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PART 1 Sun-Earth-Moon System

LESSON 1

Thinking About Earth as a Planet

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION/JET PROPULSION LABORATORY

This composite shows several images of the planets that were taken by Voyager *and made into one photo.*

INTRODUCTION

By simply looking into the sky, you have made direct observations of the Sun and Moon—the two most visible objects in our sky. Astronomers historically have made direct observations of our closest neighbors, including Mars and the Moon, but most of what astronomers know about Mercury, Venus, and the outer planets comes from the use of technological tools, especially NASA spacecraft. (NASA stands for National Aeronautics and Space Administration.) For example, *Voyager 1* and *Voyager 2* reached Jupiter in 1979. *Voyager 1* reached Saturn in 1980 and sent back close-up views of the planet. *Voyager 2* moved on to explore Uranus in 1986 and Neptune in 1989. As it orbits Earth, the Hubble space telescope has taken images of Pluto and its moon, Charon. As a result, the solar system is no longer a complete mystery to astronomers.

How much do you know about our solar system? What do your observations of the sky tell you? In this lesson, you will consider what you already know and what you want to know about Earth in space.

OBJECTIVES FOR THIS LESSON

Record your ideas and questions about Earth in space.

Record your responses to 10 common questions about space.

Analyze the class's responses to these 10 questions.

Started

1. Read the Introduction and Objectives for This Lesson. (Try to do this before every lesson.)

2. Record in your science notebook 5–10 things you know about the solar system and Earth in space.

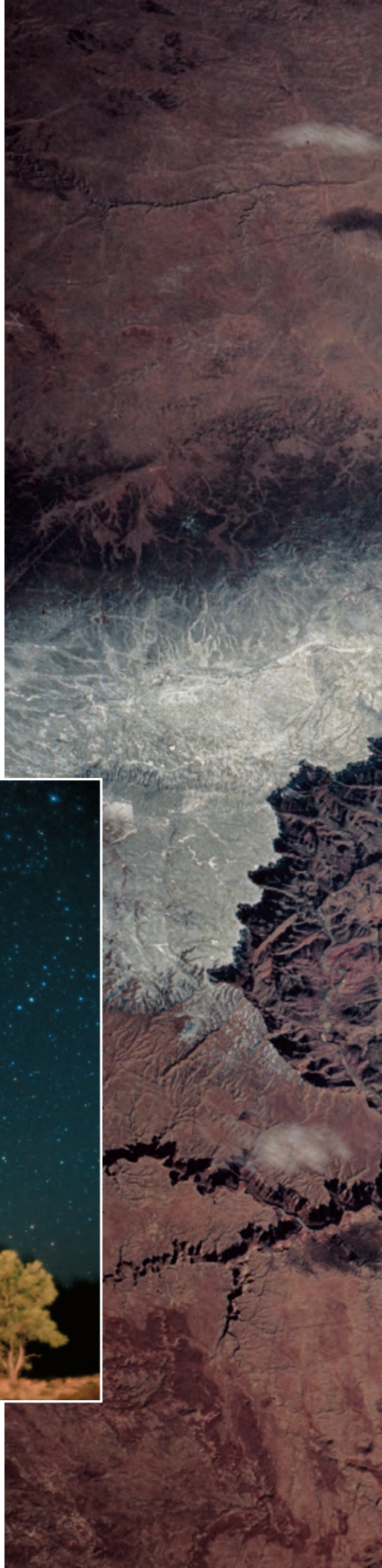
3. Share what you know about the solar system with the class.

MATERIALS FOR LESSON 1

For you

1 science notebook
10 self-stick notes
1 set of colored pencils, crayons, or fine-point markers

Getting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Inquiry 1.1
Examining Our Ideas About Space

PROCEDURE

1. Answer each of the following 10 questions individually in your notebook. Label each answer with the corresponding letter (A–J).

A. What is responsible for the length of one day? What is responsible for the length of one year?

B. What causes seasons?

C. Why does the Moon appear to change shape?

D. What causes a lunar eclipse? What causes a solar eclipse?

E. Look at Figure 1.1. What are the points of light in the night sky? Can you see them in the daytime? Why or why not?

F. Look at Figures 1.2 and 1.3. What processes created each landform? Do these landforms exist on other planets or moons? Explain why or why not.


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Figure 1.1 *Points of light in the night sky*

Figure 1.2 *Landform #1*

UNITED STATES GEOLOGICAL SURVEY/HAWAIIAN VOLCANO OBSERVATORY

Figure 1.3 *Landform #2*

G. Where does gravity exist? Where is gravity strongest? Where is it weakest? Why?

H. What keeps the planets in orbit around the Sun?

I. What causes tides?

J. Look at Figure 1.4. What do you see in the night sky? Write what you know about this object.

BRIAN MCLEOD

Figure 1.4 *What do you see in the night sky?*

2. Record each of your answers on a separate self-stick note. Write the matching letter (A–J) in the corner of the note.

3. Your teacher will circulate folders among members of your group. Each folder contains a question (A–J) and a photograph. Examine the photograph and read its matching question. Post your self-stick answers inside each matching folder.

