12

"I don't think the human race will survive the next thousand years unless we spread into space"

– Stephen Hawking

Beyond Earth

The Big Question

Look up at the night sky—those tiny twinkling lights are actually massive suns far away. Some may have worlds with rings or storms. This chapter takes you on a journey Beyond Earth, exploring stars, constellations, satellites, and our Solar System, revealing the wonders of space and the mysteries that lie beyond our planet.

Meet EeeBee.AI

Hello, curious cosmic explorers! I'm EeeBee, your AI buddy. Let's journey beyond Earth—from twinkling stars to orbiting satellites and our cosmic neighborhood!

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Explore the stars, constellations, and the structural and chemical composition of the Sun and celestial objects in the solar system.
- Understand how telescopes are used to observe far-off astronomical bodies.
- Gain knowledge about natural and artificial satellites, along with other objects within the solar system.

Science Around you

Our exploration of space, from studying distant stars to sending probes to other planets and launching satellites, has profoundly impacted life on Earth. It has driven technological innovation, fostered international collaboration, provided critical data for weather forecasting and communication, and expanded our understanding of the universe and our place within it.

NCF Curricular Goals and Competencies

CG-2 (C 2.5): Develops an understanding of the physical universe through scientific and mathematical perspectives. **CG-5 (C 5.2):** Explores the relationship between scientific advancements and technology. **CG-6 (C 6.1 and C 6.2):** Investigates the principles and progression of scientific discoveries while promoting scientific inquiry and innovation.

Mind Map

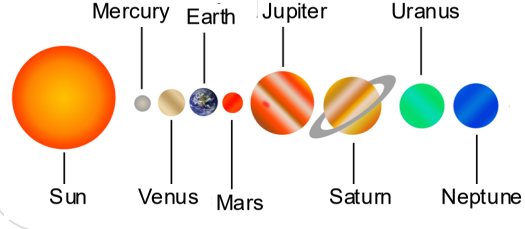
Beyond Earth

What Are Constellations?

- **What Are Constellations:** A constellation is a group of stars forming a recognizable pattern in the night sky.
- **Examples of Constellations:**
  - ✓ **Orion –** The Hunter
  - ✓ **Ursa Major –** The Great Bear
  - ✓ **Ursa Minor –** The Little Bear
  - ✓ **Cassiopeia –** The Queen
- **Role of Telescopes in Observing the Sky:** Telescopes help us observe distant celestial objects by collecting more light than the human eye.
- **Note:** The Keck Telescope, located in Hawaii, is one of the world's largest optical telescopes. It uses a 10-meter mirror to observe distant stars, galaxies, and other space objects

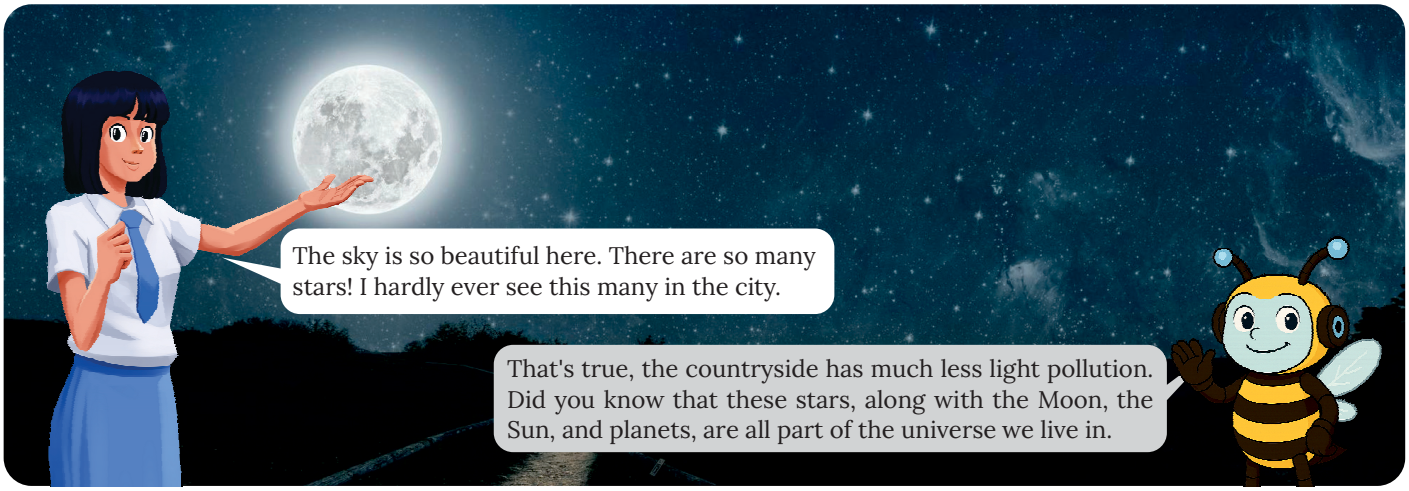
The Solar System

- **The Sun: The Central Star of Our Solar System**
  - ✓ Source of Light and Heat
  - ✓ Structure: Core, Photosphere, Corona
- **Planets: Wanderers of the Solar System**
- **Types of Planets**
  - ✓ Terrestrial Planets (Mercury to Mars)
  - ✓ Gas Giants (Jupiter & Saturn)
  - ✓ Ice Giants (Uranus & Neptune)



Satellites

- **Types of Satellites**
  - ✓ Natural Satellites (e.g., Moon)
  - ✓ Artificial Satellites (e.g., GPS, Weather Satellites)
- **Asteroids: Minor Planets of the Solar System**
  - ✓ Found mostly in the Asteroid Belt
- **Comets: The Icy Wanderers of Space**
  - ✓ Have tails when near the Sun
- **The Milky Way Galaxy**
  - ✓ Our galaxy containing billions of stars and solar systems



In Focus

- What Are Constellations?
- The Solar System
- Satellites

Introduction

The vast expanse beyond Earth has captivated human imagination for centuries, inspiring stories, discoveries, and innovations. From the twinkling stars in the night sky to the mysteries of distant galaxies, the universe holds endless possibilities and secrets yet to be unraveled. Exploring what lies beyond our planet has not only deepened our understanding of the cosmos but also redefined humanity's place within it.

From History's Pages

1. Space Age Beginnings:

The launch of Sputnik 1 by the Soviet Union on October 4, 1957, was the first artificial satellite to orbit Earth, marking the beginning of the space age.

Laika, a dog, became the first living creature to orbit Earth aboard Sputnik 2 on November 3, 1957.

