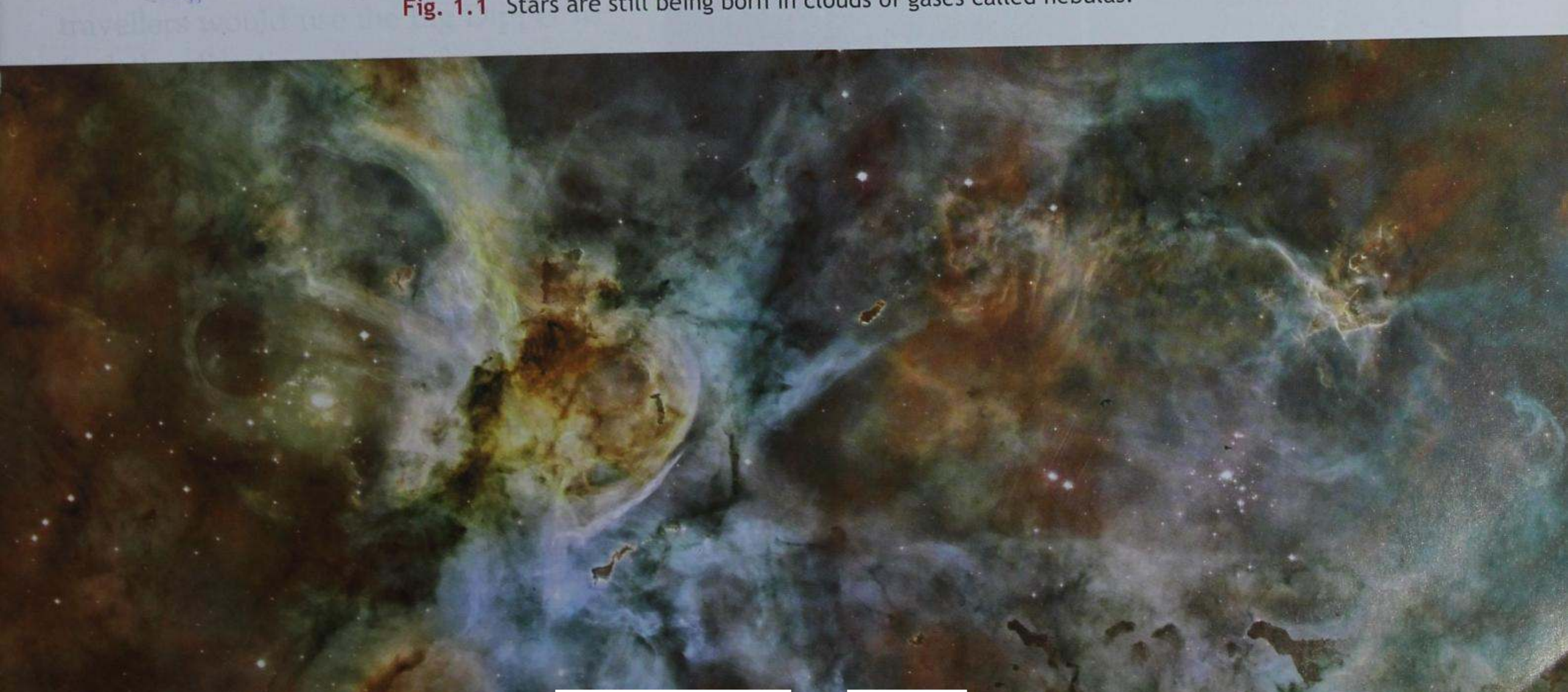
1 Universe

The earth, the sun, the moon and all the stars in the night sky belong to the universe. In fact, they form only a small portion of the universe. Most of the universe is so far away from us that we do not see it. Even the star closest to the solar system, called Proxima Centauri, is 4.2 light years away. The light year is a unit of distance used by astronomers, or scientists who study the heavenly bodies. One light year is the distance travelled by light in a year. This works out to 9.46 trillion km (9.46×10^{12} km), so you can try to imagine how far Proxima Centauri is. Then, knowing that it is the star closest to us, you can try to grasp how vast the universe is.

Cosmologists, or scientists who study the universe, believe that about 15 billion years ago, everything contained in the universe was concentrated at one point. A gigantic explosion, called the Big Bang, which occurred at that time, caused the concentrated matter to move outwards, or expand. This is what gave birth to the universe. Slowly, the clouds of gases that expanded outwards, clumped together here and there due to gravitational force, and stars were formed. In fact, the universe is still expanding and stars are still being born in clouds of gases called nebulas.

Just as stars are born, they also die when they run out of fuel. The fuel of a star is usually hydrogen. The heat and light of a star is generated by nuclear reactions in which hydrogen changes into helium (a gas). Stars are of different sizes and brightnesses. They live for different spans of time and end their lives in different ways. The sun is a medium-sized star in its middle age. It has been shining for about 4.6 billion years and will probably shine for another 5 billion years.

Fig. 1.1 Stars are still being born in clouds of gases called nebulas.



GALAXIES

Stars are not evenly distributed in the universe. They occur in clusters called galaxies. There are countless galaxies in the universe. Each galaxy consists of billions of stars and other heavenly bodies held together by gravitational force. They also contain nebulas in which new stars are forming.

(a) (b)

Fig. 1.2 (a) Elliptical galaxy (b) Spiral galaxy

Galaxies are of different shapes and sizes. Many of them are elliptical. Some look like rings, while others look like spirals, with arms coming out of a central band. There are yet others that are irregular, or do not have a clearly defined shape.

Milky Way Galaxy

We are in the central disc of a spiral galaxy called the Milky Way Galaxy. What we see of our galaxy when we look up at the sky is a faint whitish band stretching across the sky. Ancient Romans called this band of stars Via Galactica, or the 'path of milk'. That is how our galaxy got its name.

There are about 100 billion stars in our galaxy, most of which are concentrated in the central disc. All the stars move slowly around the centre of the galaxy.

CONSTELLATIONS

Some stars in the sky seem to form patterns that never change. The patterns move across the sky as the earth moves around the sun. But the stars that form a pattern do not seem to shift with respect to each other. These patterns formed by stars are called constellations.

