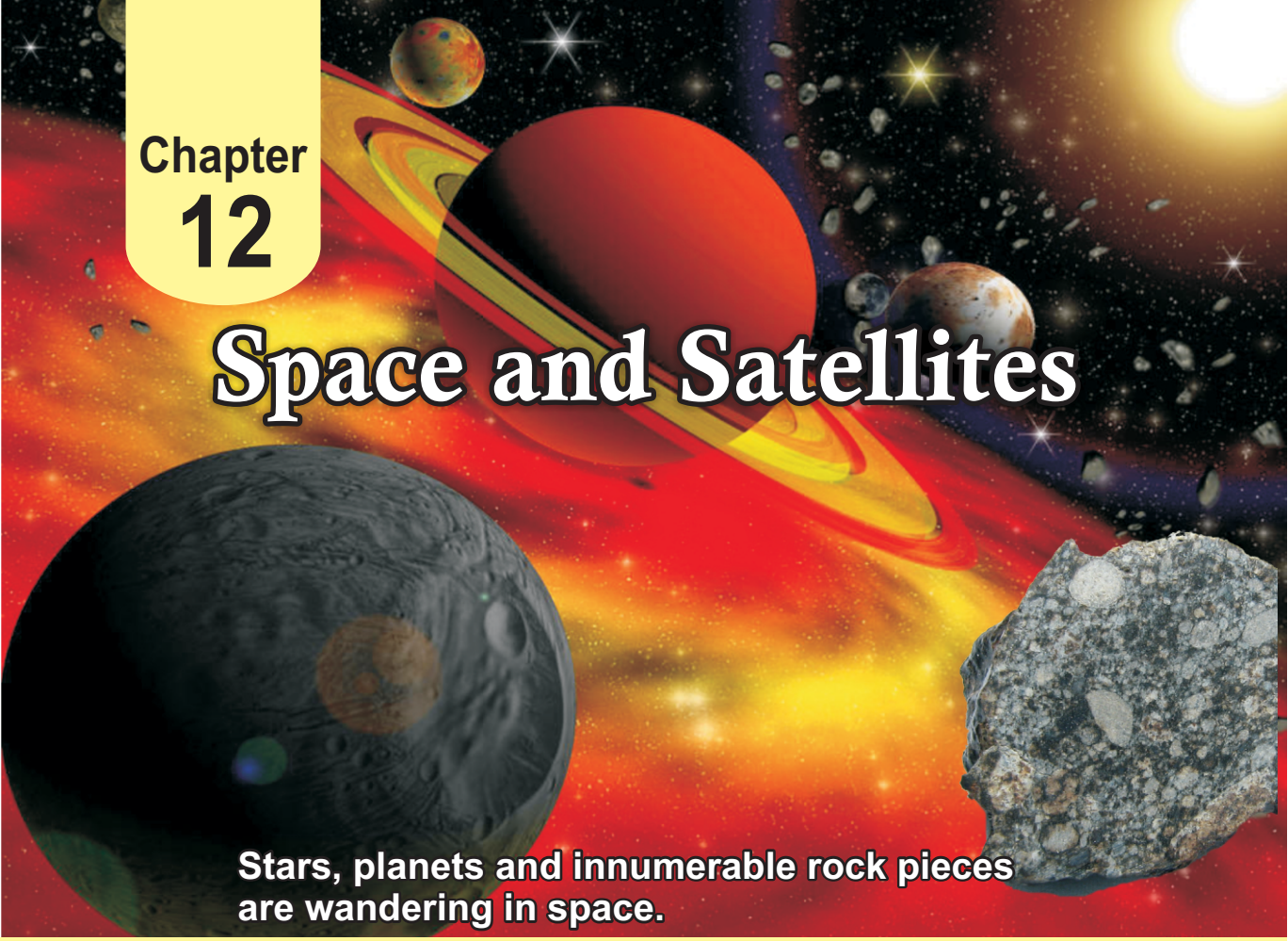
Chapter
12

Space and Satellites



Stars, planets and innumerable rock pieces are wandering in space.

