Grade 7 Science, Quarter 2, Unit 2.1

Space Science

Overview

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

Content to be learned

- Identify major discoveries from different scientists and cultures.
- Describe how technological advances made by scientists and cultures have contributed to understanding of the solar system.
- Explain how technological advances have allowed scientists to reevaluate or extend existing ideas about our solar system.
- Explain temporal or positional relationships between or among the Earth, sun, and moon (night/day, seasons, year, tides).
- Use and create a model of the Earth, sun, and moon to show rotation and revolution.
- Use a model of the Earth, sun, and moon to recreate the phases of the moon.
- Describe the universe as containing many billions of galaxies and each galaxy containing many billions of stars.

Science processes to be integrated

- Explain technological advances in science within systems.
- Identify major discoveries.
- Create a timeline, research project, or picture book.
- Use models to explain interactions within systems.
- Identify patterns of change in a system.

Essential questions

- What major discoveries from different scientists and cultures have contributed to your understanding of the solar system?
- How have technological advances allowed scientists to reevaluate or extend existing ideas about our solar system?
- How does rotation within the Earth and moon system affect day and night patterns and tides?
- How should models be used to show the predictable pattern of changes in the apparent shape of the moon that are called the *phases of the moon*?
- What are the relationships between the movement of the sun and Earth and seasons and years?
- How are stars organized in the system that makes up the universe?

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

In grades K–2, students demonstrated an understanding of temporal or positional relationships between or among the Earth, sun, and moon, having 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. Students also observed that the sun

and moon appear to move slowly across the sky. They observed that the moon looks slightly different from day to day. (There are no GSEs for the ESS2 (K-2)-8 target.) Students demonstrated an understanding of processes and change over time within the system of the universe (scale, distances, star formation, theories, instrumentation) by having observed that there are more stars in the sky than can easily be counted, but they are not scattered evenly and are not all the same in brightness.

In grades 3 and 4, students demonstrated an understanding of temporal or positional relationships between or among the Earth, sun, and moon, having observed that the sun, moon, and stars appear to move slowly across the sky. Students observed that the moon looks slightly different from day to day, but it looks the same again in about four weeks. They recognized that the rotation of the Earth on its axis every 24 hours produces the day/night cycle. Students demonstrated an understanding of processes and change over time within the system of the universe (scale, distances, star formation, theories, instrumentation) by having recognized that throughout history people have identified patterns of stars called *constellations*.

In grades 5 and 6, students demonstrated an understanding of temporal and positional relationships between or among the Earth, sun, and moon, having used models to describe the relative motion/position of them. Students also used models of the Earth, sun, and moon to recreate the phases of the moon. Students demonstrated an understanding of the structure of the universe by having described the apparent motion/position of the objects in the sky (e.g., constellations, planets). They also identified the sun as a medium-sized star located near the edge of a disk-shaped galaxy of stars.

Current Learning

Instruction begins in this unit with identifying major discoveries from different scientists and cultures. This information is taught at the developmental level. An example to introduce scientists in the field of astronomy is to reinforce students' prior knowledge that in history people have identified patterns of stars called *constellations*. From this point, you provide a working timeline for students at the developmental level.

The following is an example of an astronomy timeline:

> *Copernicus discovery of the positional relationships in the galaxy, Kepler discovery of planets orbits were elliptical and not perfect circles, Galileo discovery of and use of the telescope and moons around Jupiter, Einstein's theory of general relativity, Hubble created the Hubble telescope, which led to claims that the universe is constantly expanding, Jansky introduced the idea of radio astronomy, Queloz and Mayor made the first extrasolar planetary discovery, Wilson and Penzias won the Nobel Prize in physics after their work on Cosmic Microwave Background.*

While reviewing the timeline, students can discuss how each technological advance helped contribute to understanding of the solar system. Additional timelines can be introduced showing how one particular scientist paved the way and then a scientist from a future generation continued their research (e.g., Galileo introduced the telescope and Hubble continued by advancing the technology and creating the Hubble telescope). An activity that could be used to identify, describe, and explain scientists, discoveries, and technological advances could be allowing the students to create a timeline of their own in which the teacher lists a piece of technology while students look up all scientists involved from discovery to advancement. Students then place the scientists on a timeline and write about how each scientist was involved.

While learning about the temporal and positional relationships between or among the Earth, sun, and moon, students should create or use already created models to describe the relative motion and position of

the sun, Earth, and moon during the different seasons. They also need to use models to recreate the phases of the moon. Moon phases were introduced at the developmental level and reinforced during grade 6. When providing instruction on this topic in grade 7, it should be at the drill-and-practice level. To accomplish this and prevent redundancy from grade 6, this topic is divided into two parts. Grade 7 is responsible for creating a model that can be used to describe why moon phases occur and to explain that the light from the sun is the reason why you see moon phases. While these explanations of why there are moon phases, not just the identification of moon phases, should be taught at the developmental level, students should have the background knowledge from grade 6 to connect to this new content.

In addition, at the drill-and-practice level, there should be the topic of the Earth's day and night cycle. Students create a model to show the Earth, sun, and moon system to show rotation and revolution in the system. An example to teach rotation is to focus on how the Earth and moon system affect the day and night cycle as well as the tides. An example to teach revolution could be to refer to the revolution of the moon and Earth system as well as the Earth and sun system and how it affects the seasons and years.

When delivering instruction on the universe containing billions of galaxies and the billions of stars included in galaxies, all content should be introduced on the developmental level. Technology and portable planetariums can be used to help explain this topic to students.