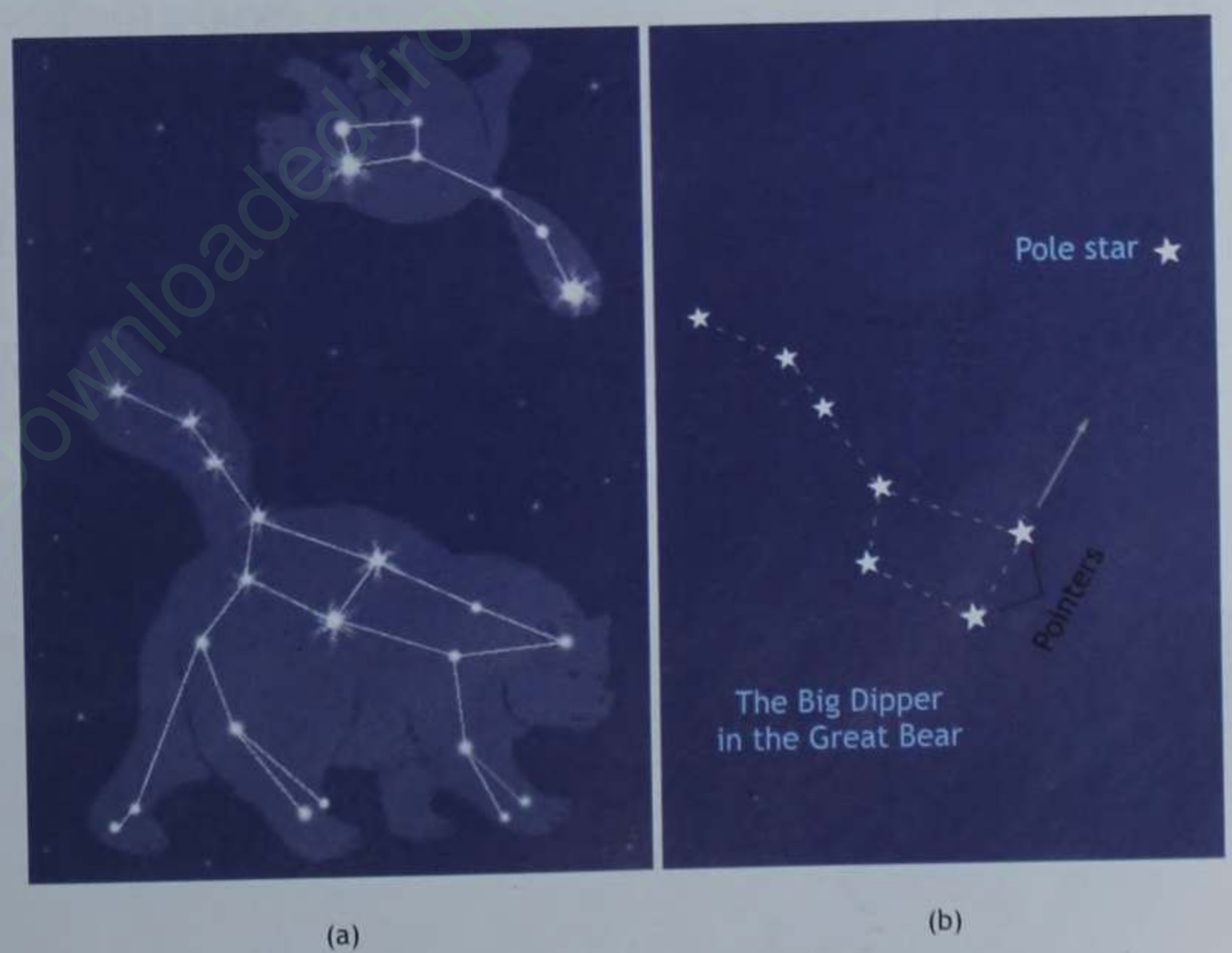
Down the ages, people from different civilisations gave different names to the constellations and made up stories about them. Some constellations that are visible in the Northern Hemisphere are

(a) (b)

Fig. 1.3 Constellations (a) Orion and (b) Scorpius

Orion, the hunter (*Kalpurush*), Scorpius, the scorpion (*Vrishchik*), Cancer, the crab (*Karkat*) and Taurus, the bull (*Vrishabh*). These constellations are not visible in the Southern Hemisphere, and the constellations that are visible there are not visible to us.

A very prominent constellation in the northern sky is the Great Bear (Ursa Major). As the name suggests, its stars roughly form the shape of a bear. Seven of the brightest stars of this constellation form the Big Dipper (*Saptarshi*), which looks like a long-handled spoon. In ancient times, travellers would use the Big Dipper to find the direction. This is because an imaginary line joining the two brightest stars of the Big Dipper points towards the Pole Star (*Dhruv tara*). The Pole Star, as you have already learnt, seems fixed, while all the other stars move across the sky. The reason is that it is situated almost directly above the North Pole, the northern tip of the earth's axis of rotation.



(a) (b)

Fig. 1.4 (a) The seven brightest stars of the Great Bear form the Big Dipper. (b) The two brightest stars of the Big Dipper point towards the Pole Star.

One thing that you must remember is that the stars of a constellation are not necessarily close together. They just seem to form a group though they might be many light years away from each other. The following activity will show you how this is possible.

ACTIVITY Fix a number of small bulbs or LEDs to straws of different lengths. Fix the straws on a board at different distances from one of the edges. Connect them to a battery and look at the lights through a dark glass or plastic screen. You will see a pattern of lights and not be able to tell that they are at different distances.