Student Learning Outcomes

After completing this chapter, you will be able to:

- Define the term satellite.
- Compare the physical characteristics of comets, asteroids and meteors.
- Describe different kinds of meteors.
- Inquire into the sighting of Halley's Comet; describe what would you feel if you saw it.
- Define the terms artificial satellites and geostationary satellites.
- Explain the key milestones in space technology.
- Describe the uses of various satellites in space.
- Investigate how artificial satellites have improved our knowledge about space and are used for space research.
- Explain that how do satellites tell us where we are.

Do you know that all stars, the Sun, the Moon, the Earth , all planets and satellites are called **heavenly bodies**? The heavenly bodies are moving in unimaginable vast space – **universe**.

The Sun, the planets, and their moons are the largest objects in the solar system. But asteroids and comets are the smaller parts of the solar system. We have already studied about the solar system and planets. In this chapter, we shall study other members of the solar system.

Satellites

Any heavenly body that moves around a planet is called a **satellite**. The Moon is a natural satellite of the Earth that orbits the Earth (Fig.12.1). Mars, Jupiter, Saturn, Uranus and Neptune have their own satellites too.

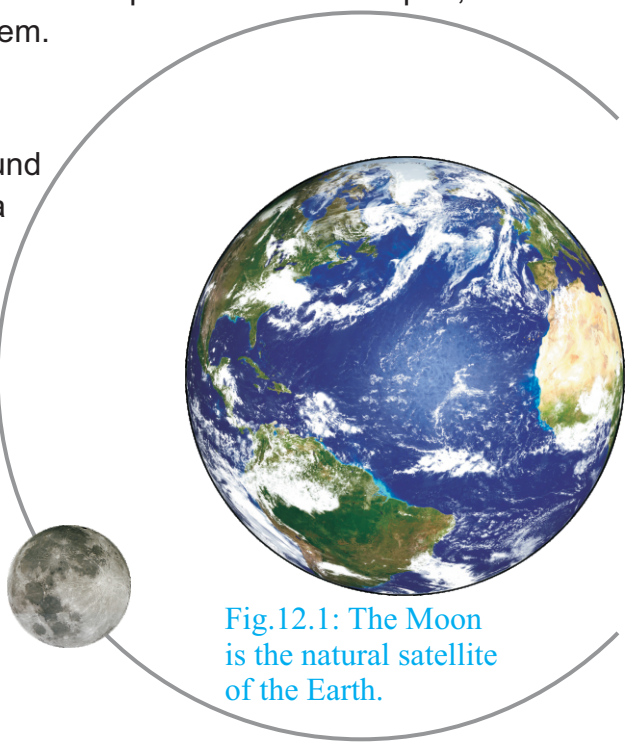


Fig.12.1: The Moon is the natural satellite of the Earth.

Natural Satellites

Beside moons of the planets, some other natural satellites are also moving around the Sun. These are asteroids, comets and meteoroids. Some of them can be seen from the Earth.

Asteroids

An **asteroid** is a piece of rock that orbits the Sun between Mars and Jupiter. The astronomers have discovered thousands of asteroids. Asteroids are made of rock, metals or minerals.

Most of the asteroids orbit the Sun between Mars and Jupiter in a wide band (Fig.12.2). This band is called the **asteroid belt**. The asteroid belt is about 15 hundred thousand kilometres wide. Asteroids come in all shapes and sizes.

Some asteroids have diameter up to 1,000 kilometres but some are very small in diameter.

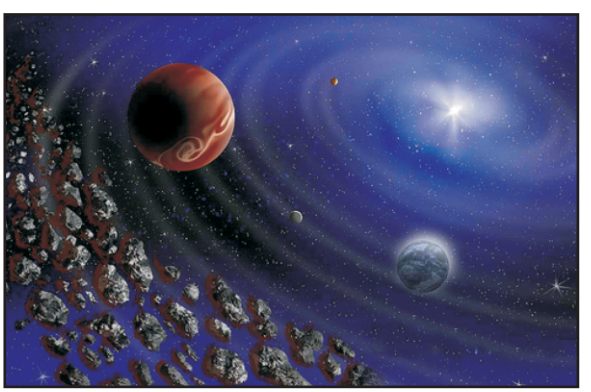


Fig.12.2: Asteroid belt between Mars and Jupiter

Two asteroids are seen from the Earth without the help of a telescope. These are **Ceres** and **Vesta**. Ceres is the largest asteroid ever discovered (Fig.12.3). Its diameter is about 933 kilometers. Vesta is half the size of Ceres.

