CHAPTER 1
Mysterious Universe

Introduction

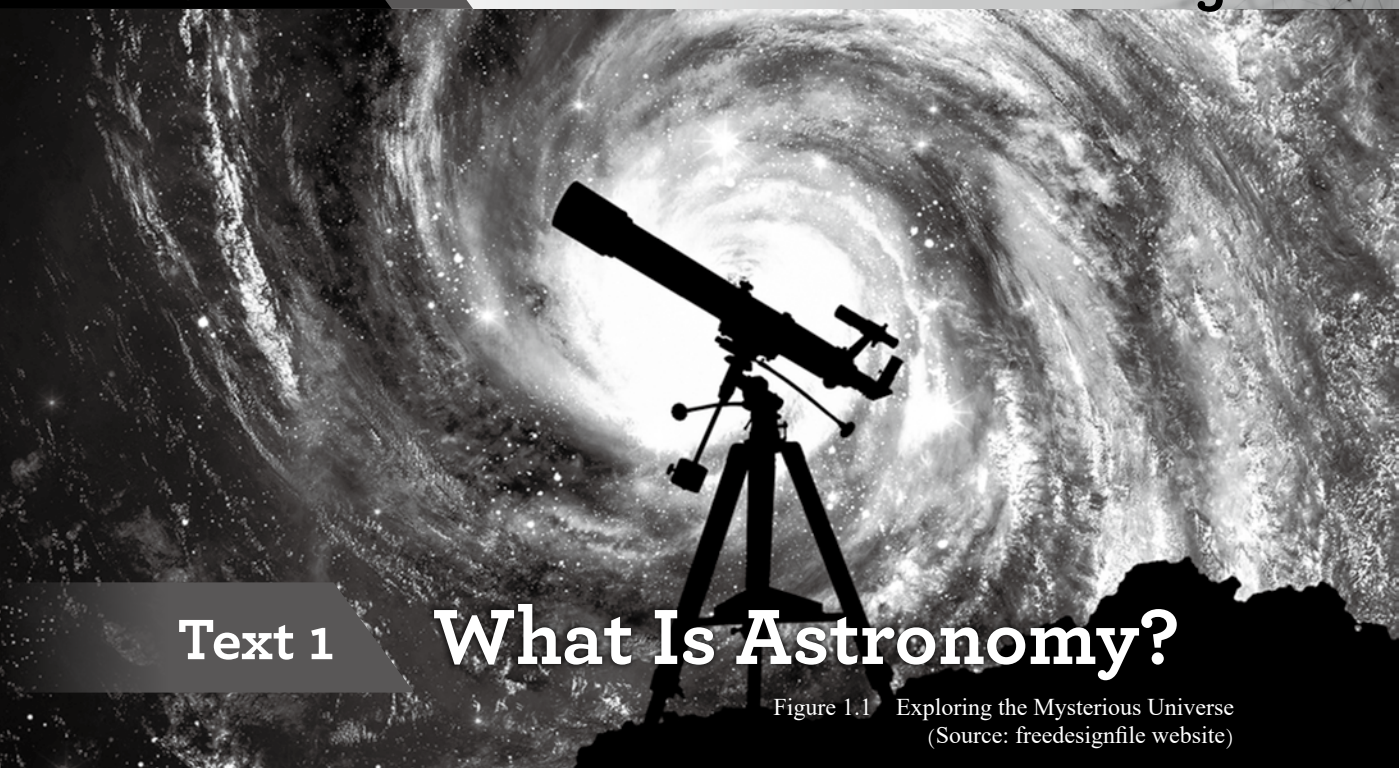
The vast and mysterious universe looks quiet and lonely ostensibly, but there are numerous mazes and wonders hidden inside, which have aroused endless reveries and imaginations. The three texts in this chapter center on the theme of the mysterious universe. To be specific, Text 1 is a passage for fast reading, dealing with the discipline of astronomy; Text 2 is a passage for intensive reading, introducing the solar system and its eight planets; and Text 3 is a passage for translation, discussing the origin of the universe. The learning objective of this chapter is to familiarize the learners with the reading strategies for EST (English for Science and Technology) and the criteria for EST translation.

Lead-in Questions

1. "The universe is the vast empty space surrounding the planets and stars. It consists of dark matter, dark energy, stars, and galaxies." Does this statement match up to your idea about the universe?