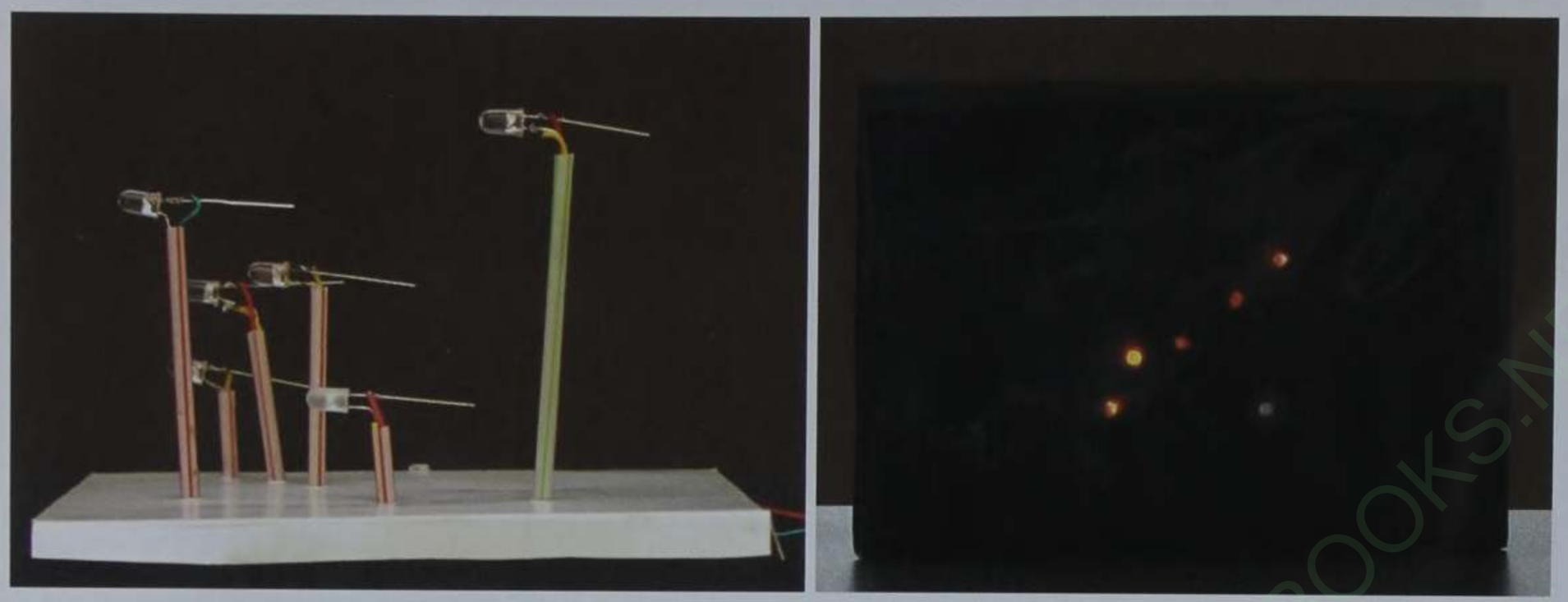


Fig. 1.5

THE SOLAR SYSTEM

The sun and all the bodies revolving around it make up the solar system. When the sun first formed, it was at the centre of a huge disc of gas and dust spinning slowly. As time went by, some of the matter in the disc clumped together to form planets. Smaller clumps formed dwarf planets, asteroids and comets. All these bodies revolve around the sun in their own orbits, or paths, held by a strong gravitational force. The strength of the force is due to the sun's mass. The sun is about 333,000 times heavier than the earth. It is about 149 million km away from us, so sunlight takes about 8.3 minutes to reach us.

Fig. 1.6 The solar system

Planets

There are eight planets in the solar system. In order of distance from the sun they are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

The four planets closest to the sun (Mercury, Venus, Earth and Mars) are called terrestrial (Earthlike) planets. They all have rocky surfaces. The other four planets, called gas giants, are much larger and made up mostly of gases. They are also called Jovian (Jupiterlike) planets. The gas giants are much colder than the terrestrial planets since they are much farther away. The farther a planet is from the sun, the longer it takes to complete one revolution.

Mercury

Mercury, the planet closest to the sun is also the smallest. It revolves around the sun very fast (the fastest), but spins very slowly. One revolution of Mercury takes only 88 days, while one spin around its axis takes over 58 days. There is hardly any air around Mercury. This makes the temperature swing immensely. During the day the temperature can soar above 400°C, while at night it plunges to –180°C.

The glare of the sun mostly hides Mercury from view. However, it is visible near the eastern horizon just before sunrise at certain times of the year. At other times it can be seen near the western horizon after sunset.

Venus

Our closest neighbour, Venus, is the most brilliant planet. When it is visible in the east before sunrise, it is called the morning star. When it is visible in the west after sunset it is called the evening star. The brilliance of Venus is due to its dense atmosphere, which is made up mostly of carbon dioxide, and reflects a lot of sunlight. The carbon dioxide also traps a lot of heat, making Venus the hottest planet, with an average temperature of 450°C.

About the same size as Earth, Venus has a surface characterised by volcanoes and craters. It takes 243 days to complete one rotation, which is even longer than the 224 days it takes to revolve around

(a) (b)

Fig. 1.7 (a) Mars, the Red Planet (b) Venus is enveloped in clouds of mostly carbon dioxide that reflect sunlight.

the sun. Thus, Venus has the longest day in the solar system. The sun rises in the west on Venus and sets in the east because Venus spins from the east to the west.

Earth

Called the Blue Planet because the oceans make it look blue from a spacecraft, Earth is the only planet with life. The presence of water, the composition of its atmosphere and its distance from the sun make our planet ideal for the existence of life. The atmosphere has the right mix of oxygen and nitrogen. Oxygen sustains life, while nitrogen prevents things from burning up uncontrolledly. Even the amount of carbon dioxide present in the atmosphere is just right. Carbon dioxide has two roles to play in the sustenance of life. It helps plants make food and traps heat. Too much carbon dioxide would make Earth terribly hot (like Venus). Too little carbon dioxide would make the nights unbearably cold.

Mars

It takes Mars about two years to complete one revolution around the sun. It is often visible to the naked eye as a reddish sphere. Called the Red Planet, Mars owes its colour to its rust-coloured soil. Like Earth, it has mountains and valleys. Its seasons change and there are ice caps over its poles. However, its atmosphere is very thin, its average temperature is around –23°C and it has no water. Naturally, it is not the kind of place where you would expect to find life. However, channels running through it speak of a time when it was warmer and had flowing rivers and possibly some form of life.

Jupiter

With a mass that is twice that of all the planets put together, Jupiter is the largest and the heaviest planet of the solar system. It spins the fastest, so it has the shortest day. When seen through a telescope, Jupiter has a striped appearance, with a huge red spot on its surface. The stripes are bands of clouds driven by stormy winds. The spot is a mighty storm that has been going on for centuries.

(a) (b)

Fig. 1.8 (a) The red spot on Jupiter (b) Saturn and two of its moons

When seen with the naked eye, Jupiter looks like a bright star that does not twinkle. (Planets do not twinkle like stars.)

Like the stars, Jupiter is mostly made up of hydrogen. It is a failed star, really. Had its mass been greater, it would have become a star. There are narrow rings of dust surrounding Jupiter that are not visible even through the most powerful telescopes. We learnt of them only from pictures taken by spacecraft.

Saturn

Saturn is the second largest planet. Like Jupiter, it is made up mostly of hydrogen and has a striped appearance due to bands of clouds swirling around it. It also has dazzling rings of rocks and ice revolving around it. The rings of Saturn are brighter than those of the other gas giants.

Uranus and Neptune

Both these planets look blue through a telescope. Each has a surface made up of hydrogen and helium. They are similar in size too and both have rings around them. However, Neptune is a stormy planet, with clouds blowing around it, while Uranus has a calmer atmosphere.

Satellites

An object revolving around a celestial body is called a satellite. Natural satellites are referred to as moons. All planets other than Mercury and Venus have moons. In fact, some dwarf planets and asteroids, which we will discuss later, also have moons. In all, 200 moons have been discovered in our solar system so far. Some moons are very small. For example, one of Mars's moons is only 10 miles across. Some other moons are almost planet-sized. Ganymede, one of Jupiter's moons, is the largest—it is larger than Mercury.

Table 1.1 Planets, moons and rings

Planet	Moons*	Rings
Mercury	None	Absent
Venus	None	Absent
Earth	1	Absent
Mars	2	Absent
Jupiter	62	Present
Saturn	60	Present
Uranus	27	Present
Neptune	13	Present

*Discovered until October 2008

Earth's moon

Earth's moon, or simply the moon, is our closest neighbour. Scientists believe that it may have formed from the matter that flew out when a huge asteroid crashed into Earth a long time ago. The moon is a barren land with no water and no atmosphere. It has mountains and many craters, or round depressions, formed by the impact of rocks that crashed into it. It also has dark patches formed by molten lava that spewed from volcanoes when it was still young, thousands of million years ago. You can see these dark patches with the naked eye.

Phases of the moon The moon takes 27 days and 8 hours to complete one revolution around Earth. It takes about the same time to complete one rotation. The result is that we always see the same side of the moon. The point X in Figure 1.10, for example, moves through a quarter rotation, starting from A, as the moon completes a quarter of its journey around Earth, and reaches the position B. So, it continues to face Earth.

Fig. 1.9 The surface of the moon is dotted with craters.