2. First Human in Space:

On April 12, 1961, Yuri Gagarin of the Soviet Union became the first human to travel into space aboard Vostok 1, completing one orbit around Earth.

At night, the sky becomes a canvas filled with countless stars, some appearing bright while others are faint. Stars are massive spheres of burning gases, primarily hydrogen and helium, that generate their own heat and light through nuclear fusion. These celestial objects have fascinated humanity for millennia, not only for their beauty but also for their significance in navigation, storytelling, and science. ecosystems and supporting life on Earth.

What Are Constellations?

Constellations are specific arrangements of stars that form recognizable patterns in the sky. These patterns were used by ancient people to organize and map the night sky. Constellations were especially valuable for navigation, as sailors and travelers used them to determine directions during their journeys. For instance, the Pole Star (Dhruva Tara), part of the Ursa Minor constellation, has been a reliable guide for locating the North in the Northern Hemisphere.

In modern times, constellations are defined as specific regions of the sky containing these star patterns. The International Astronomical Union (IAU) officially recognized 88 constellations in the early 20th century to standardize the boundaries and ensure uniformity in astronomical studies.

Cultural and Practical Importance of Constellations

1. **Navigation:** Constellations have been crucial for navigation. Sailors and travelers used constellations like Ursa Major to locate the Pole Star and find their way in the absence of compasses.
2. **Storytelling and Mythology:** Different cultures have associated constellations with myths and legends. These stories often served as a way to explain natural phenomena and passed on cultural knowledge across generations.

Examples of Constellations

Several constellations stand out due to their historical, cultural, or navigational significance. Here are some key examples:

Constellation Name	Description	Significance
Orion (Vyadha or Mriga)	Represented as a hunter with seven bright stars. The middle three stars form the "belt of the hunter," while the remaining stars form a quadrilateral.	Associated with mythology, Orion is said to be followed by Canis Major, his dog, as he battles the bull Taurus.
Cassiopeia (Sharmishtha)	A group of five bright stars forming a W or M shape.	Found near the Pole Star and visible from December to April in the Northern Hemisphere.
Canis Major (Mahaashvaan)	Contains Sirius, the brightest star in the night sky.	Also called the Dog Star or Great Dog. It is prominently visible during winter.
Ursa Major (Vrihat Saptarishi)	Consists of seven bright stars forming a "big spoon" shape, with three stars as the handle and four forming the bowl.	Also known as the Big Dipper or Great Bear. Used to locate the Pole Star by drawing a line through its top two stars. Visible in the northern sky from April to September.
Ursa Minor (Laghu Saptarishi)	Contains seven bright stars, including the Pole Star, and resembles a smaller dipper.	Also called the Little Dipper or Lesser Bear. The Pole Star remains stationary in the northern sky, aiding navigation. Visible throughout the year in the Northern Hemisphere.

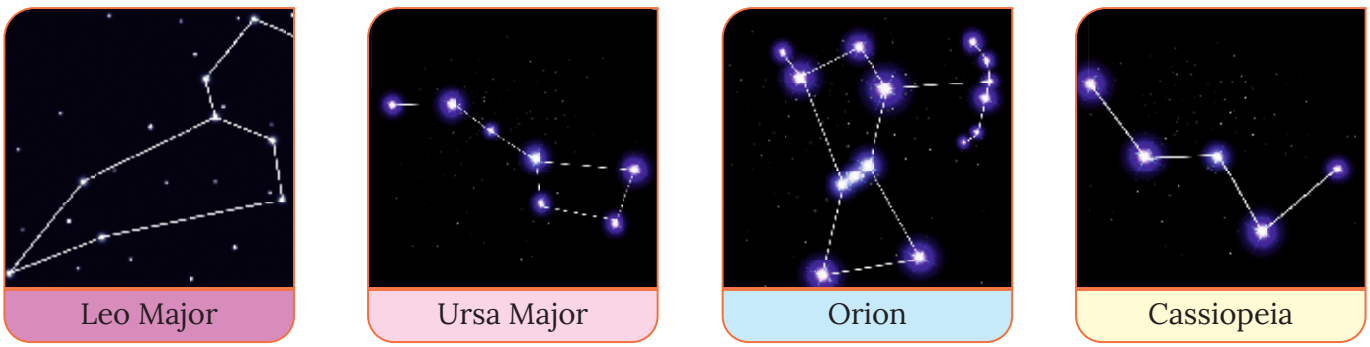


Fig. 12.1 Constellation

Role of Telescopes in Observing the Sky

A telescope is an essential instrument that allows us to observe distant celestial objects with clarity. Telescopes have revolutionized astronomy by providing detailed insights into the universe.

Key Features of Telescopes:

Magnification: Telescopes magnify distant objects, making stars, planets, and galaxies visible to the human eye.

Scientific Importance: They are used extensively in research to gather information about celestial phenomena, including the movement of stars and the composition of planets.

Types of Telescopes: Modern telescopes range from small amateur devices to massive research-grade installations.

Notable Telescope: The Keck Telescope, located in Hawaii, is one of the largest telescopes in the world. It is capable of detecting nearly a million stars and is instrumental in advancing our understanding of the cosmos.

Fig. 12.2 Telescopes

Fact Flash

Did you know that the ancient Greek astronomer Hipparchus, around 150 BCE, created one of the earliest and most comprehensive star catalogs, listing over a thousand stars and classifying them by their apparent brightness? His work laid the foundation for modern stellar magnitude systems!

Common Misconceptions

× **Misconception:** All stars are the same size.

✓ **Correction:** Stars vary enormously in size, from tiny neutron stars (only a few kilometers across) to supergiant stars (thousands of times larger than our Sun).

× **Misconception:** Stars in a constellation are physically close to each other.

✓ **Correction:** Constellations are patterns formed by stars that appear close from Earth's perspective; in reality, they can be vast distances apart in space.

Science Around You

Alpha Centauri is the closest star system to our Sun, located approximately 4.37 light-years away. It is a triple star system comprising Alpha Centauri A, a Sun-like G-type star, and Alpha Centauri B, a slightly smaller K-type star, which orbit each other over 80 years. The third component, Proxima Centauri, is a faint red dwarf and is currently the closest individual star to our Sun at 4.24 light-years. Proxima Centauri has two confirmed planets, including Proxima Centauri b, which resides within its star's habitable zone. While no planets are confirmed around A or B, the system remains a prime target for exoplanet research.

