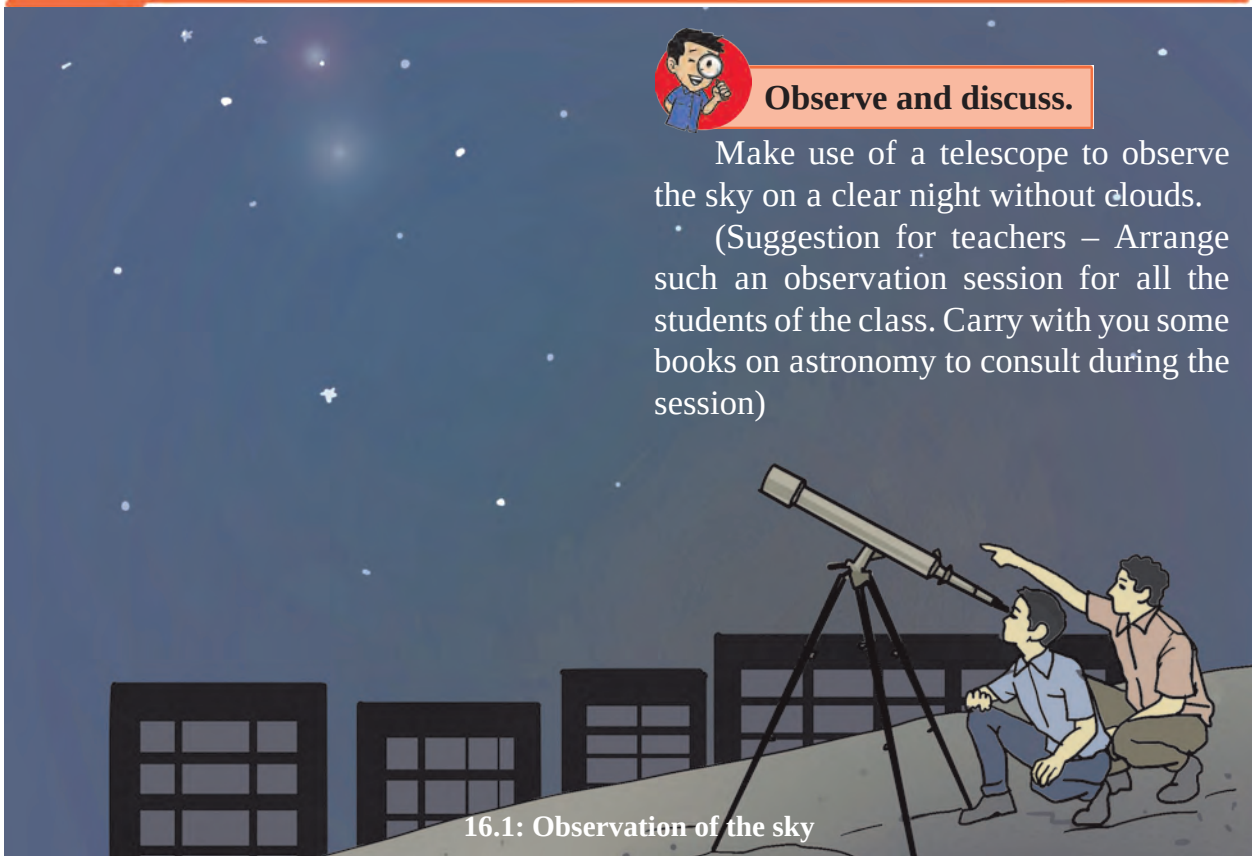
16. The Universe



Observe and discuss.

Make use of a telescope to observe the sky on a clear night without clouds.

(Suggestion for teachers – Arrange such an observation session for all the students of the class. Carry with you some books on astronomy to consult during the session)

16.1: Observation of the sky

If you observe the clear sky on a dark night, you will see a smoky white band full of stars spreading north-south in the sky. This is the Milky Way. It is also known as 'Mandakini'.