4. Once you have posted all your answers to Questions A–J, your group will get one or two completed folders on which to report. Read all the posted answers on each completed folder. Put all the answers that are the same, or nearly the same, together in piles.

5. From each pile, select one answer and post it on the inside of the folder. On that answer, indicate how many times other students gave it as an answer. Put aside the duplicates.

6. Post any unique or original answers on the folder.

7. When all groups are ready, report your findings to the class. Ask your classmates if they have any questions or want to debate any of the statements. Be prepared to revisit these statements throughout the module.

REFLECTING ON WHAT YOU'VE DONE

1. Discuss the following questions with your class.

Are any of the questions (A–J) you answered during Inquiry 1.1 related to the same topic? Explain your answer by giving an example.

What can we learn about Earth by studying the solar system?

How is Earth different from other planets? How is Earth similar to other planets?

2. Record in your notebook any questions you have about Earth in space and the solar system in general. Label these questions "What I Want To Know About the Solar System."

3. Share your questions in a class discussion. Your teacher will record your ideas. You will try to answer these questions as you work through this module.

4. In your science notebook, summarize what you learned (or did) in this lesson. Date your entry.

ASTRONOMY: Looking Back

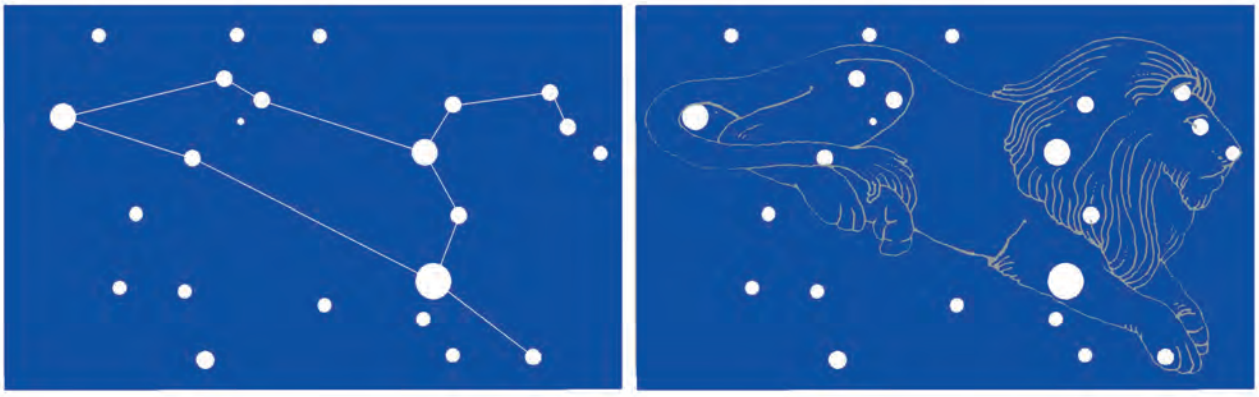
What do you see when you look into the night sky? Your first answer may be "stars." Almost everything we see at night looks like a point of light. But did you know that those points of light also include planets, moons around other planets, meteors, asteroids, and even comets? All these heavenly bodies and our Sun—a star itself—are part of the cosmic neighborhood that we call the solar system.

How did we come to learn so much about the solar system? Today, astronomers use such technological advances as Hubble, a space telescope that orbits Earth and takes pictures of the solar system and deep space, and the Solar and Heliospheric Observatory (often referred to as SOHO), a satellite designed to continuously study the Sun. However, while modern astronomy—the science of observing the sky—is only a few centuries old, skywatching has been a pastime throughout history.

Ancient Skywatching

During ancient times, people could easily see the Sun and Moon, five bright neighboring planets, an occasional comet, and frequent meteors. But they did not know what these objects were. So they made up stories to describe what they had seen. To the ancients, everything in the night sky was magical, and the stories that they told, called myths, explained that magic. Astrology grew out of these early myths. (Astrology is the belief that events in the sky—the "heavens"—control our lives and predict the future.)

The ancients tried to identify patterns in the sky. They observed the Sun as it appeared to move across the daytime sky and watched as the Moon seemed to follow that same path. These early skywatchers recognized patterns in the stars' positions, gave those patterns names, and told stories to explain how these constellation "pictures" came to be.



Constellation Leo, shaped like a lion, is best seen in early spring when it is high in the sky in the Northern Hemisphere. Regulus is the bright star that marks the lion's heart.