2. What is your comment on the German philosopher Immanuel Kant's quote: "Two things fill the mind with ever new and increasing admiration and reverence, the more often and more steadily one reflects on them: the starry heavens above me and the moral law within me"?

Section A Fast and Intensive Reading



Text 1 What Is Astronomy?

Figure 1.1 Exploring the Mysterious Universe
(Source: freedesignfile website)

A Astronomy is the study of the Sun, Moon, stars, planets, and other objects and phenomena in space. It has a long, rich history.

B Every night, using the science of astronomy, the entire universe can be revealed above us. Although at some point we've all had that "blanket of stars" moment, it is an illusion. The visible planets and the bright stars you can see with your eyes are mostly very close to us—in cosmic terms—but the night sky has incredible, almost unfathomable depth. Not only can our own galaxy, the Milky Way, be navigated and known but other galaxies can be probed using telescopes, on Earth and in space, and in various wavelengths of light from all kinds of cosmic objects. Here's everything you need to know about what astronomy is, what it's not, and how recent developments within the field of astronomy are making it more exciting than ever before.

C What does astronomy mean? A dictionary will tell you that it's the branch of science that deals with celestial objects, space, and the physical universe as a whole. Astronomy is the study of everything in the universe that's beyond our own planet's atmosphere. The planets in our own solar system, our own star the Sun, and the bright stars can all be seen with the naked eye. However, astronomy can go much deeper, taking advantage of telescopes and other

scientific instruments to study other stars and their planets in our galaxy, as well as distant galaxies beyond our own. It can gather clues about the nature of the physical, chemical, and biological universe itself.

D Astronomers aren't stargazers. Or, at least, there's no longer any need for them to be. If you think an astronomer treks up mountains to spend night after night behind the eyepiece of a giant telescope, think again. These days telescopes can be controlled remotely, so it's common for modern astronomers to simply make requests for observations and then download computer-generated data and images the next morning for their analysis. That includes space telescopes like the Hubble Space Telescope.

E People very often confuse astronomy with astrology. Every professional astronomer has had to hear someone say to them, "So you're an astrologer, right?" Astrology and astronomy are not the same thing, but they used to be. Observational astronomy can be traced back to Ancient Egypt and Mesopotamia as far back as 3,000 B.C., but the calculating of solar eclipses, the movements of the planets, and theories about how the night sky works were the jobs of ancient astrologers who presumed that celestial events and alignments had a direct impact on human affairs. Modern astrologers attempt to do something similar, making predictions about human lives based on pseudoscience. Astrology is not a science.

F In the past century or so, astronomy has been broadly split into two camps—observational astronomy (using telescopes and cameras to collect data about the night sky) and theoretical astronomy (using that data to analyze, model, and theorize about how objects and phenomena work).

G They complement each other, yet within these two broad categories modern astronomy includes many subsets, from astrometry to exoplanetology, that intrinsically overlap yet help explain the many things astronomers do. Here's what they all mean:

- **Astrometry:** This ancient branch of astronomy concerns precise calculations of the motions of the Sun, the Moon, and the planets. It includes predictions of solar and lunar eclipses, and meteor showers. It also includes exoplanetology, a relatively new and very exciting field that concerns itself with the discovery and characterization of planets outside of the solar system.

- **Planetary astronomy:** How did the solar system come to be? This is the central question penetrating planetary astronomy, which focuses on the formation, evolution, and death of planets, moons, and other objects. In the solar system, it also includes planetary geology.
- **Astrophysics:** Astrophysicists apply the laws and theories of physics to astronomical observations. It's an attempt to understand the mechanism behind how the universe was created and how it has and will evolve.
- **Astrochemistry:** Astrochemists study the composition and reactions of atoms, molecules, and ions in space.
- **Astrobiology:** This emerging and, for now, largely theoretical field of astronomy is the study of life beyond Earth.
- **Stellar astronomy:** The study of the life cycle and structure of the Sun and the stars, stellar astronomy concerns the classification and populations of stars.
- **Solar astronomy:** Galactic astronomers study our galaxy, the Milky Way, while extragalactic astronomers peer outside of it to determine how these groups of stars form, change, and die.
- **Cosmology:** Although it's sometimes used to mean astronomy, strictly speaking, cosmology refers to the science of the origin and nature of the universe. The key concept in cosmology is the Big Bang theory, the most widely accepted explanation of how the universe began. Cosmology also includes purely theoretical subjects including string theory, dark matter and dark energy, and the notion of multiple universes.