Activity

Drawing Your Own Constellation

- **Objective:** To understand how constellations are perceived patterns and encourage creative observation of the night sky.
- **Materials Required:**

  Dark blue or black paper, White pencil or chalk, (Optional) Glow-in-the-dark stickers or a flashlight.
- **Procedure:**
- Look at pictures of constellations and see how stars are joined to form shapes.
- Observe the night sky (or imagine one with stars).
- Draw random stars on dark paper, making some big and some small.
- Connect the stars to create your own shape, name it, and write a short story.
- Share your constellation and discuss how people see different patterns.

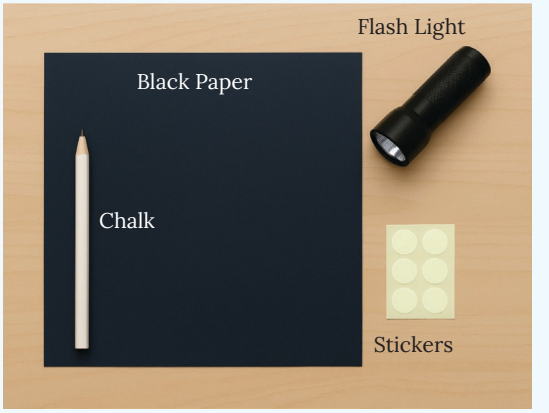


Fig. 12.3 Materials Required

Observation: Observe that constellations are imaginative patterns rather than physical groupings, demonstrating how human perception creates order from astronomical chaos.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. What is the primary process that allows stars to produce their own light and heat?

   a) Combustion ☐ b) Nuclear fission ☐ c) Nuclear fusion ☐ d) Reflection ☐

2. Why do constellations appear as patterns in the sky?

   a) The stars are all physically connected. ☐

   b) It is how we perceive and connect stars from Earth. ☐

   c) They are actual shapes formed in space. ☐

   d) They are closer to Earth than other stars. ☐

Understanding

3. If a star appears reddish, what does that indicate about its temperature?

   a) It is very hot ☐ b) It is relatively cool ☐

   c) It is the same temperature as our Sun. ☐ d) It is rapidly moving away from us. ☐

Applying

Short Answer Question:

4. State what a star is and give one example from the night sky.
5. Explain how constellations were used by humans for guidance in history.

Analyzing

Long Answer Question:

6. Explain the concept of a constellation. Why do stars in a constellation appear to be grouped together, even though they may be vastly different distances from Earth? Use an analogy to clarify your explanation.

The Solar System

The night sky, with its vast expanse of stars and planets, has captivated humanity for centuries, leading us to ponder the origins of the cosmos. The exact beginnings of the universe remain a mystery, but numerous theories attempt to explain its formation. Among the most widely accepted is the Big Bang Theory, which suggests that the universe began approximately 13.8 billion years ago. According to this theory, a singular, infinitely dense point underwent a massive explosion, leading to the expansion of space and the creation of matter.

The study of the universe and its celestial bodies falls under the branch of science known as astronomy. Astronomers, the scientists who specialize in this field, use advanced tools like telescopes, satellites, and space probes to observe and study celestial phenomena.

The Sun: The Central Star of Our Solar System

The Sun is a star and the largest object in our solar system. It is a massive sphere of primarily hydrogen and helium gases, continuously producing heat and light through nuclear fusion. Positioned approximately 150 million kilometers away from Earth, the Sun's rays take around 8 minutes to reach the planet. Its surface temperature exceeds 6,000°C, making it the primary source of energy that sustains life on Earth.

The Sun also drives Earth's climate system, influencing seasons, weather patterns, and the water cycle. By evaporating water from oceans and other water bodies, the Sun powers precipitation and replenishes freshwater supplies, ensuring the continuity of life. In India, the Sun is revered as Sūrya, symbolizing energy, power, and life. It holds a prominent place in Indian culture and spirituality, often worshipped for its vital role in sustaining life on Earth.

Planets: Wanderers of the Solar System

The term "**planet**" originates from the Greek word "**planēs**," meaning "**wanderer**." Planets are celestial bodies that revolve around the Sun in fixed paths called orbits. Each planet takes a specific amount of time to complete one full orbit around the Sun, which is referred to as its **period of revolution**. This period increases as the planet's distance from the Sun grows. For instance, Earth completes one revolution in **365.25 days**, while Neptune takes **165 years** due to its greater distance. Alongside their revolution, planets also rotate on their own axes, a motion known as their **period of rotation**.

Planets are categorized into three main types: inner planets, outer planets, and dwarf planets, based on their location, size, and composition.

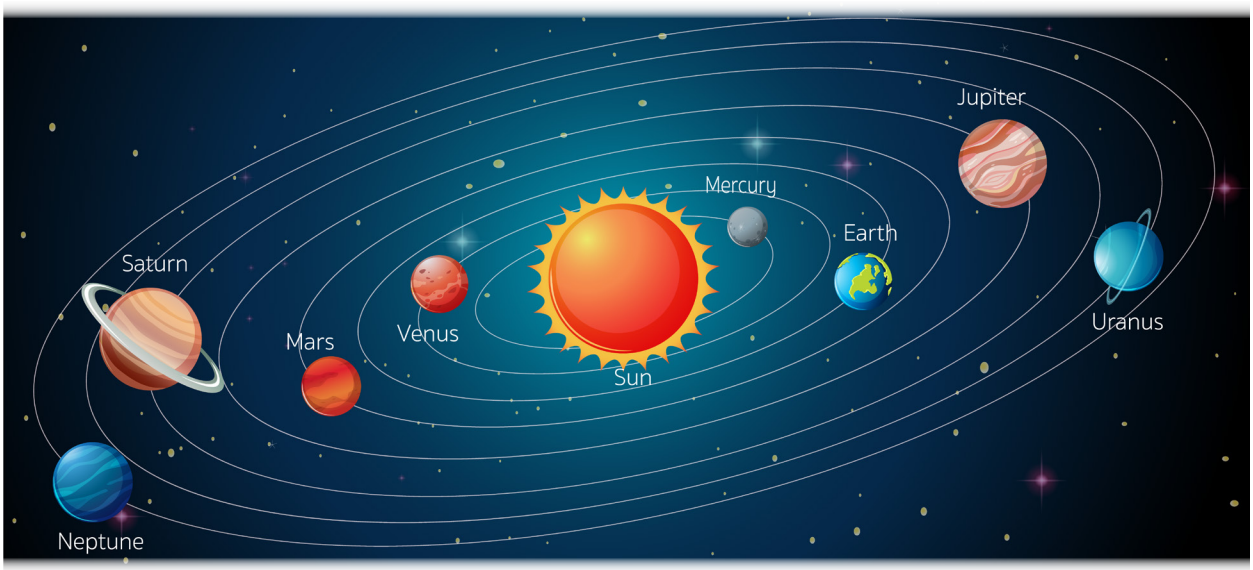


Fig. 12.4 Solar System

Types of Planets

1. **Inner Planets (Terrestrial Planets):**

- These include Mercury, Venus, Earth, and Mars.
- Inner planets are small, rocky, and dense.
- They are located closer to the Sun and lack rings around them.
- They are primarily composed of solid materials and metals.

