrate understanding of temporal or positional relationships between or among the earth, sun, and moon (night/day, seasons, year, tides).
- Create or use a model of the earth, sun, and moon system to demonstrate rotation and revolution.
- Recreate phases of the moon using a model of the earth, sun, and moon system.

Science processes to be integrated

- Explain technological advances in science within systems.
- Identify major discoveries.
- Create a timeline or research project or picture book.
- Use models to explain the interaction between or among structures within a system.

Essential questions

- How have varying cultures/scientists used technology throughout history to understand the solar system?
- How can we distinguish between the rotation and revolution of the earth, sun, moon system?
- What causes the change in moon phases within a lunar month?
- How do cyclical changes in the position of the earth, sun, and moon cause changes such as day to night, seasons, years, and tides?

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) NOS –7

Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the solar system.

ESS2 (7-8) -7 Students demonstrate an understanding of how technological advances have allowed scientists to re-evaluate or extend existing ideas about the solar system by…

7a identifying major discoveries from different scientists and cultures and describing how these discoveries have contributed to our understanding of the solar system (e.g. timeline, research project, picture book).

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 …

8a using or creating a model of the earth, sun, and moon system to show rotation and revolution.

8c using or a model of the earth, sun, and moon to recreate the phases of the moon.

ESS3 - The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time

No further targets for EK ESS3 at the 5-8 Grade Span

The GSEs listed below are assessed at the local level only

ESS3 (7-8)-9 Students demonstrate an understanding of the structure of the universe by…

9a describing the universe as containing many billions of galaxies, and each galaxy contains many billions of stars.

Clarifying the Standards

Prior Learning

Within grades 3 and 4, students recognized that the sun is the center of our solar system; the earth is one of several planets that orbit the sun; and the moon orbits the earth. Also students recognized that it takes approximately 365 days for the earth to orbit the sun. In grades 5 and 6, students learned the relationship between or among the earth, sun, and moon by using models to describe the relative motion/position of the earth, sun, and moon. Students demonstrated an understanding of gravitational relationships between

or among objects of the solar system by defining the earth's gravity as a force that pulls any object on or near the earth toward its center without touching it.

Current Learning

This unit of study reinforces the relative position of the earth, moon, and sun. The unit also reinforces the idea that the earth, moon, and sun are part of the solar system. The developmental stage of learning encompasses the phases of the moon and the rotation and revolution of the earth and the technological advances from various cultures that enable us to learn more in astronomy.

The student identifies the earth as part of the solar system, made up of distinct parts that have temporal and spatial interrelationships. Students explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the solar system. Students demonstrate an understanding of how technological advances have allowed scientists to re-evaluate or extend existing ideas about the solar system by identifying major discoveries from different scientists and cultures and describing how these discoveries have contributed to our understanding of the solar system (e.g., timeline, research project, picture book). Students explain temporal or positional relationships between or among the earth, sun, and moon (e.g., night/day, seasons, year, tides). Students demonstrate an understanding of temporal or positional relationships between or among the earth, sun, and moon by using or creating a model of the earth, sun, and moon system to show rotation and revolution and by using or a model of the earth, sun, and moon to recreate the phases of the moon.

Processes are embedded within the content throughout this unit of study. Students create a timeline, picture book, or research project showing advances in technology used to observe and understand our solar system. Students use models to explain the revolution to the moon and sun and to explain the revolution of the earth in relation to the moon and sun. Students demonstrate knowledge of the moon's phases using models and illustrations.

Students receive direct instruction and then conduct investigations. Students use models to conceptualize ideas and students produce work to demonstrate understanding in the area of technological and cultural contributions to advances in astronomy.

Students perform investigations that demonstrate understanding of rotation and revolution. Students do research and produce projects that demonstrate understanding of technological advances. Students create models and diagrams to demonstrate the phases of the moon. Students identify major discoveries from different scientists and cultures and describe how these discoveries have contributed to our understanding of the solar system (by creating a timeline, research project, or picture book).

Future Learning

Eighth-grade students will describe the relationship between mass and the gravitational force among objects in the solar system. They will also describe the relationship between distance and the gravitational force among solar-system objects. Students will explain that the sun's gravitational pull holds the earth and other planets in their orbits, just as the planets' gravitational pulls keeps their moons in orbit. Students will explain night and day, seasons, year, and tides as a result of the regular and predictable motion of the earth, sun, and moon.