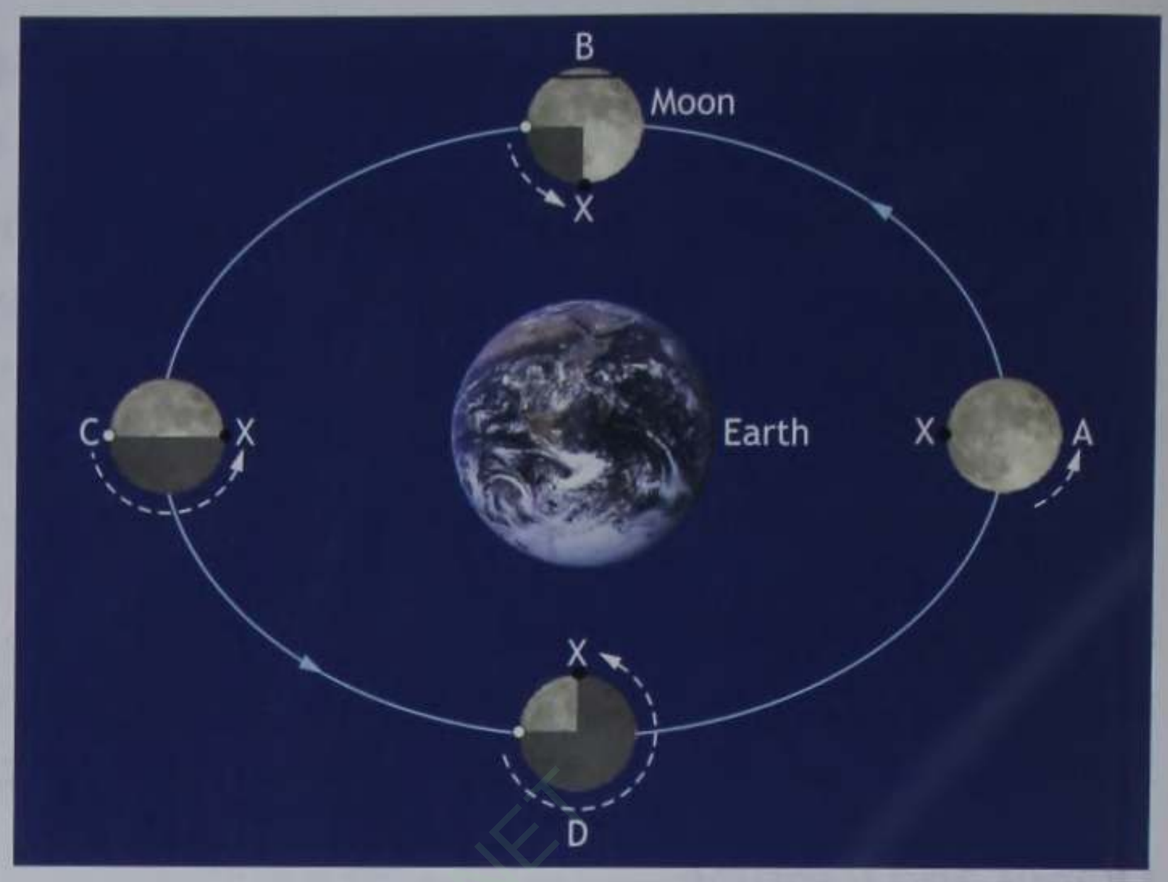


Fig. 1.10 The same side of the moon always faces us.

As the moon revolves around Earth, the face that is turned to us is sometimes fully lit up, sometimes completely dark, and at other times partly in the light. This is what makes the moon appear in different shapes in our sky. The changing shapes of the moon are called its phases. The full moon (*purnima*) appears when the sun and the moon are on opposite sides of Earth and the face of the moon turned to us is completely lit up. After a full-moon night, the moon starts waning, until it vanishes completely on the night of a new moon (*amavasya*). Then it starts growing or waxing until it appears full again. The entire cycle takes about 29.5 days.

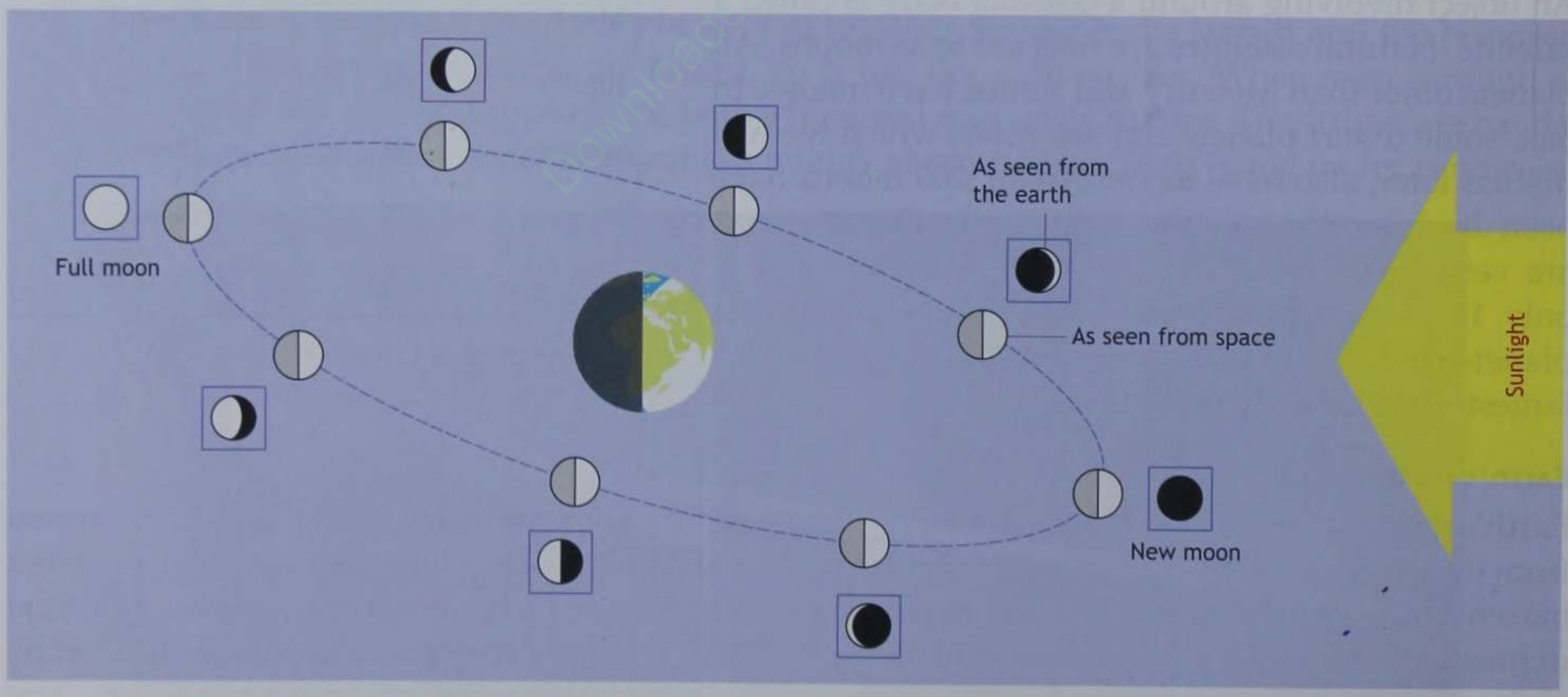


Fig. 1.11 Phases of the moon

Eclipses As the moon revolves around Earth and Earth revolves around the sun, there are times when all three are in a straight line. These are the times when eclipses occur. When the moon is between the sun and Earth, its shadow falls on Earth and there is a solar eclipse. If the umbra of the shadow reaches Earth, there is a total solar eclipse. In other words, people in the umbral region do not see the sun at all. People in the penumbral region of the shadow, however, see a part of the sun or a partial