2. **Outer Planets (Gas Giants):**

- These include Jupiter, Saturn, Uranus, and Neptune.
- Outer planets are larger, composed mostly of gases, and are farther from the Sun.
- They have ring systems made of dust, ice, and rocks and multiple moons.

3. **Dwarf Planets:**

- Examples include Pluto, Ceres, Haumea, Makemake, and Eris.
- Dwarf planets are smaller and not considered "full" planets as they fail to clear their orbits of other debris.
- They are significant **celestial bodies** in understanding the solar system's diversity.

Details of Planets

Here is a detailed breakdown of the planets, their characteristics, and their distance from the Sun:

Planet	Details	Distance from the Sun	Time for One Revolution
Mercury	Smallest planet, closest to the Sun, extremely hot during the day and cold at night.	58 million km	88 days
Venus	Brightest object after the Sun and Moon, known as the "Morning Star" and "Evening Star," with no moons.	108 million km	225 days
Earth	The "Blue Planet" with life-supporting water and atmosphere, having one natural satellite (Moon).	150 million km	365.25 days
Mars	Known as the "Red Planet" due to its reddish soil, has two small natural satellites (Phobos and Deimos).	228 million km	687 days
Jupiter	Largest planet, features a large red spot (a giant storm) and faint rings, with 95 known moons.	778 million km	11.9 years

Keywords

Celestial bodies: These are natural objects in the sky, such as the Sun, Moon, stars, and planets. They are found in space and are part of the universe.

The Sun: The Central Star of Our Solar System

Interesting Facts

Inner vs. Outer Planets:

Inner planets are rocky and smaller, whereas outer planets are gas giants and larger.

Outer planets have rings, while inner planets do not.

Fact Flash

The first artificial Earth satellite, Sputnik 1, launched by the Soviet Union in 1957, was a small, polished metal sphere about the size of a beach ball. Its successful launch marked the dawn of the Space Age!

Planetary Mnemonic:

- To remember the order of planets from the Sun, use this mnemonic:
- "**M**y **V**ery **E**fficient **M**other **J**ust **S**erved **U**s **N**oodles"
- (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune).

Common Misconceptions

× **Misconception:** All satellites are used for spying.

✓ **Correction:** While some satellites have military or intelligence purposes, the vast majority are used for peaceful and beneficial applications like communication, weather, navigation, and scientific research.

× **Misconception:** Satellites are stationary in the sky.

✓ **Correction:** Geostationary satellites appear stationary because they orbit at the same rate as Earth's rotation, but all satellites are constantly moving at high speeds to stay in orbit.

Science Around You

The Global Positioning System (GPS) operated by the U.S. Space Force, is a satellite-based radio-navigation system providing global position, navigation, and timing data. It consists of a constellation of typically 31 satellites orbiting at approximately 20,000 km altitude. Each satellite carries precise atomic clocks and transmits signals. A receiver calculates its location by measuring signal travel time from at least four satellites using **trilateration**. Originally military, GPS became widely available to civilians in the 1980s, with "Selective Availability" removed in 2000, significantly improving accuracy. It's now integral to phones, vehicles, aviation, and scientific research.

Activity

Mapping Satellite Uses

- **Objective:** To understand the diverse applications of satellites in everyday life.
- **Materials Required:** Large poster paper or whiteboard, Markers, Pictures or symbols representing different satellite uses (e.g., phone, TV, weather map, GPS icon), Scissors and glue (if using printed pictures)

Keywords

Trilateration: It is a method of finding a location by measuring distances from three or more known points. It is commonly used in GPS technology to find exact positions on Earth. Unlike triangulation, it uses distances, not angles, to calculate the location.

- **Procedure:**
  1. **Brainstorm Uses:** As a group, brainstorm all the ways you think satellites are used in our daily lives.
  2. **Categorize:** Create categories on your poster paper (e.g., "Communication," "Weather," "Navigation," "Science").
  3. **Map Examples:** For each category, draw or glue pictures/ symbols representing specific applications. For example, under "Communication," you might draw a TV antenna or a phone.
  4. **Discuss Impact:** Discuss how different aspects of your daily life would change if satellites suddenly stopped working.

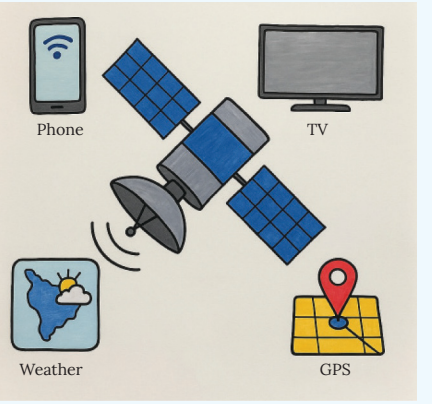


Fig. 12.5 Materials Required

- **Observation:** Observe the pervasive and often unnoticed role of artificial satellites in modern society, highlighting their critical function in communication, weather, and navigation.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following is a natural satellite of Earth?
   a) GPS satellite ☐ b) The Moon ☐ c) Mars ☐ d) Sputnik 1 ☐
2. A satellite that helps you find your location on a map is part of which system?
   a) Weather forecasting ☐ b) Global Positioning System (GPS) ☐
   c) Television broadcasting ☐ d) Astronomical observation ☐

Understanding

3. Why are most artificial satellites powered by solar panels?
   a) Solar panels make them move faster. ☐
   b) Sunlight is readily available in space and provides continuous energy. ☐
   c) Solar panels protect them from meteoroids. ☐
   d) They are lighter than other power sources. ☐

Applying

Short Answer Question:

4. State the difference between a natural satellite and an artificial satellite.
5. Name two ways in which satellites are useful in our everyday life.

Analyzing

Long Answer Question:

6. Describe the various types of information thtat weather satellites provide to meteorologists. Explain why this information is crucial for accurate weather forecasting and disaster preparedness.

Satellites

A satellite is a small celestial body that revolves around a planet. The term "satellite" is derived from the Latin word 'satelles,' meaning a "companion" or "attendant." Satellites play an essential role in both natural celestial systems and human technological advancements. They are classified into two main types: natural satellites and artificial satellites.