H All astronomy is the study of different wavelengths of the electromagnetic spectrum, which comprises radio, microwave, infrared, visible, ultraviolet, X-ray, and gamma rays. To get the full picture of what's out there, astronomers need to study various wavelengths of light.

I Optical astronomy is the study of celestial objects using telescopes and in visible light; all of the biggest telescopes on Earth are optical. Infrared light can be detected outside of the Earth's atmosphere by space-based observatories like the Hubble Space Telescope and the James Webb Space Telescope. Radio astronomy is the study of the sky in radio frequencies; radio telescopes detect and amplify radio waves from space.

J However they observe the universe, astronomers only ever get a snapshot of the planets, stars, and galaxies they study. So, although there are dozens of different branches of astronomy, in practice many of them must overlap for an astronomer to get as full a picture as possible of objects that exist for millions to billions of years.

K We're on the cusp of some tremendously exciting new technology that looks set to revolutionize astronomy. The most obvious is the James Webb Space Telescope, which from 2022 will probe the cosmos to uncover the history of the universe. Just as exciting are the Vera Rubin Observatory all-sky survey and the new generation of massive ground-based telescopes like the Extremely Large Telescope, which should all see "first light" in the mid-2020s. The Square Kilometer Array, the world's largest radio telescope, should also be operating by the late 2020s. Astronomers are about to see deeper into space to observe regions and objects never seen before.

(Source: Space website)

Notes

astrology: the study of the positions of the stars and the movements of the planets in the belief that they influence human affairs 占星术；占星学

Hubble Space Telescope: a space telescope that was launched into low Earth orbit in 1990 and remains in operation 哈勃太空望远镜

James Webb Space Telescope: The James Webb Space Telescope (JWST), previously known as Next Generation Space Telescope (NGST), is a flagship-class space observatory under construction and scheduled to launch in October 2018. 詹姆斯·韦伯空间望远镜

Mesopotamia: the region of Asia between the Tigris and Euphrates rivers 美索不达米亚［古希腊对两河（幼发拉底河和底格里斯河）流域的称谓，意为"（两条）河流之间的地方"］

Vera Rubin Observatory: Vera Rubin Observatory in Chile features an 8.4-meter telescope, a 3,200 megapixel camera, an automated data processing system, and an online public engagement platform. 薇拉·鲁宾天文台（位于智利，安装了世界上最大的天文数码照相机）

Exercises

Task A **Identify the paragraph from which each of the following statements is derived. You may choose a paragraph more than once. Each paragraph in the above text is marked with a letter.**

1. Generally speaking, there are two types of astronomy.

2. With the help of the latest telescopes, astronomers are expecting to probe deeper into the universe.

3. Even though astronomers have been studying the universe for a long time, they know just a little about it.

4. The study of the origin and nature of the universe is the focus of cosmology.

5. Astronomy can deal with the nature of the physical universe.

6. Many people wrongly take astronomers as astrologers.

7. The "blanket of stars" we often see with our eyes is an optical illusion.

8. The largest telescopes are optical so that they can detect light in outer space.

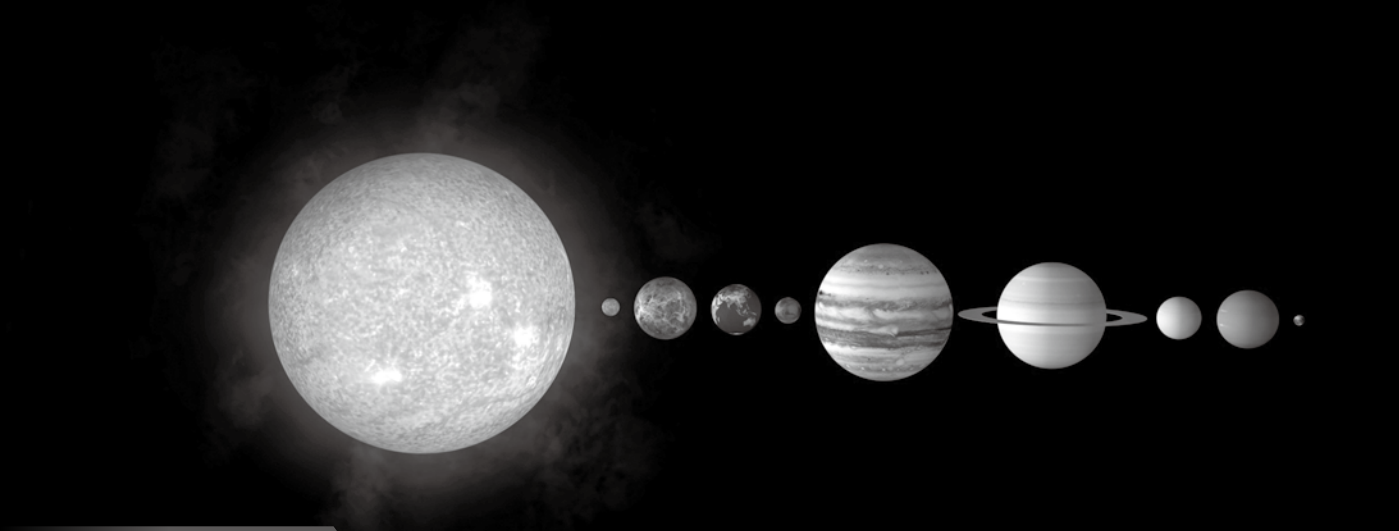
9. Astronomers can know the universe better by studying different wavelengths of lights.