A question may arise in our minds, "How were asteroids formed?" Some astronomers suggest that the asteroids are leftover matter from the time the planets were being formed. We can say that asteroids, may be the pieces of our solar system that never formed a planet.

Fig.12.3: Ceres is the largest known asteroid. It measures about 933 kilometres.

Do you know?

- Most asteroids complete their one orbit around the Sun in about five Earth years.
- A scientist who studies the stars, planets and other objects in space is called an **astronomer**.

Comets

Besides planets and asteroids some other objects also orbit the Sun. These are comets. A **comet** is a large ball of ice and dust that orbits the Sun. Comets move around the Sun in an elliptical path. They take a very long time to complete their one orbit around the Sun.

Comets probably come from the far, outer edges of the solar system. They are only seen when they come close to the Sun (Fig.12.5).

- A comet has three parts: a **head**, **coma** and a **tail** (Fig.12.4). The head is made of ice, particles of rocks and gases. The heads of most comets are only a few kilometers wide.
- When a comet comes near the Sun, gases escape from its head due to the heat of the Sun. A large, fuzzy, circular cloud around the head of a comet is called the coma.
- During orbiting near the Sun, a long tail of gases and dust particles is

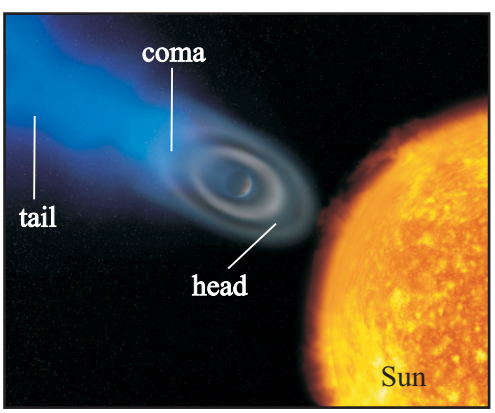


Fig.12.4: The three parts of a comet

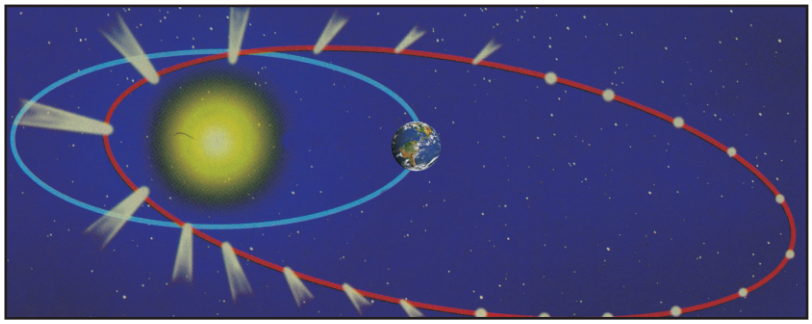


Fig.12.5: During orbiting near the Sun a comet bears a long tail of gases.

formed behind the comet. This tail can be millions of kilometres long. The tail of a comet points away from the Sun.

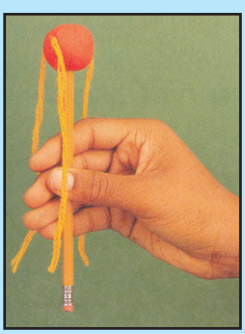
- Comets far away from the Sun bear no tail. Most of the time comets remain far away from the Sun.

A comet known as **Comet Halley** has appeared in the sky many times. It appears after every 76 years. It was seen in 1986 for the last time. When can we expect to see Comet Halley again?

People in the past had been sighting the **Comet Halley** in different ways. Some people sighted it as a long-haired star. Some sighted it as having a tail streaming like smoke up to nearly half the sky. Some sighted it as having a tail like a broom or like the blade of sword. To some people it looked like a dragon with multiple tails. Many people were also afraid of this comet.

