Module 5: The Solar System and Beyond

Core Idea: ESS1 Earth's Place in the Universe

Prerequisite Learning: *1.ESS1.1, 1.ESS1.2, 1ESS1.3, 2.ESS1.1, 3.ESS1.1, 4.ESS1.2*

Percent of Time: 27%

Standard	Questions and Phenomenon Prompts	Module Vocabulary	Teacher Background/ Clarification Statement
5.ESS1.1 Explain that differences in the apparent brightness of the sun compared to other stars is due to the relative distances from the Earth. **Learning Targets:** • Understand that the sun is a star that appears larger and brighter than other stars because it is closer to Earth than other stars. • A luminous object close to a person appears much brighter and larger than a similar object that is far away from a person (a lantern or streetlight next to a person looks bigger and brighter than if that person was down the street). • Identify land and space telescopes, space probes, and satellites as tools that have allowed scientists to see very large things that are far away, such as the sun, other stars, and galaxies. • Explain objects that are closer appear larger (a student can completely cover up an airplane in the sky with their hand but could not do the same standing next to the same airplane on the ground). **Crosscutting Concepts:** • **Scale, Proportions, and Quantity –** Natural objects exist from the very small to the immensely large. **Science and Engineering Practice:** • **Developing and using models-** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.	Why can I cover up the sun, the moon, or an airplane in the sky with my hand? What is the closest star to Earth? Is this star the biggest star in the Galaxy? How do you know? Use the phenomenon of apparent brightness; why is it dangerous to look directly at the sun but not other stars that we see at night?	Universe Solar system Stellar Constellation Spiral galaxy Irregular galaxy Elliptical galaxy Asteroid Meteoroid Comet Solar eclipse Lunar eclipse Axis Solstice Equinox Latitude Revolution Rotation Star chart	There is an immense distance between Earth and stars other than our sun. The difference in distance makes the sun appear larger and brighter than other stars. Stars appear smaller and dimmer the farther they are from Earth. A general discussion of star types and star life cycles can be used to highlight an appreciation for the actual size of the sun. Students' main focus should be on relative distance not other factors such as stellar mass, age, or stage of life.

5.ESS1.2 Research and explain the position of the Earth and the solar system within the Milky Way galaxy, and compare the size and shape of the Milky Way to other galaxies in the universe. **Learning Targets:** • Recognize that the universe contains billions of galaxies and stars. • Differentiate between the three types of galaxies. • Describe the relationship between our solar system and its location in the Milky Way galaxy and how that location in the Orion Arm, far away from the center of the galaxy, keeps our solar system stable. • Understand how technology like the Hubble Telescope has allowed access to viewing a multitude of galaxies. **Crosscutting Concepts:** • **Systems and System Models-** Students recognize that large objects are made up of collections of particles. **Science and Engineering Practice:** • **Obtaining, evaluating, and communicating information-** (Observe/Evaluate) Students can read and summarize text and embedded, non-text elements from multiple sources synthesizing an understanding on a scientific idea. Students can communicate scientific information in writing utilizing embedded elements.	How far away is our solar system from the center of the Milky Way Galaxy? How does that affect the stability of our solar system? What is the closest star system to our solar system? Galaxy? Can we travel to them now? What can the shape of a galaxy tell you about that galaxy?		Students do not need to know distances in the galaxy or universe. Students will need to view scale images of the solar system, the location of our solar system in the Milky Way galaxy and an image of multiple galaxies like the Hubble Deep Field.
5.ESS1.3 Use data to categorize different bodies in our solar system including moons, asteroids, comets, and meteoroids according to their physical properties and motion. **Learning Targets:** • Differentiate between characteristics of objects in the solar system (planets, moons, asteroids/meteoroids, comets) in terms of distance from the sun, orbital paths, size, basic temperatures, and composition.	How is a comet different from an asteroid? A moon and a dwarf planet?		The circular motion of objects within our solar system is maintained by the force of gravity (5.PS2.5). Data on the orbital motion of the rotating bodies can confirm the influence of