Additional Research Findings

Researchers observed a lack of understanding both of the relative sizes and the relative distances apart of the earth, sun and moon. Most pupils drew the three 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 caused by the models used in classrooms or by the diagrams in books, which do not use the true scale for size and distance.

Researchers have found that 65 percent of a sample of university students had no knowledge, and a further 23 percent had only fragmentary knowledge of the phases of the moon; 6 percent held the correct notion and 8 percent had an alternative eclipse notion. (*Making Sense of Secondary Science*, pp. 171–72)

By far, the most common suggestion, at all ages, for changes in seasons, was that the distance of the earth from the sun is the cause of the seasons. Many children believed the earth is nearer the sun in the summer than in the winter and that this accounts for hotter weather in summer. These ideas seem to be age related; the majority of students between the ages of 9–10 believe in the idea that the sun is farther away in winter. This trend continues until students reach the ages of 15–16 where many of the students begin to understand that seasons can be explained in terms of the earth's axis being set at an angle to the sun. (*Making Sense of Secondary Science*, pp. 173–174).

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. (*Atlas of Science Literacy, vol. 1,* p. 44)

"People are not able to see how the solar system is constructed. With the help of technology such as telescopes, we can understand the solar system and Copernicus' idea of it being heliocentric. A model is necessary to make sense of the solar system. Students need to understand first that the earth is a sphere" (*Benchmarks for Science Literacy*, p. 67).

Notes About Resources and Materials

Prentice Hall Science Explorer, Astronomy Topics

- Rotation & Revolution p. 14–17
- Phases of the Moon p. 24–27
- Activity: Phases of the Moon p. 30–31

Astronomy Online Resources

- Astronomers
  <scienceworld.wolfram.com/biography/topics/Astronomers.html>
- Nicolaus Copernicus
  <www.lucidcafe.com/library/96feb/copernicus.html>
  <www.fact-index.com/n/ni/nicolaus_copernicus.html>
- Solar System—Fact Sheets
  <nssdc.gsfc.nasa.gov/planetary/planetfact.html>
- Galileo Galilei
  <www.lucidcafe.com/library/96feb/galileo.html>
  <www.fact-index.com/g/ga/galileo_galilei.html#Astronomy>
- Johannes Kepler
  <www.fact-index.com/j/jo/johannes_kepler.html>
- Moon Phases and Cycles
  <scienceworld.wolfram.com/astronomy/topics/MoonPhasesandCycles.html>
- Sir Isaac Newton
  <www.lucidcafe.com/library/95dec/newton.html>
- Scienceworld—Planet Color, Atmosphere, and Composition
  <scienceworld.wolfram.com/astronomy/topics/Planets.html>
- Atmosphere and Surface (Bottom)—Planet Data, Atmosphere, Composition
  <pds.jpl.nasa.gov/planets/special/planets.htm>
- Solarviews—Planet Information, Views
  <www.solarviews.com/eng/homepage.htm
- Planetary Systems—Planet Information
  <www.windows.ucar.edu>
- Astrophysics spectator—Planet Information
  <www.astrophysicsspectator.com>

- Inner Planets and Asteroids—Inner Orbits Diagram
  <ssd.jpl.nasa.gov/?ss_inner>
- Outer Planets & Asteroids—Outer Orbits Diagram
  <ssd.jpl.nasa.gov/?ss_outer>
- Our Solar System—Planet Sizes
  <www.sciencemonster.com>
- NASA—Earth, etc.—Technology, News
  <www.nasa.gov>
- Solar System Discovery—Timeline
  <www.nineplanets.org/history.html>
- Astronomy Timeline
  <www.rundetaarn.dk/engelsk/observatorium/timeline.htm>

Grade 7 Science, Quarter 3, Unit 3.2

Processes That Shape the Earth

Overview

Number of instructional days: 20 (1 day = 50 minutes)

Content to be learned

- Explain how earth events bring about changes in the surface.
- Evaluate how the slow processes of weathering, erosion, and/or mountain building have changed and will change the earth over time.
- Evaluate how the fast processes of erosion, volcanoes, and/or earthquakes have changed and will change the earth over time.
- Investigate the effect of flowing water on landforms over time.