European scientists sent a space probe **Giotto** to meet Comet Halley in 1985-86. Giotto sent many pictures of the Comet Halley back to the Earth. Its head was black in colour. As the Giotto moved through the coma of the comet, it was struck by the particles of ice and dust.

1. Form a small ball out of modeling clay to represent a comet.
2. Using a pencil point, push three 10cm lengths of string into the ball. The string represent the comet's tail. Stick the ball onto the pencil point, as shown in the picture.
3. Hold the ball about 1 metre in front of a fan. The air from the fan represents the solar wind. Move the ball toward the fan, away from the fan, and from side to side.



Things to think: How does moving the ball affect the direction in which the strings point? Which way the tail of a comet points?

Meteors

Uncountable number of small heavenly bodies also orbit the Sun. These are called meteoroids. A **meteoroid** is a piece of rock or metal that orbits the Sun. Meteoroids are scattered in different orbits in space. Most of them are too small to be seen from the Earth.

Have you ever seen a shooting star or fireball in the sky? In fact, it is not a star but a meteoroid entering the atmosphere of the Earth. Due to the friction of air, it gets fire (Fig.12.6).

Fig.12.6: Meteoroids make streaks of light as they burn up in the atmosphere.

A meteoroid when enters the atmosphere of our Earth, it is called a meteor. A **meteor** is a stray particle which comes from the asteroid belt and enters the atmosphere of the Earth. Due to the friction of air, the meteor gets fire and a trail of light is seen. Some people call them falling stars, shooting stars, or fireballs. We can view 20 to 30 meteors on a clear night. But we have to move away from the glare of city lights.

Most meteors entering our atmosphere burn up 50 to 100 kilometres above the surface of the Earth. It adds tons of dust into our atmosphere everyday.

Sometimes a few big enough meteoroids do strike Earth's surface. These are called meteorites. A **meteorite** is a meteor that strikes Earth's surface.

Fig.12.7: A few big meteorites

The spots on the Moon are meteoroid craters on its surface. Can you explain how were these craters formed?

In 1920, a very big meteorite named **Hoba** struck the Earth in Namibia (Africa). It weighs 60 tons.

Very long ago a huge meteorite made a crater 180 metres deep and 1,200 metres wide. It is located in Arizona (America).

1. Place a magnet inside a clear plastic bag. Then move the bag-covered magnet through the rainwater your teacher has collected.
2. Use a hand lens to look carefully at the outside of the bag. If you find any small spheres, or round objects, use a stick to scrape them onto a microscope slide.
3. Observe the objects through a microscope. If they still look like round objects, what you probably have are meteorites–pieces of space dust that came to Earth as falling stars!

Things to think: What might cause most meteorites to be rounded in shape?

Artificial Satellites

There are many man-made satellites orbiting the Earth. These are called **artificial satellites**. Artificial satellites are very important for mankind. The first artificial satellite was sent by Russia in 1957. It was named **Sputnik-1** (Fig.12.8). Launching of this satellite opened new horizons for the scientists. After a few years of launching Sputnik-1, Russia sent **Yuri Gagarin,** the first man into space. Since then, thousands of satellites have been sent into space.

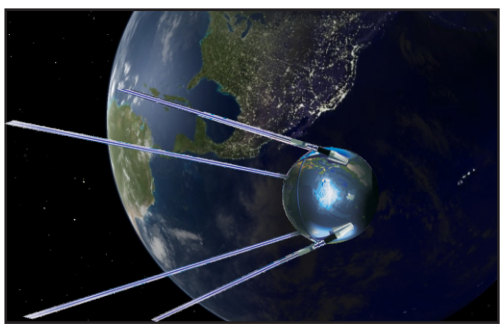


Fig.12.8: Sputnik-1 was the first small step of man in space.