A group of innumerable stars and their planetary systems are together known as a 'galaxy'. The Milky Way is the galaxy in which our solar system is located. The Milky Way is a part of the 'Local Group' of galaxies. There are many such galaxies in the universe.

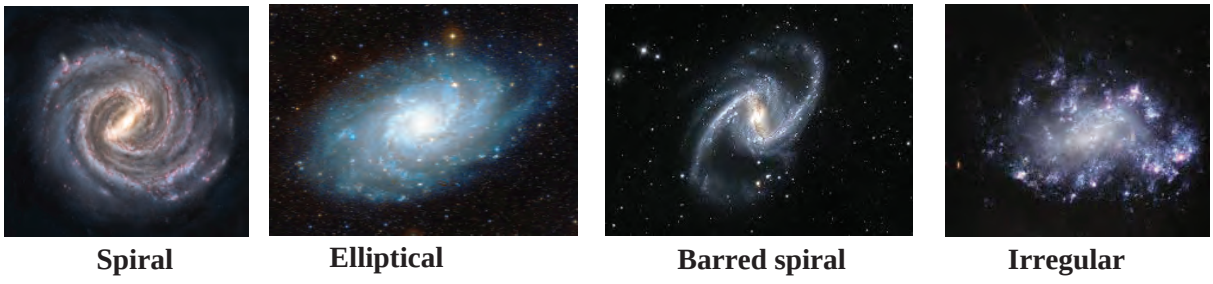
The Milky Way includes many stars smaller than our Sun as well as many others that are thousands of times bigger than the Sun. It also includes many other celestial bodies such as clusters of stars, nebulae, clouds of gases, clouds of dust, dead stars, newly born stars, etc. The galaxy that is closest to our Milky Way is called Andromeda.

The universe includes innumerable galaxies, the space between them and also energy.

16.2 : The Milky Way

16.3 : The Andromeda galaxy

Types of galaxies : Various types identified according to their shapes



16.4 : Various galaxies

The scientist Edwin Hubble showed that there exist many galaxies beyond our Milky Way. In 1990, NASA, the American space agency launched the 'Hubble Telescope' in the orbit of the earth. The Hubble telescope has made it easier to look for stars, to take photographs and to obtain spectrums.

16.5 : Hubble Telescope

Stars

The thousands of twinkling stars that we observe in the clear night sky are part of our Milky Way. Some of the stars that we see are bright whereas others are faint. Stars radiating different colours such as blue, white, yellow and reddish can be seen in the sky. We also see stars with varying brightness (luminance). The birth place of stars are the huge nebulae, made of dust particles and gases. Generally, the surface temperature of stars ranges from 3500˚C to 50000˚C. The colour of stars changes according to their temperature.

16.6 : A nebula

Some types of stars

- **Sun-like stars :** These stars can be slightly smaller or bigger than the sun. But there is a lot of difference in their temperatures. Examples : stars like Sirius, Alpha Centauri.
- **Red Giants :** The temperature of these stars ranges between 3000˚C and 4000˚C. But their luminance can be 100 times that of the sun. Their diameter is 10 to 100 times that of the sun and they are red in colour.
- **Super Nova :** These are even brighter and larger than the red giant stars. Their temperature is between 3000˚C to 4000˚C but their diameter can be more than a hundred times greater than that of the Sun.
- **Binary or Twin Stars :** More than half of the stars in sky are binary stars. They consist of two stars that revolve around each other. At times, three or four stars that revolve around each other have also been located.
- **Variable Stars :** The luminance and shape of these stars is not stable. They are constantly contracting or expanding. When a star expands, it emits less energy and at such times its brightness decreases. As against this, when a star contracts, its surface temperature increases and the star emits greater energy and appears brighter. For example, Polaris (Pole Star).

Find out.

Visit the sites of the institutes ISRO (www.isro.gov) and NASA (www.nasa.gov) and collect information about the various celestial bodies in the solar system and universe, and discuss the same in the class.

