UNIT OVERVIEW

SOLAR SYSTEM AND BEYOND

Unit Issue: Choose a proposed space mission based on which missions have the most potential for technological advancements and better scientific understanding.

Anchoring Phenomenon: There are a variety of objects in space and they move over time. Technology plays a critical role in learning more about these objects.

Listed below is a summary of the activities in this unit. Note that the total teaching time is listed as 19–35 periods of approximately 45–50 minutes (approximately 4–7 weeks). If you find that you cannot finish in this timeframe, consider skipping Activity 3 or Activity 4, and/or Activity 11 or Activity 12.

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
1. **Talking It Over: Exploring Space** Students read about different missions to space that have helped scientists understand more about our Solar System. Each mission description includes information about what was learned and some of the technological challenges faced by the mission. Students then share what they learned and discuss the trade-offs between exploring space with spacecraft and using research money elsewhere.	Space exploration, spacecraft, trade-offs, evidence LITERACY SENSEMAKING	Prepare Student Sheets.	E&T A2	1–2
2. **Investigation: The Predictable Moon** Students use Moon Phase Cards to make observations about the different phases of the Moon and look for patterns. Once they identify the pattern of the cycle of the Moon's phases, they examine observations of the Moon made over a period of time. They try to identify a pattern in the observations and make predictions about the appearance of the Moon on days missing from the data set. They establish that the cycle of the Moon's phases is a little shorter than a typical month on Earth.	Moon phases, patterns, cycles LITERACY	Obtain Moon phase calendar; prepare Student Sheet.		1–2
3. **Modeling: Explaining the Moon's Phases** Students explore physical models to help them understand the reason for the changes to the Moon's appearance over time. The models use a light to represent the Sun and a white or pale ball to represent the Moon. This model introduces students to the idea that the Moon's phase at any given time depends on the Moon's changing position relative to Earth and the Sun as the Moon orbits Earth. In the next activity, students explore a computer model of the same idea. Using both models best helps students visualize the orbit of the Moon around Earth and how it explains the changing appearance of the Moon as viewed from Earth.	Patterns, modeling, orbit, Moon phases	Confirm available space for activity; prepare Student Sheet.	EXP A5	1–2

SOLAR SYSTEM AND BEYOND (continued)

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3. **Modeling: Explaining the Moon's Phases** Students explore physical models to help them understand the reason for the changes to the Moon's appearance over time. The models use a light to represent the Sun and a white or pale ball to represent the Moon. This model introduces students to the idea that the Moon's phase at any given time depends on the Moon's changing position relative to Earth and the Sun as the Moon orbits Earth. In the next activity, students explore a computer model of the same idea. Using both models best helps students visualize the orbit of the Moon around Earth and how it explains the changing appearance of the Moon as viewed from Earth.	Patterns, modeling, orbit, Moon phases	Confirm available space for activity; prepare Student Sheet.	EXP A5	1–2
4. **Computer Simulation: Moon Phase Simulation** Working at computers, students interact with a two-dimensional simulation that shows the direction of sunlight and the relative positions of Earth and the Moon as Earth rotates and the Moon orbits Earth. Students sketch what they observe in the simulation and build toward an understanding of how the Moon orbits Earth. They then connect this experience with their observations of the Moon's phases and the physical models used in the previous activities.	Modeling, Moon phases, orbit	Arrange for computer time.	MOD A4	1
5. **Modeling: The Moon's Orbit** Students manipulate a physical model of the orbital plane in which the Moon travels as it orbits Earth. This three-dimensional model allows students to investigate why eclipses, both lunar and solar, are relatively rare. This activity is the final opportunity in this unit for students to cement their understanding regarding why the Moon's orbit results in phase changes in the Moon as seen from Earth.	Orbital plane, Moon phases, lunar eclipse, solar eclipse	Prepare the Moon's orbit model	MOD A3 (Assessment of PE MS-ESS1-1: Part 1)	1–2