Natural Satellites

Natural satellites are naturally occurring celestial bodies that orbit planets. They are formed through cosmic processes and are a vital part of planetary systems. The most well-known natural satellite is Earth's Moon, which affects tides, stabilizes the planet's tilt, and influences various natural phenomena.

Key Characteristics of Natural Satellites:

- They are naturally found orbiting planets.
- They vary in size, from small moonlets to massive satellites like Jupiter's Ganymede, which is the largest natural satellite in the solar system.
- Each planet may have one or multiple natural satellites. For instance:
- Earth has one natural satellite, the Moon.
- Jupiter has 95 known moons, including Ganymede, which is larger than the planet Mercury.

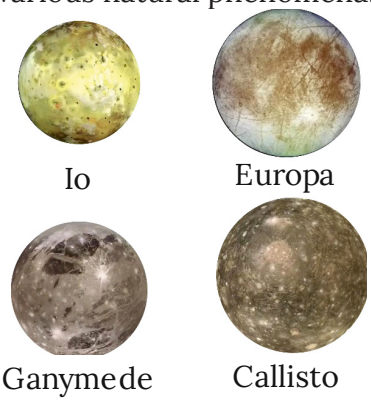


Fig. 12.6 Natiral Satellites

Artificial Satellites

Artificial satellites are human-made machines launched into space to orbit Earth or other celestial bodies. These satellites are designed for specific purposes, such as communication, navigation, weather forecasting, scientific research, and space exploration.

Key Characteristics of Artificial Satellites:

- They are built and launched by humans using advanced technology.
- Artificial satellites serve various purposes, including:
  - Communication Satellites for global connectivity.
  - Weather Satellites for tracking climate and predicting natural disasters.
  - Scientific Satellites for studying space and celestial phenomena.
- **Some notable examples include:**
  - **Sputnik 1:** The first artificial satellite launched by the Soviet Union in 1957.
  - **Aryabhata:** The first Indian artificial satellite, launched in 1975.

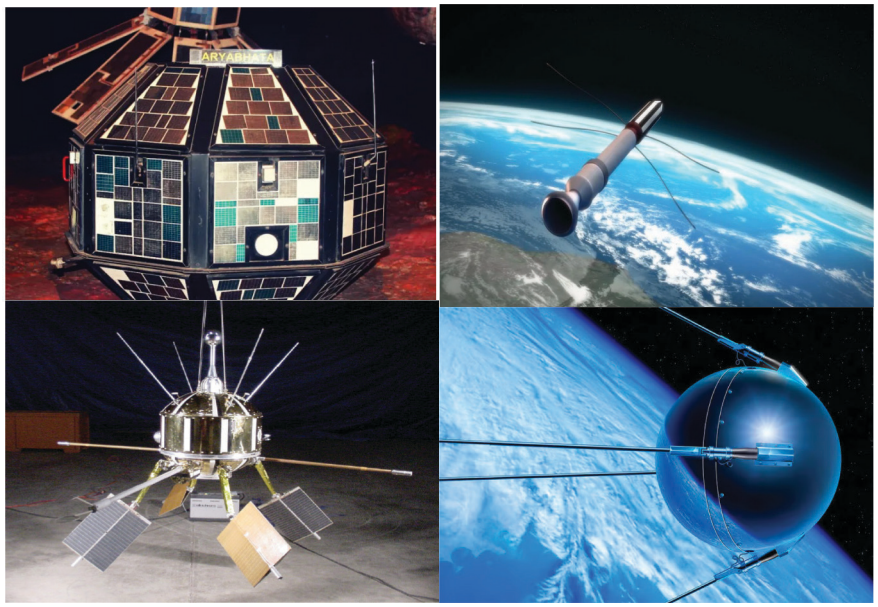


Fig. 12.7 Artificial Satellites

Asteroids: Minor Planets of the Solar System

Asteroids, or minor planets, are rocky remnants from the early solar system, mainly found in the asteroid belt between Mars and Jupiter.

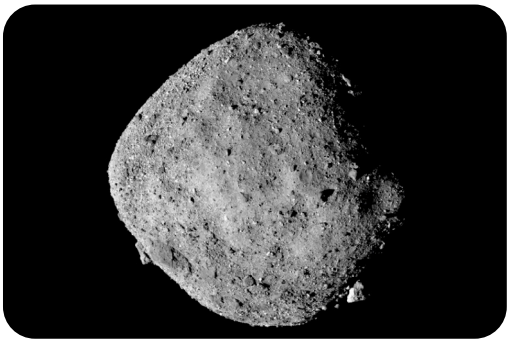


Fig. 12.8 Asteroids

Key Features of Asteroids

Composition and Size:

- Asteroids are primarily composed of rock and metal. Their sizes vary significantly, ranging from 10 kilometers to 500 kilometers in diameter.
- The largest known asteroid is Ceres, which is classified as a dwarf planet with a diameter of approximately 975 kilometers.

Comets: The Icy Wanderers of Space

Fig. 12.9 Comets

Comets are fascinating celestial objects composed of ice, gas, and dust that orbit the Sun. They are often described as "dirty snowballs" due to their icy cores mixed with dust and other materials. When a comet approaches the Sun, its ice begins to vaporize due to the intense heat, releasing gas and dust in the process. This activity forms a glowing coma (a bright halo around the nucleus) and an elongated tail that always points away from the Sun due to solar wind. This tail is what makes comets one of the most visually striking objects in the night sky.

The Milky Way Galaxy

The Milky Way Galaxy (referred to as **Akash Ganga** in Indian culture) is a vast spiral-shaped structure that contains the Sun, the solar system, and hundreds of billions of stars. This appearance is caused by the presence of gas, dust, and countless stars densely packed in its spiral arms.

Fig. 12.10 Wilky Way Galaxy

It is estimated to be 13.6 billion years old, making it almost as old as the universe itself. The closest galaxy to the Milky Way is the Andromeda Galaxy, located approximately 2.5 million light years away. Andromeda is also a spiral galaxy and is visible with the help of telescopes.

Fact Flash

In 1930, Clyde Tombaugh, an American astronomer, discovered Pluto while working at the Lowell Observatory. His painstaking, systematic search involved comparing photographic plates taken days apart to detect any moving objects against the background of stars, a monumental effort without modern digital tools!

Common Misconceptions

× **Misconception:** The planets are all very close to each other.

✓ **Correction:** While often depicted that way in diagrams, the distances between planets in the Solar System are immense, especially between the inner and outer planets.

× **Misconception:** The Sun is on fire.

