Space Systems

Content Area: **Science**
Course(s): **Science 6**
Time Period: **Trimester 1**
Length: **3 Lessons**
Status: **Published**

Unit Overview

The Space Systems unit covers the universe and its stars, Earth and the solar system and the history of planet Earth. Students examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, using models of the solar system to explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe. Students examine geoscience data in order to understand the processes and events in Earth's history. The crosscutting concepts of patterns, scale, proportion, and quantity, and systems and systems modeling are called out as organizing concepts for these disciplinary core ideas. In this unit's performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing data, and constructing explanations and designing solutions; and to use these practices to demonstrate understanding of the core ideas.

Essential Questions

What is Earth's place in the Universe?

What makes up our solar system, and can can the motion of Earth explain seasons and eclipses?

Content

Space Systems:

The universe and its stars: The solar system is part of the Milky Way, which is one of many billions of galaxies.

The Earth and solar system: The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.

Skills

- Identify what students already know about seasons.
- Demonstrate how Earth orbits the Sun.
- Read about the causes of seasons.
- Model Earth's tilt on its axis as it orbits the Sun.
- Identify Polaris as the current North Star.
- Determine the relationship between the latitude of an observer and the altitude of Polaris above the northern horizon.
- Compare sunrise and sunset times at different latitudes throughout the year.

- Relate changes in the apparent path of the Sun and the length of daylight to Earth's orbit on its tilted axis.
- Create a working definition of the term "revolution." Identify "orbit" as its synomyn.
- Describe patterns in the appearance of the Moon over a period of time.
- Discuss rising and setting times of the Moon over a period of time.
- Demonstrate that the Moon reflects the Sun's light as it orbits Earth.
- Demonstrate that half of the Moon is always illuminated.
- Track, model, and illustrate the phases of the Moon as seen from Earth.
- Create working definitions of the terms "waxing" and "waning."
- Discuss the Moon's appearance and rising and setting times based on observed patterns.
- Develop working definitions for the terms "lunar eclipse" and "solar eclipse."
- Model shadows cast by the Moon and Earth.
- Describe the phases during which a lunar and solar eclipse occur.
- Analyze solar and lunar eclipse data and compare it to phase data.
- Analyze the conditions under which the Moon's and Earth's shadows cause eclipses.

Assessments

The majority of this unit is an inquiry-based hands-on approach to learning. It consists of laboratory activities which vary in their intensity, approach, skill, and evaluative measurements. For example, some of the lab activities are “walk-through” labs, where the student is guided through a procedure and a process, and is asked to make connections among the main concepts presented in the activity and associated readings. Other lab activities consist of a problem that is presented to the student, which he or she must solve by designing an experiment (which is then peer and teacher evaluated before proceeding with the lab activity) and collecting data. Regardless of the lab activity, students are evaluated based on the quality and presentation of the collected data in graphic organizers; the efficacy and accuracy of the experimental design; the connections made between the experimental design, the data collected, and the conclusion of the laboratory report- i.e. “tying it all together to see the big picture”; and lab etiquette and adherence to safety rules.

Other evidence for learning includes several short 5-10 question quizzes, and end-of-unit lab practical (hands-on) test, end-of-unit paper test based on the labs, and several creative projects, which may include posters, skits, songs and poems, and presentations.

Lessons/Learning Scenarios

Lesson 1: “Seasons on Earth”

Objectives:

- Identify what students already know about seasons.
- Demonstrate how Earth orbits the Sun.
- Read about the causes of seasons.
- Model Earth's tilt on its axis as it orbits the Sun.
- Identify Polaris as the current North Star.
- Determine the relationship between the latitude of an observer and the altitude of Polaris above the northern horizon.

- Compare sunrise and sunset times at different latitudes throughout the year.
- Relate changes in the apparent path of the Sun and the length of daylight to Earth's orbit on its tilted axis.
- Create a working definition of the term "revolution." Identify "orbit" as its synomyn.

Learning Activities:

- Discuss what they already know about seasons.
- Model Earth in orbit around the Sun and use a flashlight to simulate the Sun shining on Earth at different locations in its orbit.
- Work as a class to use computer simulation to observe the apparent motion of the stars at night around Polaris, the North Star.
- Measure the angle of separation between Polaris and the horizon and relate it to the latitude of a location.
- Work as a class to use computer simulation to investigate changes in sunrise and sunset times at different latitudes throughout the year and use these data as indicators of Earth's revolution.
- Graph and compare the Sun's altitude at sunrise, solar noon, and sunset at different times of the year and at different latitudes.