Orbits of Artificial Satellites: Artificial satellites move around the Earth in different orbits. Some orbits are given here:

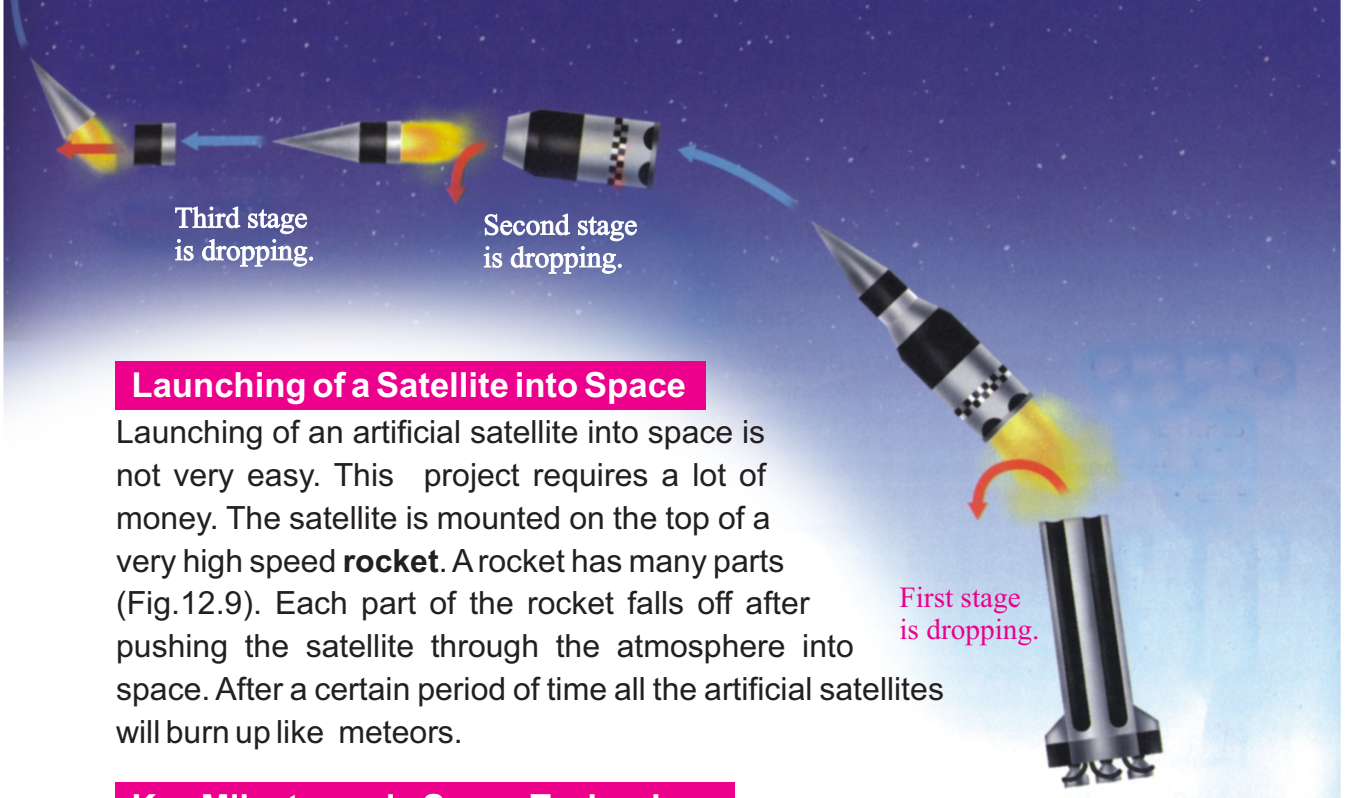
Geostationary Orbit: The orbit in which an artificial satellite completes its one orbit in the same time that the Earth takes to complete one spin, i.e. 24 hours, is called *geostationary orbit*. A satellite in this orbit looks stationary from the Earth.

Polar Orbit: *Polar orbit* passes over the north and south poles of the Earth. So, satellites moving in this orbit can scan the whole Earth during their motion.

Eccentric Orbit: The scientific satellites move in *eccentric orbit* to measure magnetism and electric fields of the Earth.

Low Earth Orbit: This orbit is very close to the Earth. *Low Earth orbit* is used by space shuttles, space stations and the Hubble Telescope. These satellites may orbit the Earth every 90 minutes.

Satellite Receiving Station: A station on the Earth that receives messages from the satellites is called a *satellite receiving station*.