✓ **Correction:** The Sun generates heat and light through nuclear fusion in its core, not through burning in the way a fire does.

Science Around You

Our Solar System is a vast and fascinating neighborhood in space, consisting of the Sun (our star) and all the celestial bodies gravitationally bound to it. This includes eight planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune), numerous dwarf planets (like Pluto), hundreds of moons, millions of asteroids (rocky bodies), and countless comets (icy bodies). The Sun, a medium-sized star, lies at the center and provides light and heat to the entire system. Each planet has unique characteristics: Earth is known for its liquid water and life, Mars for its reddish hue, Jupiter as the largest gas giant, and Saturn for its prominent rings.

Activity

Building a Scale Model of the Solar System (Simplified)

- **Objective:** To understand the relative sizes of planets and their distances from the Sun (in a simplified way).
- **Materials Required:** Large roll of paper or string (several meters long), Markers or colored pencils, Various sizes of spheres or circles (e.g., a large ball for the Sun, marbles, beads, small clay balls for planets – relative sizes can be approximated, or use a specific scale provided), Ruler or measuring tape, Labels for Sun and planets

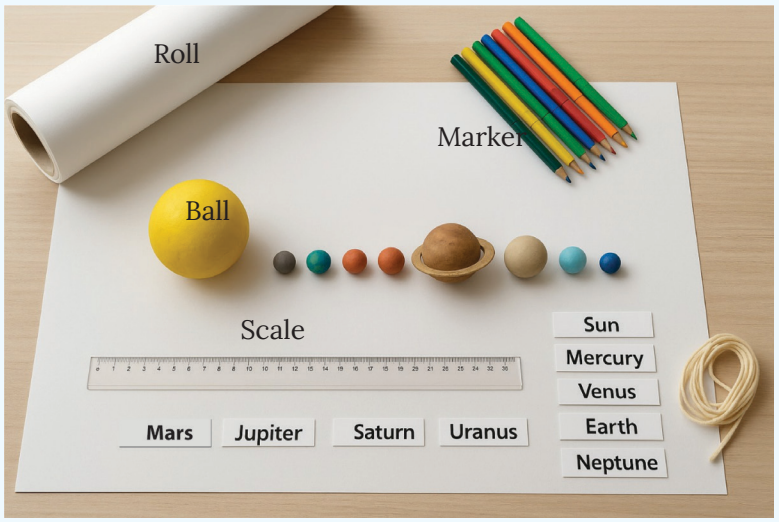


Fig. 12.11 Materials Required

- **Procedure:**
  1. **Define Scale:** Explain that trying to build a perfectly to-scale model of distances and sizes simultaneously is very difficult. Decide to focus either on relative sizes or relative distances (simplifying one). For this activity, let's focus on relative distances.
  2. **Mark the Sun:** Unroll your paper or string. Mark one end as the "Sun."
  3. **Place Planets (Relative Distance):** Using a highly simplified distance scale (e.g., Earth is 1 unit, Mars is ~1.5 units, Jupiter ~5 units, Saturn ~9.5 units, etc. or just use visual approximation for spacing), mark the positions of the planets along the paper/string.
  4. **Place "Planets" (Relative Size):** Place your chosen spheres/circles at the marked positions. Emphasize that the Sun is by far the largest, followed by Jupiter and Saturn as gas giants, and the smaller inner, rocky planets.
  5. **Discuss:** Discuss how far apart the planets actually are, even in your simplified model, and the vastness of space.
- **Observation:** Observe the immense distances between celestial bodies in the Solar System and the vast difference in scale between the Sun and the planets, even in a simplified model.

Knowledge Checkpoint

Gap Analyzer™ Homework

Watch Remedial

Remembering

Multiple Choice Questions:

1. Which celestial body is at the center of our Solar System?

   a) Earth ☐ b) Jupiter ☐ c) The Moon ☐ d) The Sun ☐

2. Which two planets are known as "gas giants" due to their large size and gaseous composition?

   a) Mercury and Venus ☐ b) Earth and Mars ☐

   c) Jupiter and Saturn ☐ d) Uranus and Neptune ☐

Understanding

3. What distinguishes Earth from other planets in our Solar System in terms of conditions for life?

   a) Its reddish color ☐

   b) Its prominent rings ☐

   c) The presence of liquid water on its surface ☐

   d) Its extremely hot temperature ☐

Applying

Short Answer Question:

4. List the four inner rocky planets that are part of the Solar System.
5. Explain the main role played by the Sun in controlling the Solar System.

Evaluating

Long Answer Question:

6. Describe the key characteristics of two different planets in our Solar System (e.g., Earth and Mars, or Jupiter and Saturn), highlighting similarities and differences in their composition, atmosphere, and surface features.

SUMMARY

Stars and Constellations

Stars are massive spheres of burning gases, primarily hydrogen and helium, that emit heat and light through nuclear fusion. They have been vital for navigation, storytelling, and science throughout history. Constellations are star patterns named by cultures worldwide, with significant cultural and practical uses.

Examples of Constellations

- **Ursa Major:** Guides to the Pole Star.
- **Orion:** Resembles a hunter, linked to mythology.
- **Canis Major:** Contains Sirius, the brightest winter star.

Indian Astronomy

Nakshatras (e.g., Ardra, Rohini) hold cultural and astrological importance.

Challenges

- Light pollution and urbanization reduce visibility.
- Telescopes, like the Keck Telescope in Hawaii, help study celestial objects.

The Solar System

The solar system comprises the Sun, eight planets, moons, and celestial objects like comets, asteroids, and meteoroids, formed billions of years ago and governed by gravity.

The Sun

- Central star made of hydrogen and helium.

Planets

- **Inner Planets (Mercury, Venus, Earth, Mars):** Small, rocky, dense, and close to the Sun; no rings.
- **Outer Planets (Jupiter, Saturn, Uranus, Neptune):** Large, gaseous, distant; have rings and many moons.
- **Dwarf Planets (Pluto, Ceres, etc.):** Small celestial bodies that do not clear their orbits.

Key Facts

- **Mercury:** Smallest and fastest.
- **Jupiter:** Largest.
- **Venus:** Hottest due to its dense atmosphere.
- **Neptune:** Farthest from the Sun.

Satellites

Satellites are either natural, like Earth's Moon, or artificial, created for purposes such as communication and research. Other celestial objects include asteroids, comets, and meteoroids. All these exist within the Milky Way Galaxy and the vast universe beyond.