Science processes to be integrated

- Investigate patterns of change.
- Use or build models to demonstrate understanding of the interaction between structures and processes within a system.
- Perform scientific investigations.
- Evaluate cause and effect relationships.

Essential questions

- How do slow processes like weathering, erosion, and mountain building contribute to the ongoing changes to earth's surface?
- How do fast processes like erosion, volcanoes, and earthquakes contribute to the ongoing changes to earth's surface?
- How does flowing water affect landforms over time?

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) 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.

3b evaluating fast processes (e.g. erosion, volcanoes and earthquakes) to determine how the earth has changed and will continue to change over time.

3c investigating the effect of flowing water on landforms (e.g. stream table, local environment).

Clarifying the Standards

Prior Learning

In grades K–4, students were introduced to the topic of weather and the use of tools to extend their senses and gather data. In grades 5 and 6, students demonstrated an understanding of processes and change over time within earth systems by describing events and the effects they may have on climate (e.g., El Niño, deforestation, glacial melting, and an increase in greenhouse gases).

Current Learning

In this unit of study, students learn that abrupt processes include erosion, volcanoes, and earthquakes and slow processes include weathering, erosion, and mountain building. Students also investigate the effects over time of the flow of water on landforms. Students will learn that weathering and erosion are constantly at work wearing away the rocks that make up earth's crust. Weathering causes rocks to fragment, crack, crumble, or break down chemically. Erosion loosens and carries away the rock debris caused by weathering. Over time, these two forces, working together, can change the shape of the land. Students have not learned about plate tectonics at this time, however they will need to understand that mountains, with the exception of volcanic mountains, are slowly built over many thousands of years. Students will need to evaluate how each of these processes impacts the shape of the earth's crust.

It will be important that students understand that erosion can be considered both a slow process and a fast process for changing the surface of the earth. Students will need to examine events that show the fast and slow movement of rock debris and evaluate how each changes the surface. Students also need to examine the effects of volcanoes and earthquakes to evaluate their impact on the earth's surface. This will be an opportunity for students to evaluate how mountains form, contrasting slow formation with the fast formation of volcanic mountains.

Future Learning

In grade 8, students will learn how the slow process of sea-floor spreading changes the earth's surface and continues to change the earth's surface over time. Within grades 9 through 11, they will also investigate how convection circulations within the mantle cause plate movement and seismic activity. Students will explore how physical and chemical processes—such as sea-floor spreading, the hydrologic cycle, weathering, and element cycling—alter the earth's crust.

Additional Research Findings

According to the *Atlas of Science Literacy,* vol. 1, researchers have stated that students may erroneously maintain the belief that the earth has always been as it is. They believe that any changes must have occurred suddenly and completely. However, students had no previous formal instruction on those particular topics. Often, middle-school students are not able to "construct coherent explanations" of volcanic and earthquake causes if merely taught by traditional means" (p. 50).

According to *Benchmarks for Science Literacy*, "students often find it difficult to comprehend the significance of the long-term effects of water and wind erosion, sediment deposition, slow movement of the continental plates, and the slow formation of mountains. Students find the general topics of earthquakes, volcanoes, and floods more interesting than the actual role each of these events play in the shaping of the earth. Also, the concept of geologic time will be difficult for students" (pp. 71–73).

Notes About Resources and Materials

Suggested book

Prentice-Hall, Inc. (2000). *Science Explorer: Inside Earth*. Upper Saddle River, NJ: Prentice-Hall.

Suggested websites

- FossWeb.com—Earth history
  <http://www.fossweb.com/modulesMS/EarthHistory/index.html>
- National Geographic—Natural disasters
  <http://www.nationalgeographic.com/environment/natural-disasters/forces-of-nature/>
- National Geographic—Erosion and weathering
  <http://www.nationalgeographic.com/science/earth/the-dynamic-earth/weathering-erosion-article/>
- National Geographic—Mountain building
  <http://www.nationalgeographic.com/science/earth/surface-of-the-earth/>
- Geology.com—Erosion
  <http://www.geology.com/teacher/erosion.shtml>
- Science-teachers.com—Erosion
  <http://www.science-teachers.com/erosion_worksheets.htm>