Can you tell?

1. Which celestial bodies form the solar system?
2. What is the difference between stars and planets?
3. How many planets are there in our solar system?
4. What is to be found between Mars and Jupiter?

The Mercury, Venus, Earth and Mars are the inner planets whereas the Jupiter, Saturn, Uranus and Neptune are outer planets. Outer planets have rings around them. The crust of all the inner planets is hard. The outer planets have gaseous outer cover.

The solar system

The solar system consists of the sun, the planets, asteroids, comets and meteors. The planets Mercury, Venus, Mars, Jupiter and Saturn can be easily seen.

The sun

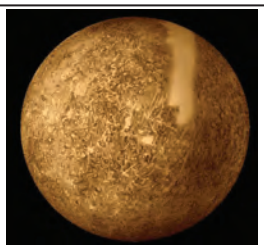
The sun which is at the centre of the solar system is a yellow coloured star. Its surface temperature is around 6000°C. The size of the sun is so huge that around 13 lakh planets of the size of the earth can be easily placed within it. Due to the gravitational force of the sun, the celestial bodies in the solar system revolve around it. The diameter of the sun is approximately 13,92,000 km. The sun rotates around its axis and while doing so, it revolves around the centre of the Milky Way taking the solar system along with it.

The sun

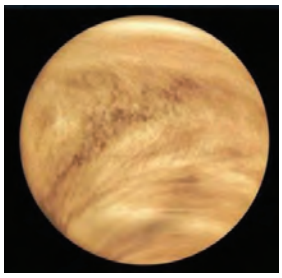
Planets of the solary system – facts and figures

Name of the planet	Number of known satellites	Inclination of the axis (in degrees)	Period of rotation*	Period of revolution*	Magnetism	Atmosphere	Rings
Mercury	0	0.01	58.65 days	88 days	No	No	None
Venus	0	177.2	243.00 days	225 days	No	Yes	None
Earth	1	23.5	24 hours	1 year (365 days)	Yes	Yes	None
Mars	2	25.2	24 hrs 37 mn	1.88 years	No	Yes	None
Jupiter	64	3.1	9 hrs 56 mn	11.87 years	Yes	Yes	Yes
Saturn	33	26.7	10 hrs 40 mn	29 years	Yes	Yes	Yes
Uranus	27	97.9	17 hrs 24 mn	84 years	Yes	Yes	Yes
Neptune	13	28.8	16 hrs 11 mn	164 years	Yes	Yes	Yes

Mercury : This planet is closest to the sun. It is visible in the morning and the evening if it is away from the sun. A number of depressions, which look like volcanic craters, but are actually caused by meteoric falls can be seen on the surface of Mercury. Mercury is the fastest moving planet.



Venus : It is the brightest planet in the solar system. It is seen in the sky in the east before the sunrise and in the west after the sunset. It rotates around itself from east to west. It is the hottest planet.



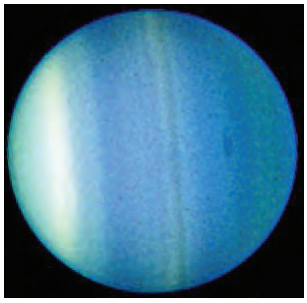
Earth : It is the third planet of the solar system. No other planet other than the earth has life on it. As the earth is a magnet, there is a magnetic field around the earth. It diverts the harmful rays from the sun towards the polar regions of the earth.

Mars : It is the fourth planet in the solar system. As the soil on Mars contains iron, its colour is reddish. Hence Mars is also called the Red Planet. The highest and longest mountain in the solar system 'Olympus Mons' is located on Mars.

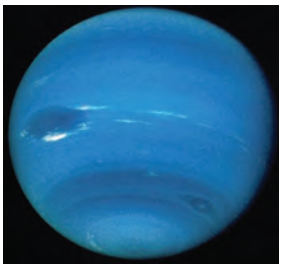
Jupiter : This is the largest planet of the solar system. It is so huge that as many as 1397 planets of the size of the earth can get accommodated in it. Even though the planet is so huge, it revolves around itself with a great speed. As huge storms occur frequently on it, it is also called the 'Stormy Planet'.