Concepts:

- Earth is tilted on its axis as it orbits the Sun.
- Seasons are the results of different amounts of sunlight falling on a hemisphere at different times of the year.
- The tilt of Earth on its axis affect the length of daylight in any area.
- When a hemisphere is tilted toward the Sun, it experiences summer, with longer day lengths.
- When a hemisphere is tilted away from the Sun, it experiences winter, with shorter day lengths.
- The north pole of Earth's axis currently points to Polaris, the North Star.
- Because of Earth's rotation on its axis, the stars seen in the Northern Hemisphere appear to circle around Polaris.
- The altitude of the North Star above the horizon in the Northern Hemisphere is the same as the latitude of the observer.
- Shadows change according to the time of day (position of Earth in its rotation) and time of year (position of Earth in its orbit).
- The length of daylight and apparent path of the Sun for each season vary at different latitudes.

Assessments:

- Laboratory Report, including data tables, charts, diagrams, and graphs, where applicable
- Class Discussion (Pre-lab, Post-lab)
- Reading selection discussion

Lesson 2: “Investigating Lunar Phases”

Objectives:

- Describe patterns in the appearance of the Moon over a period of time.
- Discuss rising and setting times of the Moon over a period of time.
- Demonstrate that the Moon reflects the Sun's light as it orbits Earth.
- Demonstrate that half of the Moon is always illuminated.
- Track, model, and illustrate the phases of the Moon as seen from Earth.
- Create working definitions of the terms "waxing" and "waning."
- Discuss the Moon's appearance and rising and setting times based on observed patterns.

Learning Activities:

- Identify patterns that they observed the rising and setting of the Moon and its appearance.
- Investigate how objects reflect light and create shadows.
- Use SEM Board to model the Moon in its orbit around Earth, and use a flashlight to observe how much of the Moon is lit

by the Sun at different points in its orbit.
- Use a small sphere and flashlight to model the Moon as it orbits Earth, and relate the portion of the sphere they see at different points in the orbit to the phases of the moon.

Concepts:

- The Moon changes its appearance as it orbits Earth. These changes in appearance are called phases of the Moon.
- The Moon rises and sets later each day.
- The Moon is a sphere and reflects the Sun's light. Therefore, only half the Moon is illuminated at one time - the half turned toward the Sun.
- The Moon goes through a predictable cycle of changes in its apparent shape, called "phases."
- The Moon's phases occur because we see only portions of the Moon's illuminated side, depending on the Moon's position relative to Earth.
- The pattern of lunar phases is predictable.
- From any place on Earth where the Moon is visible, the phase of the Moon is the same on any given day.

Assessments:

- Laboratory Report, including data tables, charts, diagrams, and graphs, where applicable
- Class Discussion (Pre-lab, Post-lab)
- Reading selection discussion

Lesson 3: “Solar and Lunar Eclipses”

Objectives:

- Develop working definitions for the terms "lunar eclipse" and "solar eclipse."
- Model shadows cast by the Moon and Earth.
- Describe the phases during which a lunar and solar eclipse occur.
- Analyze solar and lunar eclipse data and compare it to phase data.
- Analyze the conditions under which the Moon's and Earth's shadows cause eclipses.

Learning Activities:

- Discuss what they already know about eclipses and investigate shadows.
- Determine the lunar phase during which lunar and solar eclipses occur, and then read about eclipses.
- Use SEM Board to model the revolution of Earth and investigate why eclipses do not occur every month.

Concepts:

- Shadow cones cast by planetary bodies contain both an umbra and a penumbra.
- Eclipses occur when the Sun, Earth, and Moon align at a time when the Moon crosses the plane of the ecliptic.
- A solar eclipse can occur only during a new moon; the Moon comes between the Sun and Earth and casts a shadow on parts of Earth.
- A lunar eclipse can occur only during a full moon; Earth comes between the Sun and Moon and casts a shadow on the Moon.
- The location of the planetary body within the shadow cone determines the type of eclipse.

Assessments:

- Laboratory Report, including data tables, charts, diagrams, and graphs, where applicable
- Class Discussion (Pre-lab, Post-lab)
- Reading selection discussion

Standards

SCI.6-8.MS-ESS1-1	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.
SCI.6-8.MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.
SCI.6-8.MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

Resources