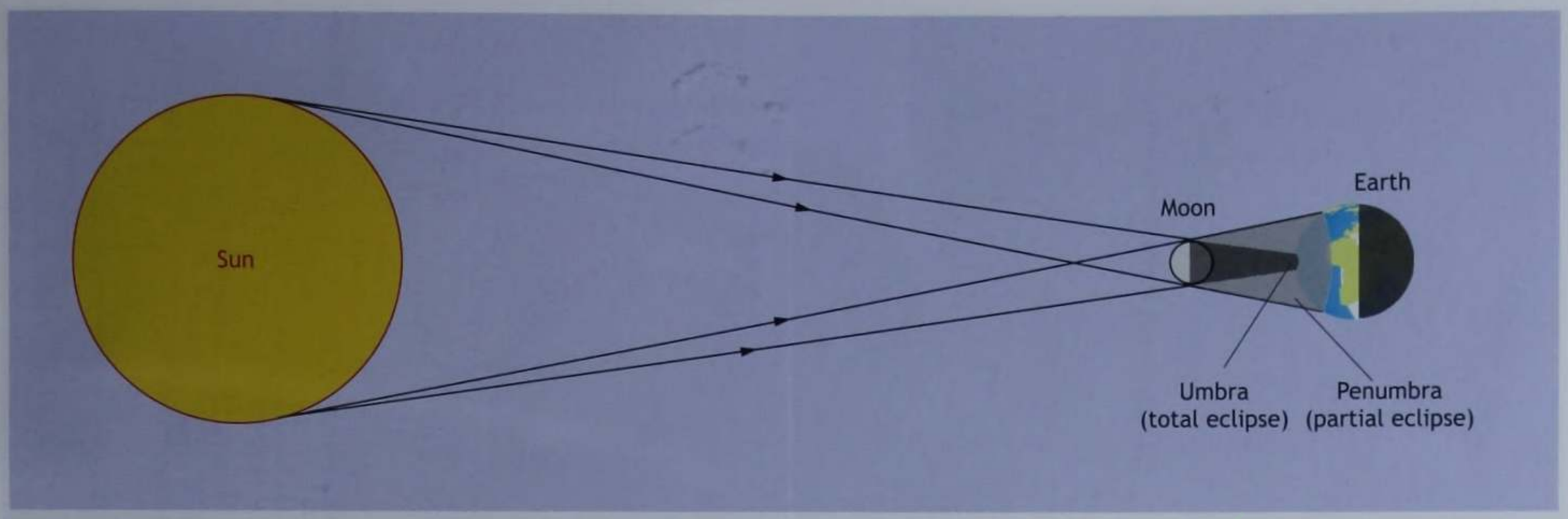


Fig. 1.12 A solar eclipse occurs on the day of a new moon.

eclipse. [Warning: never watch a solar eclipse directly or through a darkened glass or film. Use a pinhole camera to get an image of the sun.]

When Earth comes between the moon and the sun, there is a lunar eclipse. If only a part of the moon passes through the umbra, there is a partial eclipse, and if all of it passes through the umbra, there is a total eclipse. When the moon passes through the penumbra, it just looks a little dull.

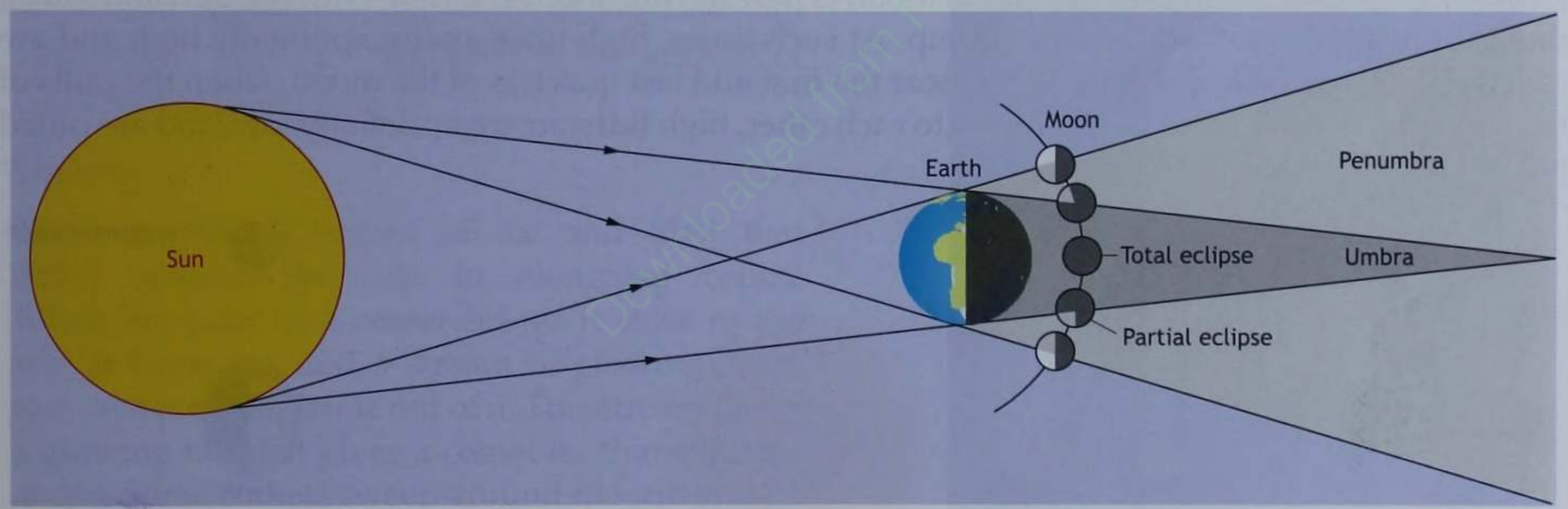


Fig. 1.13 A lunar eclipse occurs on a full-moon night.