Launching of a Satellite into Space

Launching of an artificial satellite into space is not very easy. This project requires a lot of money. The satellite is mounted on the top of a very high speed **rocket**. A rocket has many parts (Fig.12.9). Each part of the rocket falls off after pushing the satellite through the atmosphere into space. After a certain period of time all the artificial satellites will burn up like meteors.

Key Milestones in Space Technology

Here is a look at some of the key milestones in space technology:

October 4, 1957: Soviet Union launches Sputnik-1.

January31,1958: United States launches Explorer 1.

April 12,1961: Yuri Gagarin becomes the first human to enter space and return safely.

July 16, 1969: Launch of Apollo 11. It puts first man on the Moon.

May 14, 1973: United States launches its first space station, the Skylab.

June 18, 1983: Sally Ride becomes first American woman in space.

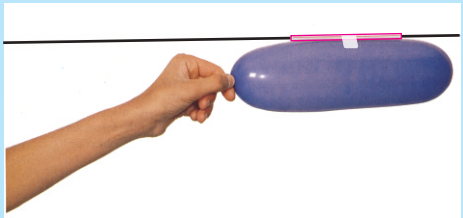
February 19, 1986: Mir space station launches.

September 30, 2003: First privately owned spaceship launches.

August 4, 2007: Phoenix lander lands on Mars.

Fig.12.9: Launching of a rocket into space

Pass a length of strong thread through a drinking straw. Tie the ends of the thread to window grills on opposite sides of a room. Inflate a long balloon and pinch its end with your fingers. Fix the balloon to the straw with the tape. Remove your finger to see the balloon rocket fly across the room.



Kinds of Artificial Satellites

Scientists have sent many satellites which move around the Earth. These satellites help scientists to learn about weather and many more things on the Earth.

Sputnik-I

On October 4, 1957, Russia sent the world's first artificial satellite, Sputnik-1 into space. The name comes from a Russian word for "travelling companion of the world." It weighed just 83 kg. It carried a thermometer and two radio transmitters which sent information about the atmosphere to the Earth. Its two transmitters only functioned for 21 days. After 57 days in orbit, it was destroyed.

Explorer 1

Explorer 1 was the first satellite launched by the United States of America. It was sent into space on January 31, 1958. It weighed only 14kg. Explorer 1 sent information about the radiation environment in Earth orbit.

Geostationary Satellites

Geostationary satellites move at a height of about 36,000 km above the Earth. At this height they move around the Earth at the same speed as the Earth moves around its axis. This satellite seems to be stationary. They are used as communication satellites. Pakistan has launched its first geostationary satellite, PAKSAT–1R on August 11, 2011.

Landsat Satellites

The Landsat satellites is a series of satellite missions. Since 1972, Landsat satellites have collected information about Earth from space. Landsat satellites have taken photographs of Earth's continents and surrounding coastal regions.

Fig.12.10: A landsat satellite that follows the Earth's weather

Communication Satellites

Communication satellites have a great effect on our daily lives. They link remote areas of the Earth with telephone and television. Newspapers are typed and transmitted to printing machines via satellite in some countries.

Fig.12.11: This telecom satellite passes telephone messages from one side of the world to the other.

Polar Satellite

Polar satellite was launched on February 24, 1996 by America. Polar satellite studies atmosphere of the Earth in polar orbit after every 18 hours. Polar satellite will help scientists to protect future satellites from atmospheric dangers.

Global Positioning System

Satellites have improved our knowledge about space and even about our Earth. Using satellites, you can find your position anywhere in the world accurate to 10m or less. Locating the position of objects with the help of a satellite is called the **Global Positioning System** or **GPS**. It is freely accessible by anyone with a GPS receiver.

Visiting The Space

- In 1969, two Americans were the first men to step on the Moon. They were **Neil Armstrong** and **Edwin Aldrin**.
- India sent her first satellite **Aryabhatta** into space in 1975.
- Pakistan sent her satellite **Badr-I** in 1990s.