Scientific 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 Earth in relation to the moon and sun. Students demonstrate knowledge of the moon's phases using models and illustrations.

Future Learning

In grade 8, students will demonstrate an understanding of temporal and positional relationships between or among the Earth, sun and moon by explaining night/day, seasons, year, and tides as a result of the regular and predictable motion of them. Students will learn how gravitational force affects objects in the solar system (e.g., moons, tides, orbits, satellites) by describing the relationship between mass and gravitational force between objects. In addition, they will learn about the relationship between distance and the gravitational force between objects. Students will learn that the sun's gravitational pull holds Earth and other planets in their orbits, just as the planet's gravitational pull keeps their moons in orbit. In high school, students will demonstrate an understanding of processes and change over time within the system of the universe (scale, distances, star formation, theories, instrumentation) by applying the properties of waves/particles to explain the movement, location, and composition of the stars and other bodies in the universe. They will demonstrate an understanding of the life cycle of stars by relating the process of star formation to the size of the star and including the interaction of the force of gravity, fusion, and energy release in the development of the star, identifying and describing the characteristics common to most stars in the universe.

Additional 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 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 and 72*)

By far, the most common suggestion, at all ages, for changes in seasons was that the distance of Earth from the sun is the cause of the seasons. Many children believed 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 ages 9–10 believe in the idea that the sun if farther away in winter, This trend continues until students reach ages 15–16 where many begin to understand that seasons can be explained in terms of Earth's axis being set at an angle to the sun. (*Making Sense of Secondary Science*, *pp. 173 and 174)*

Explanations of the day-night cycle, phases of the moon, and 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 Earth. (*Atlas of Science Literacy, Volume 1,* p. 44)

According to *Benchmarks for Science Literacy,* people are not able to see how the solar system is constructed. With the help of technology such as telescopes, you 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 Earth is a sphere. (p. 67)

Grade 7 Science, Quarter 2, Unit 2.2

Processes That Shape the Earth

Overview

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

Content to be learned

- Evaluate how the slow processes of weathering, erosion, and mountain building have changed and will change Earth over time.
- Evaluate how the fast processes of erosion, volcanoes, and/or earthquakes have changed and will change Earth over time.
- Explain how Earth events bring about changes in the surface with regard to landforms, ocean floor, rock features, or climate.
- 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 Earth events bring about changes in the surface with regard to landforms, rock features, or climate?
- How have the slow processes of weathering, erosion, and mountain building changed Earth over time? How will these processes change Earth over time?
- How do the fast processes of erosion, volcanoes, and/or 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–2, students demonstrated an understanding of how the use of scientific tools helps extend senses and gather data about weather.

In grades 3 and 4, students demonstrated an understanding of processes and change over time within Earth systems by conducting investigations and using observational data to describe how water moves rocks and soils. Students continued to demonstrate an understanding of how the use of scientific tools helps extend senses and gather data about weather. Students explained how the use of scientific tools was used to gather data about weather. Given a task, students selected appropriate scientific tools and described the information they provided. Continuing their understanding of processes and change over time within Earth systems, students investigated local landforms and how wind, water, or ice have shaped and reshaped them. They used or built models to simulate the effects of how wind and water shaped and reshaped the land (e.g., erosion, sedimentation, deposition, glaciation). Students identified sudden and gradual changes that affect Earth. (Sudden changes are fast processes such as flooding, and gradual changes are slow processes such as erosion caused by oceans.)

In grades 5 and 6, students demonstrated an understanding of processes and change over time within Earth systems by describing events and the effect they may have on climate (e.g., El Niño, deforestation, glacial melting, an increase in greenhouse gases).

Current Learning

It is important that the teacher connects the content learned in the grade 6, quarter 4 unit called "Processes That Change Earth," to the content in this unit. Students are introduced to slow processes that change Earth's surface at the developmental level. The slow processes of weathering and erosion are effects of Earth's weather. (Weather is taught in grade 6.)

For this grade level, the vocabulary changes, but the concepts are reinforced and taken to the drill-and-practice level by the end of the unit. Some examples include the introduction of "fast processes" opposed to "sudden changes" and "slow processes" opposed to "gradual changes." The word *weathering* is new to this grade level; however, the concept is not. Students have learned in grades 3 and 4 about wind, water, and ice causing erosion. Mountain building and how it has changed over time due to plate tectonics is taught at the developmental level.

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 of the flow of water over time on landforms. Students 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 need to understand that mountains, with the exception of volcanic mountains, are slowly built over many thousands of years. They need to evaluate how each process affects the shape of Earth's crust.

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

As part of their investigations, students need to identify patterns of change as well as cause-and-affect relationships between Earth processes and the changes in Earth's surface. Models are utilized as students demonstrate their understanding of the interaction between structures and processes within the various Earth systems.

Future Learning

In grade 8, students will continue to demonstrate an understanding of processes and change over time within Earth systems by evaluating slow processes such as seafloor spreading to determine how Earth has changed and will continue to change over time. In high school, students will explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, seafloor spreading). Students will demonstrate an understanding of processes and change over time within Earth systems in several ways. They will explain how heat affects the rock cycle. Students will explain how convection circulation of the mantle initiates the movement of the crustal plates, which then cause plate movement and seismic activity. They will investigate and use evidence to explain that conservation in the amount of earth materials occurs during the rock cycle. Students will explain how the physical and chemical processes of Earth alter the crust.

Additional Findings

According to the *Atlas of Science Literacy, Volume 1*, researchers have stated that students may erroneously maintain the belief that 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)