Tides The waters of the sea at any place rise and fall twice a day. The regular changes in the level of sea water (every six hours) at any place are called tides. Tides are caused mainly by the gravitational force of the moon. The pull of the sun plays a much smaller role because the sun is much farther away than the moon. The side of Earth that is closer to the moon feels a greater attraction, so the waters pile up on that side and there is a high tide. In Figure 1.14, there is a high tide at A and B, while there is a low tide at C and D. You can guess why A has a high tide. But B too has a high tide because the waters there feel

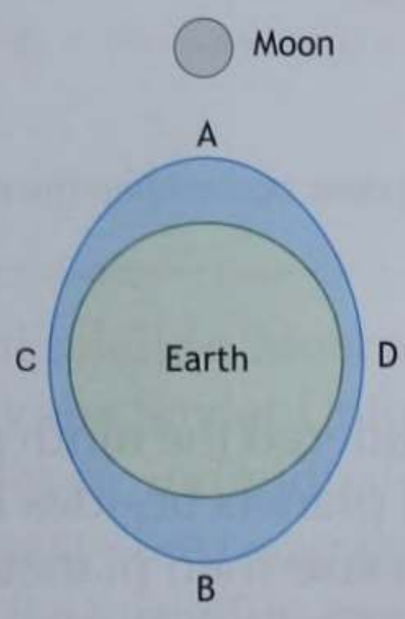


Fig. 1.14 A and B have high tides, while C and D have low tides.

Fig. 1.15 The difference in the level of water at high and low tides can be as much as 50 feet.

the least pull, so they sort of drag behind. As Earth rotates, the tide passes on and the level of the sea falls at A and B. Six hours later, when C and D have high tides, A and B have low tides. So, every place has two high tides and two low tides in a day.

The sun plays a smaller role in causing tides than the moon does, because it is much farther away. However, twice every month, when the moon is new or full, and it is in line with the Sun and Earth, the pulls of the moon and the sun add up. At such times, high tides are exceptionally high and are called spring tides. On the other hand, near the first and last quarters of the moon, when the pulls of the sun and the moon act at right angles to each other, high tides are exceptionally low, and are called neap tides.

Fig. 1.16 (a) Spring tides occur when the moon and the sun are in the same line. (b) Neap tides occur when they are at right angles.

Dwarf Planets

Pluto, once considered the ninth planet of the solar system, is now classified as a dwarf planet. There are many dwarf planets besides Pluto orbiting the sun in a belt beyond Neptune. Dwarf planets are much smaller in size than planets. It is believed that when the solar system was forming, these tiny planets could not pull in the small objects near them the way the larger planets did (gravitational attraction depends on mass). Pluto and many other dwarf planets have their own moons.

Asteroids

Millions of small rocky bodies called asteroids orbit the sun in a belt between the orbits of Mars and Jupiter. This belt is known as the asteroid belt. Most probably asteroids are pieces of material that failed to come together to form a planet. Some asteroids have moons.

Fig. 1.17 Asteroid Gaspra

Meteoroids

These are pieces of rock left over from when the solar system was forming, or from the breaking up of asteroids, or even bits of comets. When these pieces of rock come close to Earth they get pulled in by gravitation. As they enter the atmosphere, they heat up due to friction with the air and start burning. Then we see them as streaks of light. Streaks of light caused by burning meteoroids are called meteors or shooting stars. Sometimes a meteoroid falling through the air does not burn up completely. Then it crashes on to the surface of Earth and is called a meteorite.

Comets

These are small bodies of ice and dust that move around the sun in elongated orbits. When the path of a comet brings it close to the sun, it heats up, and a stream of glowing gases and dust particles come out of it. This stream forms a glowing tail that gives a comet its characteristic shape. Some comets sweep around the sun and go back to the outermost region of the solar system, while others return at fixed intervals. Halley's comet, for example, returns every 76 years. The last time it was seen was in 1986.

Fig. 1.18 Comets have long tails.

ARTIFICIAL SATELLITES

A man-made object orbiting a planet or a moon is called an artificial satellite. Most artificial satellites revolve around Earth. The very first such satellite was launched by the Soviet Union in 1957. It was called Sputnik 1. Since then many countries, organisations and even individuals have launched satellites that have orbited or are still orbiting Earth. India, too, has a satellite programme managed by the Indian Space Research Organisation (ISRO). Aryabhatta, the first satellite made in India, was launched in 1975 by a Soviet rocket. Now India is among the handful of countries that can not only make, but also launch their own satellites.

Satellites are of many types. Some revolve around Earth at a height just above the atmosphere. They are said to have low-earth orbits. Such satellites can take detailed pictures of Earth's surface. Some satellites complete one revolution in 24 hours. Since this is the time Earth takes to complete one rotation, such satellites seem fixed at a particular point above Earth. Hence, they are called geostationary. Geostationary satellites are generally used for communications. Some satellites have polar orbits. Circling Earth from the north to the south, such satellites are used to study climate patterns and many other things. Broadly speaking, satellites are used for the following purposes.

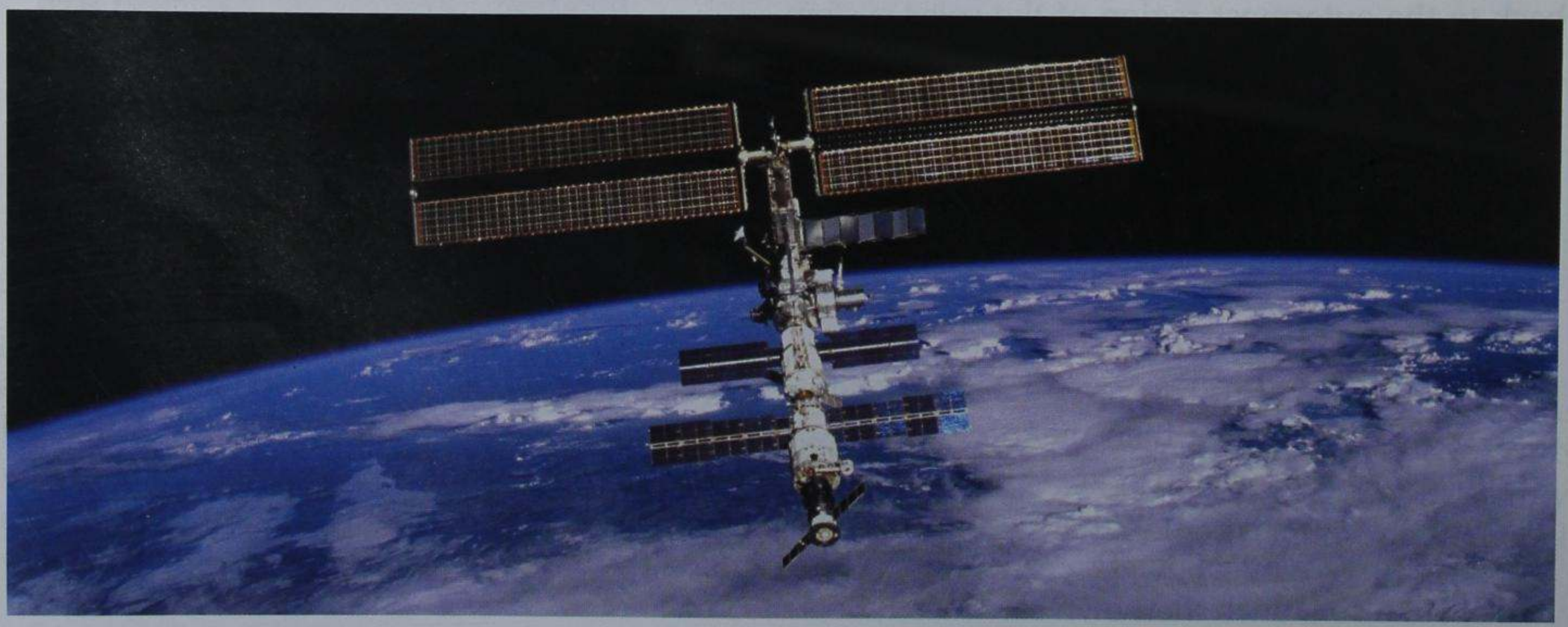
Fig. 1.19 Technicians working on India's satellite INSAT 1B