10. Telescope data can be generated by its computer and sent to astronomers from afar.

Task B **Work in groups to discuss the following topic and share your opinions with the class.**

What Motivates Humans to Explore the Universe?

Have you ever wondered why humans devote considerable resources to studying celestial bodies beyond the Earth's atmosphere? Some may argue that it allows us to gain insights into the universe, uncover its origins, advance technological development, and spark a sense of awe and inquisitiveness. What are your own reasons for your stance on this matter?



Text 2 The Solar System

Figure 1.2 Planets in the Solar System
(Source: Pixabay website)

Solar system consisting of the Sun—an average star in the **Milky Way Galaxy**—and those bodies orbiting around it: 8 (formerly 9) planets with about 210 known planetary satellites; countless **asteroids**, some with their own satellites; comets and other icy bodies; and vast reaches of highly tenuous gas and dust known as the **interplanetary medium**.

Milky Way Galaxy 银河系

asteroid 小行星

interplanetary medium 星际介质

The Sun, Moon, and brightest planets were visible to the naked eyes of ancient astronomers, and their observations and calculations of the movements of these bodies gave rise to the science of astronomy. Today the amount of information on the motions, properties, and compositions of the planets and smaller bodies has grown to immense proportions, and the range of observational instruments has extended far beyond the solar system to other galaxies and the edge of the known universe. Yet the solar system and its immediate outer boundary still represent the limit of our physical reach, and they remain the core of our theoretical understanding of the **cosmos** as well. Earth-launched space probes and landers have gathered data on planets, moons, asteroids, and other bodies, and this data has been added to the measurements collected with telescopes and other instruments from below and above Earth's atmosphere and to the

cosmos 宇宙

information extracted from meteorites and from Moon rocks returned by astronauts. All this information is scrutinized in attempts to understand in detail the origin and evolution of the solar system—a goal towards which astronomers continue to make great strides.

Located at the center of the solar system and influencing the motion of all the other bodies through its gravitational force is the Sun, which in itself contains more than 99% of the mass of the system. The planets, in order of their distance outward from the Sun, are **Mercury**, **Venus**, Earth, **Mars**, **Jupiter**, **Saturn**, **Uranus**, and **Neptune**. Four planets—Jupiter through Neptune—have ring systems, and all but Mercury and Venus have one or more moons. **Pluto** had been officially listed among the planets since it was discovered in 1930 orbiting beyond Neptune, but in 1992 an icy object was discovered still farther from the Sun than Pluto. Many other such discoveries followed, including an object named **Eris** that appears to be at least as large as Pluto. It became apparent that Pluto was simply one of the larger members of this new group of objects, collectively known as the **Kuiper belt**. Accordingly, in August 2006 the International Astronomical Union (IAU), the organization charged by the scientific community with classifying astronomical objects, voted to revoke Pluto's planetary status and place it under a new classification called **dwarf planet**.