Key Points:

1. Satellites

Natural Satellites: Orbit planets; e.g.,

- **The Moon:** Influences tides, lacks atmosphere, extreme temperatures.
- **Ganymede:** Jupiter's moon, largest in the solar system.

4. The Universe

- A vast expanse of galaxies, stars, and cosmic phenomena.
- ~13.8 billion years old, studied using advanced telescopes like Hubble and James Webb.

Example Based Questions

Multiple Choice Questions

1. Which of the following is an example of a constellation?

(a) The Moon (b) Orion
(c) Mars (d) Earth

Answer: (b) Orion

Explanation: A constellation is a group of stars forming a recognizable pattern in the sky. Orion is called The Hunter and is one of the most famous constellations. The Moon, Mars, and Earth are celestial bodies but not constellations.

2. Which planet is known as the "Red Planet"?

(a) Jupiter (b) Saturn
(c) Mars (d) Neptune

Answer: (c) Mars

Explanation: Mars looks reddish because of iron oxide (rust) on its surface. Its colour makes it easily visible from Earth and gives it the name "Red Planet."

3. Which of the following is an artificial satellite of Earth?

(a) The Moon (b) Sputnik 1
(c) Jupiter (d) Sun

Answer: (b) Sputnik 1

Explanation: The Moon is a natural satellite, while Sputnik 1 was the first artificial satellite launched by humans in 1957. Artificial satellites are man-made and serve purposes like communication, weather forecasting, and GPS.

Short Answer Questions

4. What is a constellation? Give one example and explain its importance.

Answer: A constellation is a group of stars forming a particular pattern in the night sky. Example: Ursa Major (Great Bear), also called the Big Dipper. Constellations are important because they help in navigation, identifying stars, and connecting ancient astronomy with cultural stories.

5. How is the solar system structured?

Answer: The solar system consists of:

- The Sun at the centre (a star providing light and energy).
- Eight planets revolving around it: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.
- Other celestial bodies: dwarf planets, asteroids, comets, and meteoroids.

The gravitational pull of the Sun keeps everything bound together.

6. Differentiate between natural and artificial satellites with one example each.

Answer:

- Natural Satellite: A heavenly body that orbits a planet naturally. Example: The Moon (Earth's only natural satellite).
- Artificial Satellite: A man-made object launched into space to orbit Earth or another planet. Example: INSAT (used for weather forecasting and communication in India).

Thus, both types of satellites are useful—natural ones for scientific study, artificial ones for technology and communication.

Long Answer Questions

7. Explain the role and importance of artificial satellites in our daily life. Give at least four uses.

Answer: Artificial satellites are human-made machines launched into space to orbit Earth. They play a very important role in modern life:

1. **Communication:** Satellites help in mobile phone networks, TV broadcasting, and internet services.
2. **Weather Forecasting:** Satellites provide data about clouds, storms, and climate changes, helping in predicting natural disasters.
3. **Navigation (GPS):** Satellites guide airplanes, ships, and even cars through global positioning systems.
4. **Scientific Research:** Satellites are used for space exploration, studying Earth's atmosphere, and mapping.

Conclusion: Without artificial satellites, modern communication, navigation, and scientific progress would not be possible. They are an essential part of our daily lives.

Gap Analyzer™
Complete Chapter Test

EXERCISE

A. Choose the correct answer.

1. Which of the following is the brightest star in the night sky?
   (a) Polaris ☐ (b) Sirius ☐
   (c) Betelgeuse ☐ (d) Vega ☐
2. What is the primary purpose of artificial satellites?
   (a) To reflect sunlight ☐
   (b) To orbit other planets ☐
   (c) To aid in communication, navigation, and research ☐
   (d) To create craters on the Moon ☐
3. Which constellation is known as the “Great Bear”?
   (a) Orion ☐ (b) Ursa Major ☐
   (c) Cassiopeia ☐ (d) Canis Major ☐
4. Which celestial object is also referred to as a “dirty snowball”?
   (a) Asteroid ☐ (b) Comet ☐
   (c) Meteoroid ☐ (d) Moon ☐
5. What galaxy is home to the solar system?
   (a) Andromeda Galaxy ☐ (b) Milky Way Galaxy ☐
   (c) Whirlpool Galaxy ☐ (d) Sombrero Galaxy ☐

B. Fill in the blanks.

1. The constellation _____, also known as the “Hunter,” has a belt formed by three bright stars.
2. The _____, located approximately 384,400 km from Earth, is its only natural satellite.
3. _____ are icy celestial bodies that develop glowing tails when they approach the Sun.
4. The largest known asteroid in the solar system is _____.

C. Write True or False.

1. Sirius is the brightest star visible in the night sky. ____
2. Artificial satellites can only orbit Earth and no other celestial bodies. ____
3. The Moon has no atmosphere, causing extreme temperature variations. ____
4. Comets remain visible even when they move far away from the Sun. ____
5. The Milky Way Galaxy is older than the universe itself. ____

D. Define the following terms.

1. Constellations
2. Natural Satellites
3. Artificial Satellites
4. Light Pollution
5. Telescope

E. Match the columns.

	Column A		Column B
1.	Constellations	(a)	Form patterns used for navigation and study
2.	The Milky Way Galaxy	(b)	Spiral galaxy containing the solar system
3.	Artificial Satellites	(c)	Machines launched for communication and research
4.	Comets	(d)	Develop glowing tails when near the Sun
5.	The Moon	(e)	Earth's only natural satellite

F. Assertion and Reason

Instructions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is NOT the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

e) Both A and R are false.

1. **Assertion:** Constellations are useful for navigation.
   Reason: The stars within a constellation are physically close to each other, forming distinct markers.
2. **Assertion:** The Sun is considered a star.
   Reason: The Sun generates its own light and heat through nuclear fusion.
3. **Assertion:** GPS systems rely on artificial satellites.
   Reason: Artificial satellites can transmit signals that help determine precise locations on Earth.

G. Give reasons for the following statements.

1. The Pole Star has been a reliable guide for navigation for centuries.
2. Artificial satellites are vital for modern communication and weather forecasting.
3. Light pollution affects the visibility of celestial objects in urban areas.
4. Telescopes have revolutionized astronomy and the study of the universe.
5. The Milky Way Galaxy is important for understanding the structure of the solar system.

H. Answer in brief.

1. What are constellations, and how are they used in navigation?
2. Name two key differences between natural and artificial satellites.
3. Why does the Moon experience extreme temperature variations?
4. What role do telescopes play in observing the night sky?
5. Explain the significance of comets in understanding the solar system.