Scientific research Satellites are the perfect solution for scientists wishing to make observations that are undisturbed by the earth's atmosphere and magnetic field. The Hubble Space Telescope, for example, is a scientific satellite that can take clear pictures of celestial bodies without the distorting effect of the atmosphere. The very first space station or space laboratory put into orbit for conducting scientific experiments was Soviet Russia's Salyut I. The most modern space station called International Space Station is managed with the collaboration of several countries, including the US and Russia. It is permanently manned, or always has people on board.

Communications Satellites are used to provide television, telephone, radio and computer links over the world. For example, TV signals sent out from a TV station in one part of the world may be picked up by a satellite and sent out all over the world. Satellite dishes or antennae in different parts of the world then pick up these signals and send them to our homes.

Weather forecasting Pictures taken by satellites are a great help in forecasting weather phenomena, such as storms, cyclones and the arrival of monsoons. Satellites are also used to make a study of climatic patterns.

Fig. 1.20 The International Space Station has been put together bit by bit in space. The first module was launched in 1998.



(a) (b)

Fig. 1.21 Satellite pictures of (a) a cyclone over India and Sri Lanka, and (b) smog caused by fires and pollution over north India

Remote sensing Remote-sensing satellites are used to collect information on crops, forests, pollution, water and mineral resources, and so on. They have powerful cameras which take detailed photographs of the surface of Earth.

Navigation Some satellites are used to help in the navigation of ships and aircraft. They are also used by hikers and for tracking transport vehicles. Small electronic devices on the ground receive signals from a system of satellites. These signals are used to calculate the geographical location.

Military uses Some satellites are used to get information about military bases and troop movements in other countries. Often called spy satellites, they monitor the launching of rockets or missiles in other countries and are vital in providing early warning in case of a war. They can also target weapons (smart bombs) with precision.

POINTS TO REMEMBER

- Astronomers use a unit of distance called the light year. One light year is the distance travelled by light in one year.
- Stars are born in clouds of gases called nebulas. The heat and light of a star is generated by nuclear reactions in which hydrogen changes into helium. When a star runs out of hydrogen it dies.
- Galaxies are clusters of stars and other celestial bodies held together by gravitational force. A galaxy may be spiral, elliptical, ring-shaped or irregular. Our galaxy is a spiral galaxy called the Milky Way Galaxy.
- A group of stars that forms a pattern is called a constellation.
- The sun and all the bodies revolving around it form the solar system. The solar system has eight major planets and their moons, dwarf planets, asteroids, meteoroids and comets.
- The first four planets (Mercury, Venus, Earth and Mars) are called terrestrial planets because they have rocky surfaces. The other four planets (Jupiter, Saturn, Uranus and Neptune) are gas giants. All gas giants have rings around them. Saturn has the brightest rings.

- An object revolving around a celestial body is called a satellite. Natural satellites are called moons. All planets other than Mercury and Venus have moons.
- The moon takes 27 days and 8 hours to complete one revolution around Earth. It takes about the same time to complete one rotation. This is why the same side of the moon always faces us.
- The changing shapes of the moon are called the phases of the moon. When the moon is between the sun and Earth, the face turned to us is in the dark. We call this new moon. When the moon and the sun are on opposite sides of Earth, the face of the moon turned to us is fully lit. This is called full moon. The entire cycle from one new moon to the next takes about 29.5 days.
- Eclipses occur when the sun, the moon and Earth are in a straight line. At such times, if the moon is between the sun and Earth, its shadow falls on Earth, and there is a solar eclipse. If, on the other hand, Earth comes between the sun and the moon and its shadow falls on the moon, there is a lunar eclipse.
- The regular changes in the level of sea water at any place are called tides. They are caused mainly by the gravitational pull of the moon. High tides occur on the sides of Earth closest to and farthest away from the moon. Low tides occur at right angles to these two points.
- Spring tides occur at full moon and new moon, when the pulls of the moon and the sun add up. Neap tides occur close to the first and third quarters of the moon, when the pulls of the moon and the sun act at right angles to each other.
- Dwarf planets are tiny planets beyond Neptune. These minor planets failed to draw in other small objects near them. Pluto, once considered a planet, is now classified as a dwarf planet. Pluto and many other dwarf planets have their own moons.
- Asteroids are tiny rocky objects orbiting the sun in a belt between Mars and Jupiter. Some of them have moons.
- Meteoroids are pieces of rock orbiting the sun. They burn up when they enter the atmosphere. The streaks of light caused by their burning are called meteors or shooting stars. When they fall on Earth, they are called meteorites.
- A comet is a small body of ice and dust that moves around the sun in an elongated orbit. When it comes near the sun, a stream of glowing gases and dust comes out of it, forming a long tail behind it.
- A man-made object orbiting a planet or moon is called an artificial satellite. Most artificial satellites revolve around Earth. Some have low-earth orbits, or revolve just above the atmosphere. Some are geostationary, or complete one revolution in 24 hours. Others have polar orbits, or circle Earth from the north to the south.
- Satellites are used for scientific research, communications, weather forecasting, remote sensing, navigation and military purposes.

EXERCISE

Short-Answer Questions

1. What is a light year?
2. What is the general opinion about how the universe was formed?
3. What is a galaxy? Mention some common shapes of galaxies.
4. What are constellations?
5. Which are the terrestrial planets?
6. Which planets have rings around them?
7. What makes Venus the hottest and most brilliant planet?
8. Why do we always see the same side of the moon?

Long-Answer Questions

1. Explain how solar and lunar eclipses occur.
2. What are tides? Use a diagram to explain how tides are caused.

3. Why does the sun not play a major role in causing tides? At which times does the pull of the sun make a significant difference to high-tide levels?
4. What are dwarf planets? Name one that was earlier classified as a planet.
5. Explain the terms 'meteoroids', 'meteors' and 'meteorites'.
6. What are artificial satellites? Write about any three uses of such satellites.
7. Which conditions make Earth suitable for the existence of life?

Objective Questions

Choose the correct option.