Saturn : It is the sixth planet of the solar system and next only to Jupiter in size. It is considered to be a peculiar planet because of the rings around it. Though its mass is 95 times that of the earth, its density is very low. If it were dropped into a sea large enough to hold it; it would actually float in it!

Uranus : It is the seventh planet in the solar system. It cannot be seen without a telescope. Its axis is so greatly inclined that it appears as if it is rolling along on its orbit.



Neptune : It is the eighth planet in the solar system. A season on Neptune lasts for about 41 years. On this planet winds blow with extremely high speed.



*** The periods of rotation and revolution of the planets are expressed relative to those periods on the earth (Page 114).**

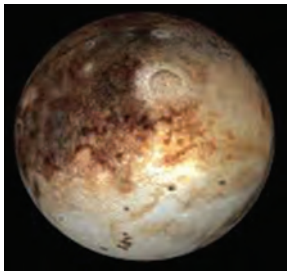
Satellite : The celestial bodies that revolve around a planet without independently revolving around the sun are called satellites. Like planets, satellites rotate around their respective axes. The Moon is the satellite of the earth. It does not have an atmosphere. Its periods of rotation and revolution are both of 27.3 days. Except for Mercury and Venus all other planets have satellites but in varying numbers.

Satellite

Asteroid : A great number of small sized bodies could not turn into planets when the solar system was formed, but continued to revolve around the sun. These bodies are known as asteroids. A belt of such celestial bodies has formed between the planets Mars and Jupiter.

Asteroid

Dwarf planet : A small sized celestial body that revolves independently around the sun is called a dwarf planet. A celestial body like Pluto can be classified as a dwarf planet. Pluto takes around 248 years to complete its revolution around the sun whereas it takes around 6.38 days for one rotation.



Dwarf planet

Use your brain power!

1. Why do we see only one side of the moon?
2. Which planet has a day longer than its year?

Find out.

Obtain information about the various asteroids and dwarf planets in the solar system and discuss it in the class.

Can you tell? Have you ever seen in the evening or in the predawn hours a large celestial body with a long tail? What is it called?

A comet

A comet is a celestial body that revolves around the sun. Comets are formed out of ice and dust particles. They are part of the solar system. Since olden times, the appearance of a comet has been considered to be an inauspicious event. Comets appear like points when they are far away from the sun. But when they are close to the sun, they become easily visible to us because of the shorter distance and the heat of the sun.

Comets are made up of frozen matter and dust particles. When they are close to the sun, this frozen matter gets converted into gas due to the solar heat. These gases get thrown in a direction away from the sun. As a result, certain comets appear to have a long feathery tail. Due to their long elliptical orbits, their appearance in the sky is very rare. They reappear in the sky after very long periods of time.

Comets are classified in two main groups.

Long period comets : These comets take more than 200 years to complete one revolution around the sun.

Short period comets : These comets take less than 200 years to complete one revolution around the sun.

Do you know this?

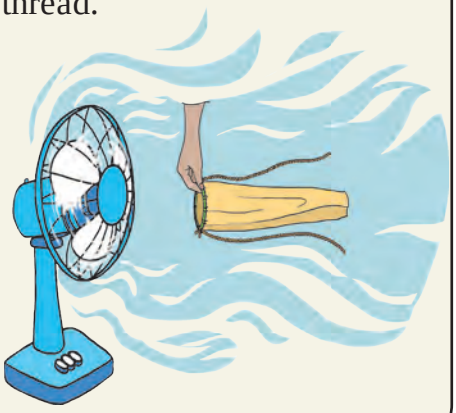
Halley's comet appeared in the year 1910 and reappeared in 1986. Its central part or nucleus was found to be 16 km long and 7.5 km wide. Halley's comet takes 76 years to complete its revolution around the sun.