1. Any heavenly body that moves around a planet is called a satellite.
2. Asteroids are discovered moving between Mars and Jupiter.
3. A comet is a heavenly body made of ice and dust particles. It has three parts; a head, coma and a tail.
4. Meteoroids are pieces of rock or metal. They also orbit the Sun.
5. Man-made satellites orbiting the Earth are called artificial satellites. Sputnik, Explorer 1, Communication and Polar are different kinds of artificial satellites.
6. Artificial satellites move around the Earth in different orbits.
7. A rocket is used to launch a satellite into space.

1. Write proper term/word against each statement.

i. First artificial satellite in space _____

ii. A system which helps us find our position anywhere in the world _____

iii. The largest asteroid ever discovered _____

iv. A small body made of ice and dust that orbits the Sun _____

2. Circle the letter of the best answer.

i. The asteroid belt is located between:

(a) Jupiter and Saturn (b) Earth and Mars

(c) Mars and Jupiter (d) Venus and Mars

ii. The Comet Halley appears after:

(a) 35 years (b) 50 years

(c) 60 years (d) 76 years

iii. The first human in space was:

(a) Edwin Aldrin (b) Neil Armstrong

(c) Dr. Sally Ride (d) Yuri Gagarin

iv. Locating the position of objects with the help of a satellite is called:

(a) GRS (b) GMS

(c) GPS (d) PGS

v. The tail of a comet points:

(a) towards the Sun (b) away from the Sun

(c) towards the Earth (d) away from the Earth

vi. The first artificial satellite was sent into space in:

(a) 1939 (b) 1952

(c) 1957 (d) 1969

3. Answer the following questions in detail.

i. Write a detailed note on comets.

ii. What do you know about asteroids and meteors?

iii. What are the key milestones in space technology?

iv. Write a note on any three artificial satellites.

4. Extend your thinking.

i. How are asteroids and meteorites alike? How are they different?

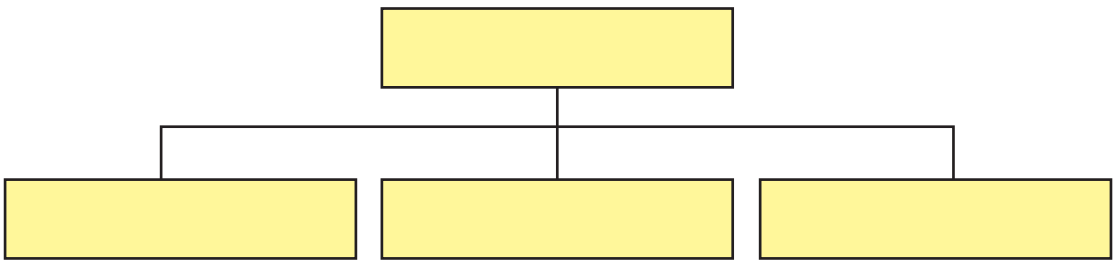
ii. Why does a comet's tail always stream away from the Sun?

iii. Why do you think it's good idea to make the space station an international project?

iv. The Comet Halley was seen in 1990. When it will be seen again?

5. Concept map

Complete the concept map using following words:
asteroids, solar system, comets, meteors



sometimes enter Earth's atmosphere

space objects made of ice and dust

move between Mars and Jupiter

1. Fill a tray with flour. From a height, drop a small stone into it. Carefully remove the stone to see the crater it has made. How are craters formed on the surface of the Moon?

2. On a table next to a window place a shaving mirror facing the Moon. Place another mirror opposite the first one facing inwards. Take a magnifying glass in your hand and stand at an angle from where you can see the Moon in the mirror facing inwards. Raise the magnifying glass and through it see a magnified (larger) view of the Moon in the mirror facing inwards.

   Caution: Do not try to observe the Sun using this experiment. It can damage your eyesight.

Today there is a large telescope in orbit around the Earth. Its name is the Hubble Space Telescope. Even though the mirror in the Hubble Space Telescope is smaller than that of many telescopes on the Earth, it can see more clearly. Why does the Hubble Telescope takes clearer pictures than telescopes on Earth? Why do you think there is a need of such telescopes in space?

Computer Links

http://www.space.com/
http://www.nasa.gov/worldbook/asteroid_worldbook.html