The earliest skywatchers who kept records were the Sumerians, Babylonians, and Egyptians. Their records dated as far back as 5000 B.C. The Greeks, in 1000 B.C., continued to try to find order in the sky and in the motions of objects in the sky. They went beyond earlier, simple observations and tried to develop theories or models for the nature of celestial objects and their motions.

Classifying "Stars"

The ancients thought that everything in the sky was a star. They classified stars this way:

- "Fixed stars" that didn't change and didn't move relative to one another (which we know as *stars* today)
- "Shooting stars" that flashed across the sky (these are now known as *meteors)*
- "Hairy stars" that moved across the sky with a tail following behind them (we know these as *comets)*
- "Wandering stars" that moved across the sky following the Sun's path (these are now known as *planets)*

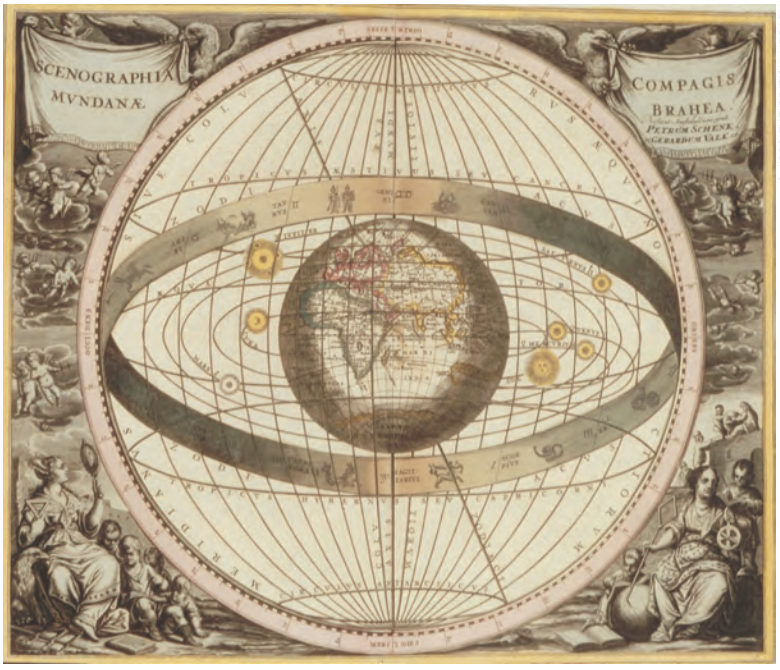
The Greeks gave the name *planetes*, meaning "wanderers," to the Sun, Moon, and planets—which to them were points of light that moved against the background of fixed stars. It became apparent over time that these *planetes* were part of a closely associated group of objects that we now know as our solar system.

Earth-Centered System

The Greeks believed that Earth was the center of the universe and that all the planets and stars moved around Earth. According to Greek philosophy, everything about Earth was perfect. The Greeks believed that the sphere was the perfect shape, and they theorized that the planets, the Sun, and the Moon were attached to a huge, turning, transparent crystalline sphere that was centered on Earth.

In the second century A.D. in Alexandria, Egypt, the Greek astronomer Claudius Ptolemy proposed that planets moved in little circles that moved on bigger circles around Earth. His theory explained why some points of light seemed to move in strange patterns. For almost 1400 years, people believed Ptolemy's theory to be true.

In the early 1500s, the astronomer Nicolaus Copernicus modified the Earth-centered model with the revolutionary theory that the Sun, not Earth, was the center of the solar system. After Copernicus died in 1543, the Danish astronomer Tycho Brahe used Copernicus's observations to confirm that the planets orbited the Sun. With careful measurements, he showed that comets were well beyond the Moon. But Brahe still believed that the Moon and the Sun revolved around Earth. Finally, Brahe's student Johannes Kepler, who used Brahe's measurements, confirmed that all the planetary objects, including Earth, orbited the Sun.



Early map of the solar system

Galileo used one of the first telescopes to look at the sky.

The Italian scientist Galileo Galilei adapted one of the first telescopes for astronomical use in 1610. This new invention made distant objects appear to be nearer and clearer. Fainter objects became visible, and astronomers' measurements became more precise. Among Galileo's first discoveries were four satellite moons revolving around Jupiter. Since Galileo could see for himself that these moons orbited Jupiter, he could demonstrate that Earth was not the center of the universe. Galileo was arrested for his discoveries and claims, which contradicted many beliefs held by the Church. However, Galileo and many others made new discoveries over the years, including the rings of Saturn, satellites or moons around several planets, sunspots, and other phenomena.

Looking Beyond

The sky that we see at night is the same sky that skywatchers of old saw and studied. The biggest difference is that we have the benefit of technology and much more knowledge to explain our observations. Exciting new discoveries about the universe are made every day. □

QUESTIONS

1. What is astronomy?
2. What did ancient skywatchers do to explain the night sky? Why?
3. What did the Greeks believe about Earth? How did their ideas change over time?