Halley's comet

A bit of fun !

Material required – a table fan, a bangle, a piece of light cloth, twinned string and thread.

As shown in the picture, sew the cloth around the bangle. Take a string as long as the length of the cloth and tie it to the bangle. Now hold the bangle in front of the fan and put on the fan.



In the past ...

Fred Whipple, an American astronomer, proposed that comets consist of an icy cluster of various constituents. That is why, comets came to be called 'dirty snowballs'. By 1950, Whipple had discovered six comets.

5Y5NZA

A meteor

At times, we see a falling star. This event is called a meteor fall. Mostly these meteors are rocky pieces originating from the asteroid belt. Smaller rocky pieces get completely burnt due to friction with air after they enter the earth's atmosphere. Sometimes the meteors do not burn completely and fall to the surface of the earth. These are called meteorites. It is believed that the Lonar lake in Maharashtra has been formed by the impact of such a meteorite. Meteors or meteorite falls occur on other celestial bodies, too.

Always remember...

Science tries to explain different events occurring in the universe. We should study phenomena like meteor falls, eclipses, etc. rather then attach any blind faith or superstition with them.

What we have learnt–

- There are innumerable galaxies in the universe. Our solar system, various star clusters are part of the Milky Way.
- Various types of stars like the sun can be seen in the Milky Way.
- Different planets in the solar system have peculiar characteristics. Some planets have satellites whereas others do not have any.
- Comets have a characteristic structure but their appearance keeps on changing.

Exercise

1. Name these -

(a) Birth place of stars
(b) Biggest planet in the solar system
(c) The galaxy which is our neighbour.
(d) Brightest planet in the solar system
(e) Planet with largest number of satellites
(f) Planets without a single satellite
(g) Planet with a rotation different from other planets.
(h) A celestial body that carries a tail along.

2. Fill in the blanks.

(a) The group of galaxies of which our Milky Way is a part is called ..... .
(b) Comets are made of ..... .
(c) The planet ..... appears as if it is rolling along its orbit.
(d) ..... is a stormy planet.
(e) The Pole Star is the best example of a ..... type of star.

3. Say if the statements given below are right or wrong. Rewrite the statements after correcting them.

(a) Venus is the planet closest to the sun.
(b) Mercury is called a stormy planet.
(c) Jupiter is the biggest planet.

4. Answer the following.

(a) What is a special characteristic of the planet Mars?
(b) What are the types of galaxies?
(c) Which celestial bodies does a galaxy include?
(d) Name the different types of stars.
(e) What are the types of comets and on what basis are they classified?
(f) What is the difference between meteors and meteorites?
(g) What are the characteristics of the planet Neptune?

5. Match the following.

Group A	Group B
(1) Galaxy	(a) From east to west
(2) Comet	(b) 33 satellites
(3) Sun-like star	(c) Spiral
(4) Saturn	(d) Sirius
(5) Venus	(e) Halley

Activity :

- Using the material you can find in your house, prepare a model of the solar system.
- Collect information about different aspects of each planet such as its distance from the sun, its diameter, its volume, etc. and present it in a science exhibition.