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
6. **Investigation: Changing Sunlight** Students graph and analyze data on length of daylight and the angle of the Sun during the course of a year in the Northern Hemisphere and relate the patterns they observe to seasonal changes. They discover the correlation between daylight length and the position of the Sun in the sky, and relate these variables to the seasons. This awareness of seasonal patterns in the Sun's position and apparent motion prepares them for a discussion of the reasons behind these changes in the next three activities.	Year, Northern Hemisphere, Southern Hemisphere SENSEMAKING MATHEMATICS	Prepare Student Sheets	QUICK CHECK A4-A6	1–2
7. **Computer Simulation: A Year Viewed from Space** Students use a computer model to investigate the effects of Earth's orbit around the Sun and Earth's tilt on seasonal changes in the Northern Hemisphere. Students use the simulation to observe Earth as it revolves around the Sun and to record data for different seasons. They use their observations to develop an explanation for the cause of Earth's seasons.	Seasons, Earth's orbit, Earth's axis, Earth's tilt	Arrange for computer time; prepare Student Sheets.	EXP A3, A6	1–2
8. **Modeling: Earth's Tilt** Students continue to explore the effect of Earth's tilt in determining the seasons. Two teacher demonstrations show that light is more concentrated, or less spread out, when it strikes a surface at a 90-degree angle than at any other angle. Using a photovoltaic cell, students explore how the angle of the sunlight striking it affects the amount of solar energy the cell absorbs.	Seasons, energy from the Sun, Earth's tilt SENSEMAKING	Check weather forecast for sunny weather, prepare Student Sheet.	QUICK CHECK A3 EXP A4	1–2
9. **Reading: Earth on the Move** Students read a summary of the reason for Earth's seasons. The reading emphasizes the role of Earth's tilt in determining the angle of the Sun's rays and the length of the day, both of which contribute to observed seasonal variations in temperature at Earth's surface. Students complete a Three-level Reading Guide to help them process the information in the reading.	Earth's tilt, Earth's orbit LITERACY SENSEMAKING	Prepare Student Sheet.	MOD A1 (Assessment of PE MS-ESS1-1: Part 2)	1–2

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
10. **Investigation: Observing Objects in Space** Students make observations of celestial bodies and learn to identify different kinds of objects that can be seen in space. They identify various objects (e.g., planets, stars, asteroids, comets, galaxies, and moons) by such features as apparent size, brightness, and visual appearance. Students use telescopic images to make accurate observations of the different space objects.	Space objects, Solar System	Review celestial observation tips, obtain local stargazing information.	E&T A6	1–2
11. **Modeling: Drawing the Solar System** Using a distance scale, students calculate the distance from the Sun to each planet in the Solar System. They make a model of the Solar System by drawing the scaled distance to each planet. Using the same scale, they investigate the diameters of the planets and discover that the scale used for distances in the Solar System is inadequate for drawing an accurate model of each planet. The activity is supported by a literacy strategy that helps students articulate their prior knowledge and reflect on the development of the main concepts in the activity.	Scale, models, planets SENSEMAKING	Prepare Student Sheets.		1–2
12. **Project: How Big Are the Planets?** Students explore the sizes of planets in the Solar System, and create a physical model showing the relative sizes of the planets. To do this, they select an appropriate scale, calculate the diameter of the scaled objects, and find round objects that accurately represent the size of each planet. They consider how large the Sun would have to be in their scale model. Students use a literacy strategy to reflect on what they have learned about the diameters of the planets.	Scale, planets	Prepare Student Sheet, gather equipment for Extension.	COM PROC. 7 AID A4	2–3
13. **Investigation: Identifying Planets** Students analyze data on planets and objects in the Solar System. They are then given four descriptions of different planets based on actual space missions. They use the planet descriptions and their analysis of the planetary data to identify which planets in our Solar System the transmissions are referring to.	Space missions, planet properties, analyzing data	Prepare Student Sheet.	AID A2 (Assessment of PE MS-ESS1-3)	1–2

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
14. **Investigation: Gravitational Force** Students are introduced to some of the characteristics of gravity as they explore the relationship of gravitational pull to distance and mass. They graph the gravitational force between Saturn and some particles in its orbiting rings. Students compare the gravitational force of smaller and larger mass particles orbiting at the same distance, and of particles of equal mass orbiting at different distances from the planet.	Gravity, gravitational force, mathematics, mass		AID A1	1–2
15. **Reading: The Effects of Gravity** This reading about gravity summarizes for students the relationship between mass, distance, and gravitational force. Students also read about gravity's role in the orbits of space objects, and how objects are put into orbit around Earth. Two literacy strategies are used to support students' comprehension of the ideas in the reading.	Gravity, galaxy, orbital motion LITERACY		MOD A4	1–2
16. **Computer Simulation: Modeling Gravity** Students use a computer simulation to model how gravity affects the orbits of planets in the Solar System. They use their model and data related to the planets to figure out how massive the Sun must be for us to observe the planetary orbits seen in our Solar System. They then complete a short reading relating their model to the motions of stars and solar systems within a galaxy. Finally, students are asked to develop and use a model to describe the role of gravity in the motions of space objects within solar systems and galaxies.	Orbital motions, gravity	Prepare Student Sheet.	MOD A3 (Assessment of PE MS-ESS1-2)	2–3
17. **Talking It Over: Choosing a Mission** Students make a decision about funding a space exploration mission to Saturn's moon Titan. Presented with three proposed missions, students must recommend one. To aid their decision-making, students discuss the feasibility of each mission and what it could accomplish. The student groups make a decision based on information in the mission proposals and content from the previous activities. As a culmination of their work on the issue, each student then writes a letter citing the evidence that forms the basis of their recommendation.	LITERACY	Prepare Student Sheet.	COM Proc. 5 E&T A3	1–2