I. Answer in detail.

1. Compare and contrast the features of natural and artificial satellites, with examples.
2. Discuss the impact of light pollution on stargazing and suggest ways to reduce it.
3. Explain the differences between the inner and outer planets of the solar system.
4. Describe the importance of the Sun in sustaining life on Earth and its role in the solar system.

SKILL-BASED PRACTICE

Activity Time

STEM

Creating a Planet Scale Model (Size Only)

- **Materials Needed:**

  A large ball (e.g., basketball, exercise ball) to represent the Sun

  Various smaller spherical objects to represent planets, attempting a rough size scale (e.g., pea, marble, cherry, grape, plum, tennis ball, bowling ball –

Materials Required

- **Note:** Perfect scale is very hard, aim for relative differences):
  - o **Mercury:** Tiny bead/pea
  - o **Venus/Earth:** Small marble
  - o **Mars:** Small bead/pea
  - o **Jupiter:** Orange/grapefruit
  - o **Saturn:** Orange/grapefruit (slightly smaller than Jupiter)
  - o **Uranus/Neptune:** Plum/tennis ball
- **Activity Steps:**
  1. **Gather Materials:** Collect your chosen objects for the Sun and planets.
  2. **Label:** Label each object with the name of the celestial body it represents.
  3. **Arrange and Compare:** Arrange the planets in order from the Sun. Observe and discuss the vast differences in size, particularly the huge difference between the Sun and even the largest planets, and between the gas giants and the terrestrial planets.
  4. **Discuss:** Emphasize that this model only represents size and not the vast distances between them.

Questions:

- Which object did you use to represent the Sun, and how much larger is it compared to your Earth model?
- Which are the largest planets in your model, and how do they compare to the smaller ones?
- What is the biggest challenge in trying to create a truly accurate scale model of the Solar System (considering both size and distance)?
- What did this activity teach you about the scale of objects in our Solar System?

Skills Covered: Model Building, Understanding Scale & Proportion, Observation, Scientific Communication

Creativity

Art

"Night Sky Constellation Art"

Create an artistic representation of a specific constellation or a section of the night sky. Use glow-in-the-dark paint or small LED lights to make the stars pop. You can research a constellation and draw its traditional imagery, or create your own imaginative interpretation of the stars.

- **Materials to Use:** Dark blue or black paper/canvas, Glow-in-the-dark paint, glow stickers, or small battery-operated LED fairy lights, Paints, markers, glitter (for non-glowing parts), Pencil for sketching, **(Optional) Constellation guide or star chart**

Materials Required

Questions:

- Which constellation or part of the night sky did you choose to represent?
- How did you use your chosen materials to create the effect of glowing stars?
- What story or feeling does your artwork evoke about the night sky?

Skills Covered: Creativity, Artistic Expression, Understanding Patterns, Visual Representation

Satellite Orbit Inquiry

Group Activity

Simulating a Geostationary Satellite

1. **Understand Geostationary Orbit:** Explain that a geostationary satellite orbits Earth at a specific altitude (approx. 35,786 km) and speed, making it appear stationary relative to a point on the Earth's surface. This is ideal for communication.
2. **Setup:**

- One student stands in the center, slowly rotating, representing Earth.
- Another student stands at a certain distance, also slowly moving in a circle around the "Earth" student, representing a geostationary satellite.
- Ensure the "satellite" student always faces the "Earth" student's face, or a specific point on their body.

3. **Demonstrate:** Have the "Earth" student slowly spin (Earth's rotation). The "satellite" student must orbit at the same rate and direction, always staying "above" the same spot on Earth.
4. **Discuss:** Talk about why this type of orbit is useful for TV broadcasts or continuous communication.

Questions:

- Why does a geostationary satellite appear to stay in the same spot in the sky?
- What type of services (e.g., TV, GPS) would most benefit from geostationary satellites?
- What are the challenges of getting a satellite into such a precise orbit?

Skills Covered: Understanding Orbits, inesthetic Learning, Collaboration, Problem-Solving

The Lost Hikers

Case Study

Read the given passage below and answer the question:

A group of hikers gets lost in a dense forest. Their cell phones have no signal, and it's nighttime, so they can't see any landmarks. They remember learning about stars and constellations in school.

The Lost Hikers

Guiding Questions for Analysis:

1. If they could see the stars, how might knowing about constellations help them find their way?
2. Which constellation is famously used in the Northern Hemisphere to locate Polaris, the North Star?
3. If their cell phones did have signal, what space-based technology would typically help them find their exact location?
4. Why do stars appear to move across the night sky throughout the night?

Skills Covered: Classification, Analysis, Teamwork, Communication, Scientific Investigation

Planning a Future Mission to Mars

Source Based Question

NASA is planning a long-term human mission to Mars. For such a mission, scientists need reliable communication between Earth and Mars, detailed maps of the Martian surface, and knowledge of the best time to launch for an efficient journey. Because Earth and Mars are millions of kilometers apart, messages between the two planets can take up to 20 minutes to travel one way. Robotic missions, such as orbiters and rovers, are already helping scientists learn about Mars's surface, its history, and whether it may have supported life in the past. If astronauts ever look back at Earth from Mars, they will see Earth shining as a bright bluish star in the Martian sky—similar to how we see other planets from Earth.

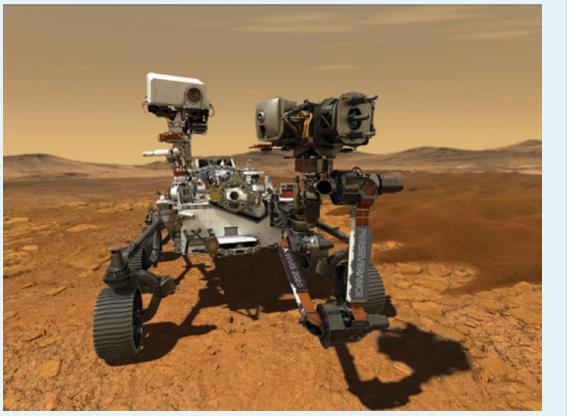


Image Credit: : NASA

Questions:

1. **Understanding the Source**
   a) Why is there a time delay in communication between Earth and Mars?
   b) What does this time delay tell us about the distance between the two planets?
2. **Exploring Life on Mars**
   a) How do robotic missions like orbiters and rovers help scientists?
   b) What evidence are scientists searching for to know if Mars might have supported life in the past?
3. **Sky-Watching from Mars**
   a) If astronauts stand on Mars and look back, how would Earth appear in the Martian sky?
   b) How is this view similar to how we see other planets from Earth?

Skills Covered: Observation, Curiosity, Critical thinking, Connecting real-life observations