Glossary

amphibian – उभयचर
annual – वार्षिक
appendicular skeleton – उपांग सांगाडा
aquatic – जलचर
asteroids – लघुग्रह
autotrophic – स्वयंपोषी
axial skeleton – अक्षीय सांगाडा
balanced diet – संतुलित आहार
ball and socket joint – उखळीचा सांधा
bar magnet – पट्टी चुंबक
biennial – द्विवार्षिक
blood vessel – रक्तवाहिनी
boiling – उत्कलन
boiling point – उत्कलनांक
brittleness – ठिसूळपणा
cartilage – कूर्चा
cellular structure – पेशीमय रचना
chemical energy – रासायनिक ऊर्जा
circular motion – वर्तुळाकार गती
comet – धूमकेतू
complex machine – गुंतागुंतीचे यंत्र
compound leaf – संयुक्त पान
condensation – संघनन
conventional resource of energy – पारंपरिक ऊर्जा साधन
deficiency diseases – अभावजन्य आजार
density – घनता
dermis – त्वचा
disaster – आपत्ती
displacement – विस्थापन
ductility – तन्यता
elasticity – स्थितिस्थापकता
electric energy – विद्युत ऊर्जा
electrical conductivity – विद्युतवाहकता
electrostatic force – स्थितिक विद्युत बल
epidermis – बाह्यत्वचा
excretion – उत्सर्जन
fat, fatty subtance – स्निग्ध पदार्थ
fibrous – तंतुमय
first aid – प्रथमोपचार
fluidity – प्रवाहिता
food adulteration – अन्नभेसळ
force – बल
freezing point – गोठणांक (गोठणबिंदू)
frictional force – घर्षण बल
fulcrum – टेकू
funnel – नसराळे
galaxy – दीर्घिका
gravitational force – गुरुत्वाकर्षण बल
groundwater – भूजल
hardness – कठीणपणा
heterotrophic – परपोषी
hinge joint – बिजागरीचा सांधा
horseshoe magnet – नालाकृती चुंबक
humus – कुथित मृदा
immovable joint – अचल सांधा
inclined plane – उतरण
inert gas – निष्क्रिय वायू
insectivorous – कीटकभक्षी
invertebrate – अपृष्ठवंशीय
joint – सांधा
kinetic energy – गतिज ऊर्जा
lever – तरफ
lifespan – आयुर्मान
linear motion – रेषीय गती
load – भार
lustre – चकाकी
magnetic field – चुंबकीय क्षेत्र
magnetic force – चुंबकीय बल
magnetic substance – चुंबकीय पदार्थ
magnetism – चुंबकत्व
malleability – वर्धनीयता

malnutrition – कुपोषण
mechanical energy – यांत्रिक ऊर्जा
melting – विलयन
melting point – विलयबिंदू
meteor – उल्का
meteorite – अशनी
Milky Way, the – आकाशगंगा
minerals – खनिजे
motion – गती
movable joint – चल सांधा
multicellular – बहुपेशीय
natural substance – नैसर्गिक पदार्थ
nebula – तेजोमेघ
non-conventional energy resource– अपारंपरिक ऊर्जा साधन
nutrients – पोषकतत्त्वे
oscillatory motion – आंदोलित गती
oviparous – अंडज
perennial – बहुवार्षिक
periodic motion – नियतकालिक गती
Pole Star – ध्रुव तारा
potential energy – स्थितिज ऊर्जा
prism – लोलक
propagation of sound – ध्वनिप्रसारण
proteins – प्रथिने
pulley – कप्पी
random motion – यादृच्छिक गती
reflection of light – प्रकाशाचे परावर्तन
reproduction – पुनरुत्पादन/प्रजनन
satellite – उपग्रह
sensory organ – ज्ञानेंद्रिय
shadow formation – छायानिर्मिती
simple machine – साधे यंत्र
Sirius – व्याध तारा
skeletal system – अस्थिसंस्था
skull – कवटी
solubility – विद्राव्यता
states of substances – पदार्थांच्या अवस्था
sterile – निर्जंतुक
sternum – उरोस्थि
sublimation – संप्लवन
sunstroke – उष्माघात
taproot – सोटमूळ
terrestrial – भूचर
thermal conductivity – उष्णतावाहकता
transparency – पारदर्शकता
unicellular – एकपेशीय
uniform motion – एकसमान गती
universal solvent – वैश्विक विद्रावक
vacuum – निर्वात
variable star – रूपविकारी तारा
vertebral column – पाठीचा कणा
vertebrate – पृष्ठवंशीय
vibration – कंपन
viviparous – जरायुज
vocal cord – ध्वनितंतू
volume – आकारमान
weathering – अपक्षय
wedge – पाचर
worm – कृमी