• Describe the relationships that exist between planetary body distance from the sun and the effects of this distance (farther away from the sun the colder the object would be). • Review the similarities and differences between the characteristics of inner and outer planets (moons, temperatures, rings, size). • Identify a solar system body in a data table by using information on mass, orbit, revolving around another body or the Sun, and distance from the sun. **Crosscutting Concept:** • **Systems and System Models-** Students group and describe interactions of the components that define a larger system. **Science and Engineering Practice:** • **Analyzing and interpreting data-** Students should be able to organize experimental data to reveal patterns and utilize data using simple graph- to form explanations.	What kinds of orbits do the solar system bodies have? What can I infer about an object in our solar system just by knowing its location?		mass and distance on the force of gravity (5.PS1.4). Students should know the difference in orbit and composition of a comet, (ice, gas, rock, & dust) an asteroid, (large space rock) a meteoroid (smaller space rock) and a meteorite (space rock that has hit the Earth)
5.ESS1.4 Explain the cause and effect relationship between the positions of the sun, earth, and moon and resulting eclipses, position of constellations, and appearance of the moon. **Learning Targets:** • Explain and demonstrate that the moon and star patterns (constellations) in the sky do not move although they appear to shift across the sky at night due to the rotation of the Earth from east to west. • Compare the positions of the Earth, Sun, and Moon during solar and lunar eclipses. • Explain why there is not a solar or lunar eclipse every month.	If I go outside at night at 8:30 and find a constellation then go back again at 12:30, why can't I find that constellation in the same place? If the Moon revolves around the Earth every month, why do we not		Students will not need to memorize the phases of the moon in isolation. They will need to know the causes of phases and positions of the Earth, moon, and sun. Students will not need to know penumbra and umbra in eclipses.

• Describe the changes (patterns) that occur to the observable shape of the moon over the course of a lunar cycle (about a month). • Explain that the moon's physical shape does not actually change in a lunar cycle, only its appearance because of its revolution around the Earth. • Predict the locations of the sun, Earth, and moon during a new moon, full moon, solar eclipse, and lunar eclipse. **Crosscutting Concept:** • **Cause and Effect-** Students routinely search for cause and effect relationships in systems they study. **Science and Engineering Practice:** • **Developing and using models-** Student models begin to become abstract and metaphorical, incorporating relationships between events and predictive aspects for recurring events.	have an eclipse every month? Why does the Moon appear to change shape about every 2 to 3 days? Observe phenomena such as moon phases, eclipses, and apparent size of the moon that makes it appear the same size as the sun.		Student models should include labeled components (sun, moon, Earth) of the sun, moon, Earth system and the relationship between the component and the phenomenon. Example: a model demonstrating the cause of an eclipse.
5.ESS1.5 Relate the tilt of the Earth's axis, as it revolves around the sun, to the varying intensities of sunlight at different latitudes. Evaluate how this causes changes in day-lengths and seasons. **Learning Targets:** • Explain how the length of year of a planet is related to the distance from the sun and how long it takes to revolve around the sun. • Recognize that Earth is rotating on its axis takes approximately 24 hours and causes day and night. • Understand the Earth is rotating on its axis and is revolving around the sun tilted on its axis causing the sunlight to strike the earth at different angles at different positions in its revolution. • Diagram to explain that Northern and Southern hemispheres experience opposite seasons because of this tilt and revolution. • Communicate why summer has the longest daylight hours and winter has the shortest.	What are predictable patterns caused by Earth's rotation and Earth's movement in the solar system? What places on Earth do not experience much seasonal change? Why do the poles experience periods of complete darkness and complete daylight?		The cause of seasons is rooted in the tilt of Earth's axis combined with varying intensities of sunlight based on the angle the sun's ray hit earth. The duration of daylight hours and intensity of sunlight changes over the year.

Crosscutting Concepts: • **Systems and System Models-** Students group and describe interactions of the components that define a larger system. **Science and Engineering Practice:** • **Planning and carrying out controlled investigations-** Students carry out investigations in groups, where conditions and variables are controlled, utilize appropriate instruments, and deliberately plan multiple trials.	Which season in Tennessee would you experience the longest daylight hours and why? Why do we experience the phenomenon of seasons?		
5.ESS1.6 Use tools to describe how stars and constellations appear to move from the Earth's perspective throughout the seasons. **Learning Targets:** • Demonstrate that the constellations in the sky do not move (translate) across the sky, change their shape, or their distance from one another although they appear to move (translate) across the sky nightly due to the rotation of the Earth and from season to season due to revolution around the sun. • Use a star chart, constellation map, or other technology (tablet app) to identify what constellations are visible in the night sky each season. • Explain that the north celestial pole is marked by the star Polaris and it never sets below the horizon when viewing from our location. **Crosscutting Concept:** • **Pattern-** Students recognize, classify, and record patterns involving rates of change. **Science and Engineering Practice:** • **Asking questions (for science) and defining problems (for engineering)-** Questions generated by students are still based on experience, and begin to incorporate relationships between two things.	Why are there different constellations in the night sky in September and in April? Why is the star Polaris almost always visible from Tennessee in the night sky? How can I figure out what stars or constellations I will be able to view in December?		Students will not be required to recognize or name constellations. Students need to recognize that as the seasons change and Earth is traveling around the sun, we are looking in a different direction in space to see different constellations.