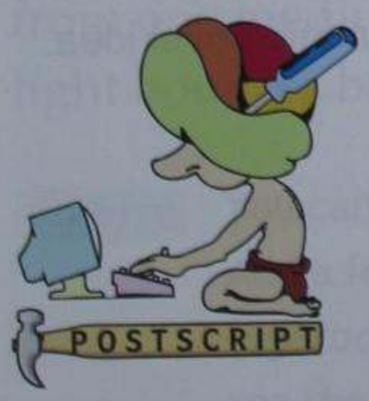
1. The red spot on Jupiter is
   (a) a storm that has been going on for centuries
   (b) a gigantic crater
   (c) a volcanic eruption
   (d) caused by reflection of light
2. The time taken by a geostationary satellite to complete one revolution around Earth is
   (a) one year (b) one month
   (c) one day (d) one week
3. Asteroids orbit the sun in a belt
   (a) beyond Uranus
   (b) between Jupiter and Saturn
   (c) between Jupiter and Mars
   (d) between Earth and Mars
4. Stars are born in
   (a) galaxies (b) constellations
   (c) solar systems (d) nebulas
5. Comets are made of
   (a) ice and dust (b) gases
   (c) rocks (d) metals
6. The temperature on Mercury swings immensely because
   (a) of its closeness to the sun
   (b) it has a very thin atmosphere
   (c) it is the smallest planet
   (d) of the composition of its surface

Write 'true' or 'false'.

1. Venus is the smallest planet.
2. Mercury and Venus are the only planets that do not have moons.
3. Only planets have moons.
4. The constellations visible in the Northern Hemisphere are also visible in the Southern Hemisphere.
5. Our galaxy is a spiral galaxy.
6. The stars of our galaxy move slowly around its centre.

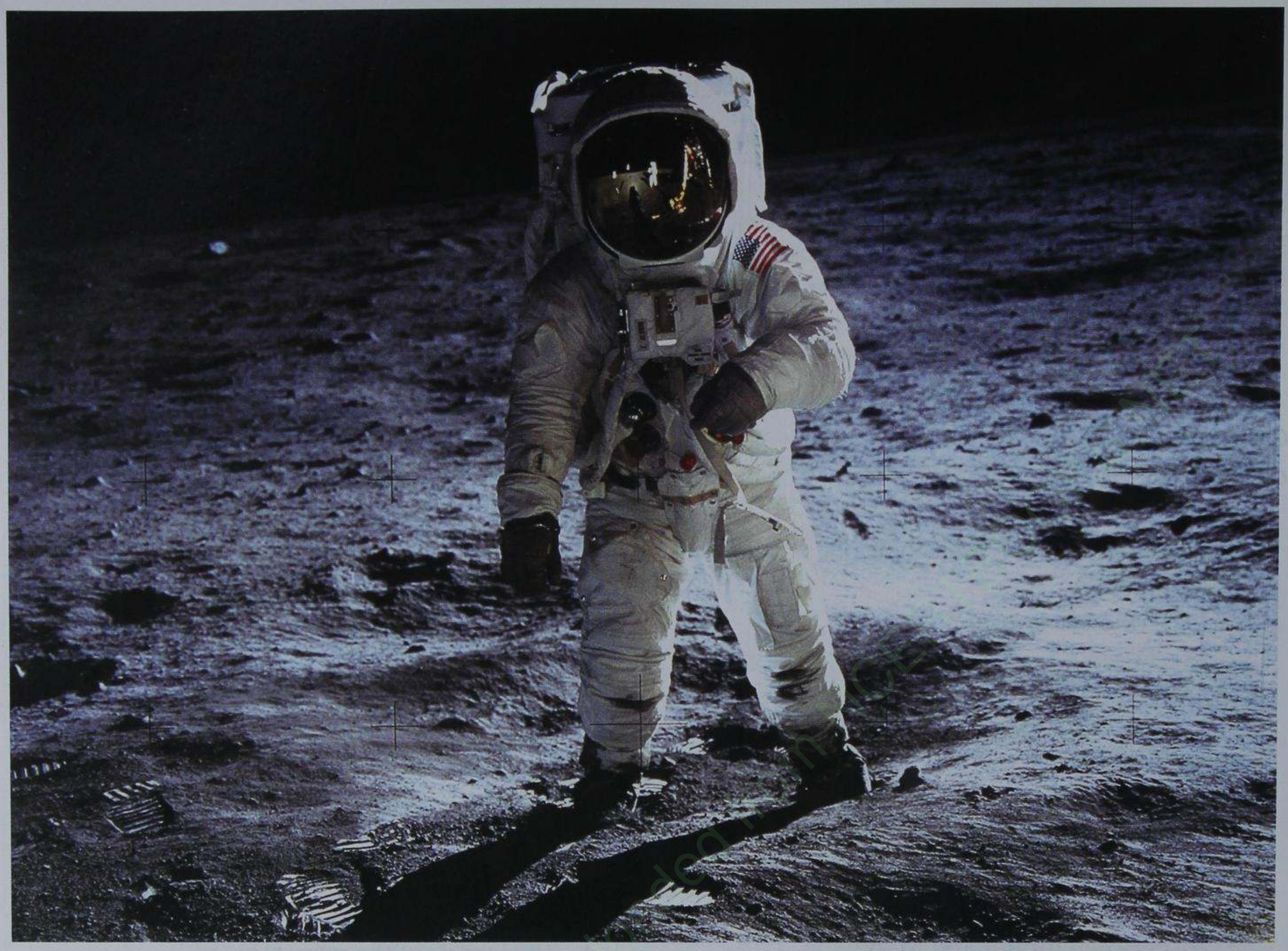
Fill in the blanks.

1. The name of our galaxy is the ..... Galaxy.
2. The two brightest stars of the .... point towards the Pole Star.
3. Mars is often called the ..... Planet.
4. The largest of the planets is ..... .
5. A total solar eclipse occurs when the ..... of the moon's shadow reaches Earth.
6. The planet with the brightest rings is ..... .



Chandrayan, India's first satellite to the moon, was launched by the Indian Space Research Organisation (ISRO) on October 22, 2008. It took off from Sriharikota in Andhra Pradesh, with the aim of studying the surface of the moon. On November 8, the satellite was put into orbit around the moon, and on November 14, a part of it detached itself and landed on the moon. That was a great date for India, as it became the fourth nation to put its flag on the moon, after the Soviet Union, the US and Japan.

Man has long dreamt of going to the moon. The first success came in January 1959, when Luna 1, a satellite sent into space by the Soviet Union, flew past the moon and went into orbit around the sun. The next step was the landing on the moon by Luna 2 in September 1959. After many more Soviet and US lunar missons, came the crowning glory on July 20, 1969. That was a great day for the history of mankind. It was on that day that the US spacecraft Apollo 11 carried Neil Armstrong and Edwin Aldrin to the moon. The whole world watched in awe as the astronauts took their first steps on the surface of the moon.



Edwin Aldrin on the moon

Project Ideas Divide your class into four or five groups and prepare reports on topics of your choice. Some ideas are given here.

1. GPS is a satellite system launched for military purposes, but also used successfully for civilian navigation. Find out about this and other global navigation satellite systems (GNSS).
2. The concept of space tourism was pioneered by Russia. Find out more about this novel idea.
3. Find out what the Indian National Satellite (INSAT) programme is about.

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