Mercury 水星
Venus 金星
Mars 火星
Jupiter 木星
Saturn 土星
Uranus 天王星
Neptune 海王星
Pluto 冥王星
Eris 阋神星
Kuiper belt 柯伊伯带
dwarf planet 矮行星

Any natural solar system object other than the Sun, a planet, a dwarf planet, or a moon is called a small body; these include asteroids, meteoroids, and comets. Most of the several hundred thousand asteroids, or minor planets, orbit between Mars and Jupiter in a nearly flat ring called the **asteroid belt**. The myriad fragments of asteroids and other small pieces of solid matter (smaller than a few tens of meters across) that populate interplanetary space are often termed meteoroids to distinguish them from the larger steroidal bodies. The solar system's several billion

asteroid belt 小行星带

comets are found mainly in two distinct reservoirs. The more-distant one, called the **Oort cloud**, is a spherical shell surrounding the solar system at a distance of approximately 50,000 astronomical units (AU)—more than 1,000 times the distance of Pluto's orbit. The other reservoir, the Kuiper belt, is a thick disk-shaped zone whose main concentration extends 30–50 AU from the Sun, beyond the orbit of Neptune but including a portion of the orbit of Pluto. (One astronomical unit is the average distance from Earth to the Sun—about 150 million km [93 million miles].) Just as asteroids can be regarded as rocky debris left over from the formation of the inner planets, Pluto, its moon Charon, Eris, and the myriad other Kuiper belt objects can be seen as surviving representatives of the icy bodies that accreted to form the cores of Neptune and Uranus. As such, Pluto and Charon may also be considered to be very large comet nuclei. The Centaur objects, a population of comet nuclei having diameters as large as 200 km (125 miles), orbit the Sun between Jupiter and Neptune, probably having been gravitationally perturbed inward from the Kuiper belt. The interplanetary medium—an exceedingly tenuous plasma (ionized gas) laced with concentrations of dust particles—extends outward from the Sun to about 123 AU.

Oort cloud 奥尔特云

As the amount of data on the planets, moons, comets, and asteroids has grown, so too have the problems faced by astronomers in forming theories of the origin of the solar system. In the ancient world, theories of the origin of Earth and the objects seen in the sky were certainly much less constrained by fact. Indeed, a scientific approach to the origin of the solar system became possible only after the publication of Isaac Newton's **laws of motion and gravitation** in 1687. Even after this breakthrough, many years elapsed while scientists struggled with applications of Newton's laws to explain the apparent motions of planets, moons, comets, and asteroids. In 1734, Swedish philosopher Emanuel Swedenborg

laws of motion and gravitation 运动和引力定律

proposed a model for the solar system's origin in which a shell of material around the Sun broke into small pieces that formed the planets. This idea of the solar system forming out of an **original nebula** was extended by the German philosopher Immanuel Kant in 1755.

original nebula
原始星云

(Source: Britannica website)

Exercises

Task A Decide whether the following statements are true (T) or false (F).

1. The solar system is composed of the Sun, nine planets, countless asteroids, comets and other icy bodies, and interplanetary medium.

2. The Sun, Moon, and brightest planets were invisible to the naked eyes of ancient astronomers.

3. The Sun locates at the center of the solar system and contains more than 99% of the mass of the solar system.

4. Four planets—Jupiter through Neptune—have ring systems and one or more moons.

5. Several billion comets are found mainly in two distinct reservoirs, namely the Oort shell and Kuiper belt.

Task B Choose the word or phrase which is closest in meaning to the underlined part in each sentence.

1. The Sun, Moon, and brightest planets were visible to the naked eyes of ancient astronomers, and their observations and calculations of the movements of these bodies gave rise to the science of astronomy.

A. produced ***B.*** attracted ***C.*** operated ***D.*** deduced

2. All this information is scrutinized in attempts to understand in detail the origin and evolution of the solar system—a goal towards which astronomers continue to make great strides.

A. analyzed ***B.*** scanned ***C.*** searched ***D.*** examined

3. It became apparent that Pluto was simply one of the larger members of this new group of objects, collectively known as the Kuiper belt.

A. appealing ***B.*** obscure ***C.*** obvious ***D.*** understandable

4. The Centaur objects, a population of comet nuclei having diameters as large as 200 km (125 miles), orbit the Sun between Jupiter and Neptune, probably having been gravitationally perturbed inward from the Kuiper belt.

A. the number of ***B.*** a number of ***C.*** a group of ***D.*** a portion of

5. In the ancient world, theories of the origin of Earth and the objects seen in the sky were certainly much less constrained by fact.

A. enforced by ***B.*** subject to ***C.*** restricted by ***D.*** provoked by

Task C Answer the following questions based on the text.

1. What is the solar system composed of?

2. Can you name the eight planets in order of their distance outward from the Sun?

3. Why is Pluto removed from the list of planets in the solar system?

4. What is the difference between asteroids and meteoroids?

5. What makes it possible for us to take a scientific approach to the origin of the solar system?