

Earth and Space Science:

Unit 5

Earth in Space: Introduction

Purpose: The Why, What, and How of This Unit

Essential Question: An alien from a faraway planet has just landed in New York. How can we help him explain the puzzling phenomena he has observed in his home solar system?

Unit Storyline Synopsis: In this unit, scholars explore the components that make up the universe, model and experiment to learn how these elements interact, and study the effects these interactions have on our daily lives, all through the engaging lens of learning alongside an alien visitor named Peeko.

Why This Unit? Since the dawn of humanity, people have been fascinated by outer space. Eclipses, the apparent movement of the stars, and the changing moon phases“ among other phenomena“ have been the subject of great interest throughout recorded history. Although we have made many discoveries about the universe over the past several centuries, our body of knowledge is still being developed and refined daily, and much remains a mystery.

The universe is vast and largely unexplored, but as technology improves, so does our ability to collect data from beyond our world. Through modeling and the use of specially designed tools such as the telescope we are able to learn more about the development of the universe around us and how our own planet came to be the unique home we know today.

What Is the Bottom Line?

Big Idea: The relative movements of celestial bodies create cyclical, observable patterns on Earth.

- The orbits of Earth around the Sun and the Moon around Earth, together with the rotation of Earth on an axis between its north and south poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.
- This model of the solar system can explain eclipses of the Sun and the Moon. Earth's axis is fixed in direction over the short-term, but it is tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the varying intensity of sunlight on different areas of Earth during the year.

Big Idea: Gravity plays a key role in developing and maintaining the composition of the universe.

- The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them.
- The solar system appears to have formed from a disk of dust and gas drawn together by gravity.

How do Next Generation Science Standards practices and crosscutting concepts support mastery of the Big Ideas? Science and Engineering Practices highlighted in this unit:

- **Developing and Using Models**

- Develop and use a model of the Earth–Sun–Moon system to demonstrate the cyclic patterns of lunar phases, eclipses of the Sun and the Moon, and the seasons.
- Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
- Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
- Analyze and interpret data to determine scale properties of objects in the solar system.

- **Engaging in Argument from Evidence**

- Support an argument that the apparent brightness of the Sun and stars is due to their relative distances from the Earth.
- Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Crosscutting Concepts highlighted in this unit:

- **Systems and System Models**

- Systems may interact with other systems; they may have subsystems and be part of larger complex systems.
- Models are limited in that they only represent certain aspects of the system under study.

- **Scale, Proportion, and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Safety

Plan carefully for safety in all lessons. The top safety risks in this unit include:

- In lessons 6 and 8, scholars use flashlights. Do not allow scholars to look into the beams of the flashlights, as this can present a safety hazard—they should make all observations by projecting flashlight beams onto a wall or the floor.

Important Note: These lesson plans highlight some of the safety risks you should be aware of while teaching these lessons. These safety suggestions are not meant to take the place of a formal science safety training. Please be sure to follow all safety rules from your district, as well as all local, state, and federal science safety guidelines.

Unit Storyline

Engage: Why do we study space? Scholars begin the unit by considering our human desire to unravel the secrets of the unknown as well as the practical reasons why studying the universe matters to scientists. By the end of these investigations, scholars will be excited to learn more and motivated to answer the unit's Essential Question.

- **Lesson 1: Is Anyone Out There?** Why do we study space? Scholars discuss everything from the search for life in the universe to space travel, discover what it's like to be a real astronaut, and leave this introductory investigation excited to learn about our universe and motivated to answer the Essential Question.
- **Lesson 2: The Beginning** Is it possible to look into the past? Is there really evidence left behind that might tell the story of the creation of the universe billions of years later? Scholars investigate and learn how scientists study phenomena that cannot be directly observed.

Explore: Scholars begin to examine the pieces of our universe through modeling and research. In these investigations they develop new understandings that help them to begin to answer the Essential Question.

- **Lesson 3: Our Universe, to Scale** We know the universe is big, and we believe it is expanding by the minute! But just how big is it? Does it have edges? Scholars explore interactive models of the universe to find out.
- **Lesson 4: Our Solar System, to Scale** Scholars are tasked with creating scale models of the planets in our solar system. In this challenging investigation, they design their own models and evaluate them, highlighting their strengths and limitations.
- **Lesson 5: Pieces of the Universe** What makes a moon a moon? What is an asteroid, and do we really need to worry about one crashing into our planet like we see in the movies? In this investigation, scholars conduct research to learn about the other objects in our universe.
- **Lesson 6: Is the Sun the Largest Star?** In this investigation, scholars learn how one's perspective can massively distort the apparent size of an object.

Explain: Scholars solidify their understanding of the organization and movement of celestial bodies in space through experimentation and developing representational models. This helps them to answer many of Peeko's questions! Prepare to witness everything from a total lunar eclipse to the bending of the (spandex) fabric of space-time, right in your science lab!

- **Lesson 7: The Celestial Dance** Why does the night sky look different throughout the year? Building on their knowledge from earlier lessons in this unit as well as from elementary school, scholars emerge from this investigation understanding the apparent motion of the stars.
- **Lesson 8: Total Eclipse of the Science Lab** What are the different types of eclipses, and why do they happen? Scholars are challenged to create their own models to find the secrets behind the phenomena that have mystified civilizations throughout history.
- **Lesson 9: Invisible Forces** How can scientists model something that cannot be seen? Scholars explore two provided models to learn about the laws of gravity and the fabric of space-time. By the end of the investigation, scholars will have developed a more complete picture of the essential role gravity plays in maintaining the composition of the universe.

Elaborate: In this futuristic simulation, scholars discover that their spacecraft needs to make a crash landing in a foreign solar system. Given the available data about the surrounding planets and moons, scholars must decide where to land before time runs out!

- **Lesson 10: Crash Landing** Scholars are in the year 2335, and space travel is common. While they are flying through an unfamiliar solar system, the unthinkable happens: Their ship is going down, and they must make a decision, fast! Based on the limited data available, where will they choose to land to ensure their survival?

Evaluate: In this culminating investigation, scholars have the opportunity to demonstrate their mastery of major unit goals! Finally they can help Peeko answer all those pressing questions!

- **Lesson 11: A Cosmic Finale** In this culminating investigation, scholars demonstrate their mastery of the content and skills from the unit through one final challenge: helping Peeko understand his home solar system!

Extra Resources

- [Printable Exit Tickets](#)
- [Printable Lab Notebook](#)