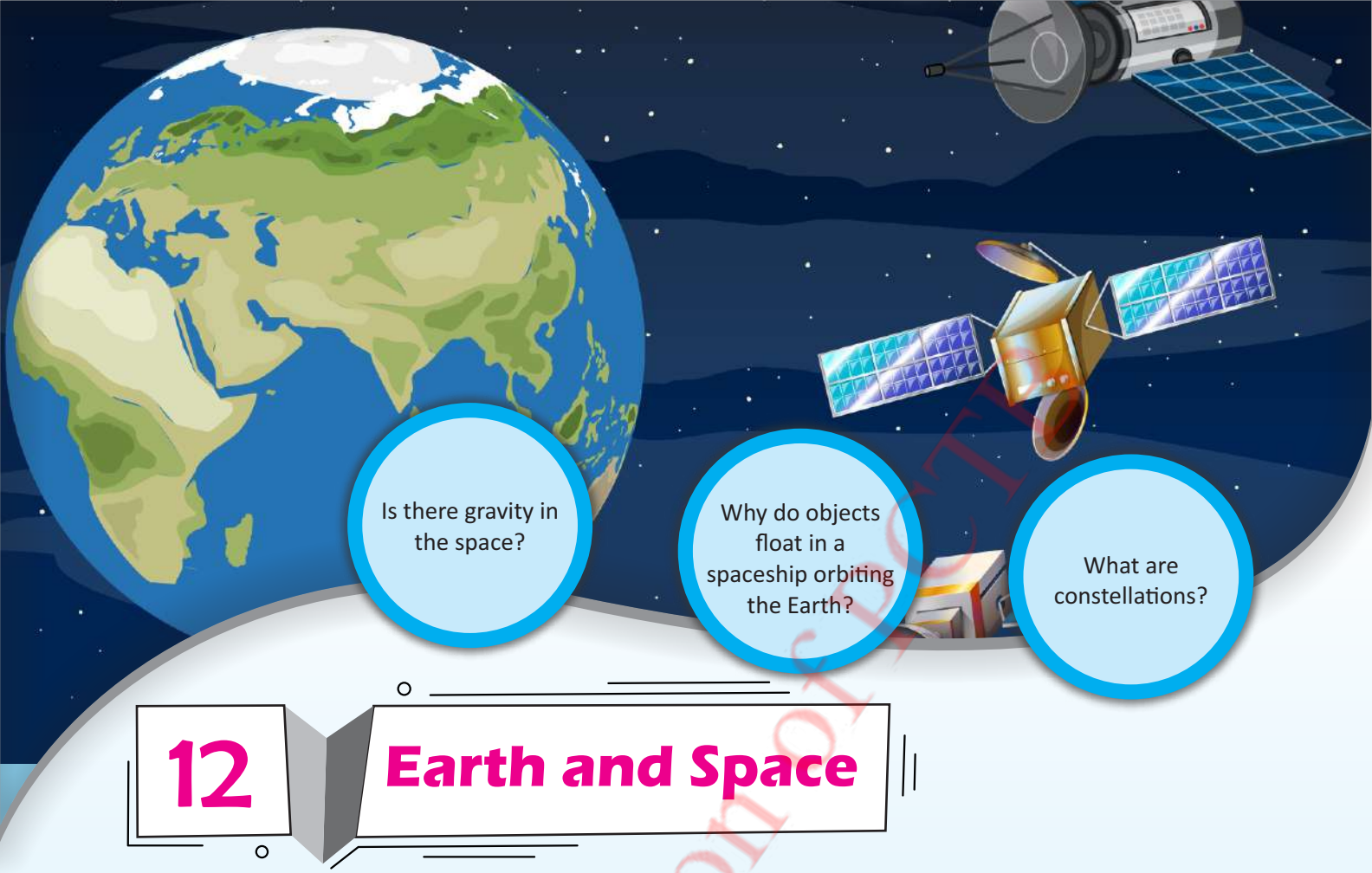


12 Earth and Space

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Recognize that the force of gravity keeps planets and moons in their orbits.
- Differentiate between mass and weight, using examples of weightlessness experienced by astronauts on the surface of the Moon.
- Recognize that tides are caused by the gravitational pull of the Moon
- Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).
- Describe how seasons in Earth's Northern and Southern Hemispheres are related to Earth's annual movement around the Sun.

VOCABULARY

Mass
The amount of matter in an object

Weight
Gravitational force acting on an object

Weightlessness
A situation where a mass has zero weight

Tides
The waves that move through an ocean in response to the forces exerted by the Moon or the Sun

Recall what you have learnt

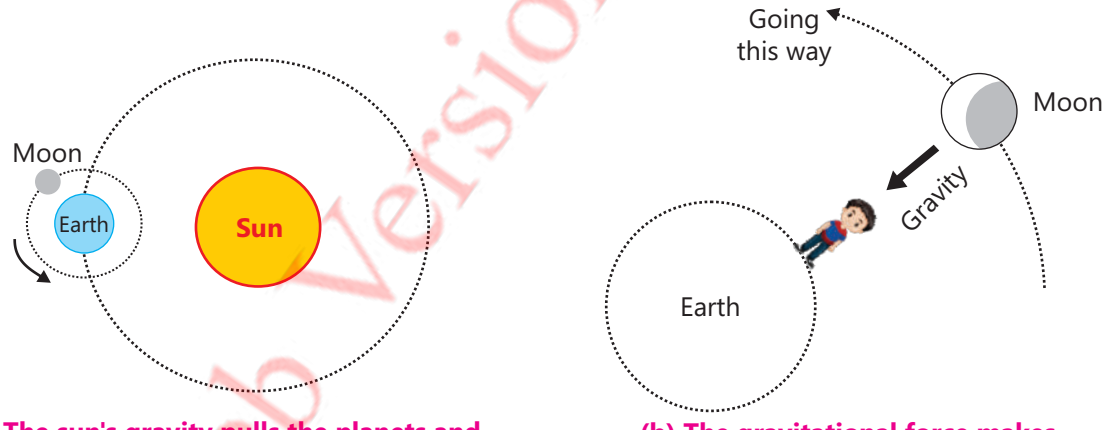
We have learnt about solar system (The Sun and Planets) and that the Earth being part of the solar system is the third planet from the Sun. The surface of the Earth is made of water, air and solid ground. Its atmosphere consists of nitrogen, oxygen, carbon dioxide and other gases. Mass of the Earth is about 6×10^{24}kg. The Earth is the only planet where life exists.

In this chapter we will learn:

- Gravitational force
- Mass and weight
- Weightlessness
- Tides
- Annual rotation of the Earth around the Sun

12.1 GRAVITATIONAL FORCE

Every object in this universe attracts every other object towards its centre. The force of attraction between objects (masses) is called **gravitational force**. The effect of the gravitational force between two small masses is too little to be felt. However, the effects of gravitational forces exerted by massive objects such as the Sun and the Earth are easily observable. Planets are revolving around the Sun and moon revolves around the Earth due to gravitational force **(Figure 12.1)**. If there is no gravitational force of the Sun, the planets will not continue to revolve around it.



(a) The sun's gravity pulls the planets and their moons to orbit around it.

(b) The gravitational force makes the moon to move round the Earth

Figure 12.1 Skin cells in skin tissue (epithelial tissue)

The space around an object where gravitational force acts is called its **gravitational field**.

12.1.1 The Earth's Gravity

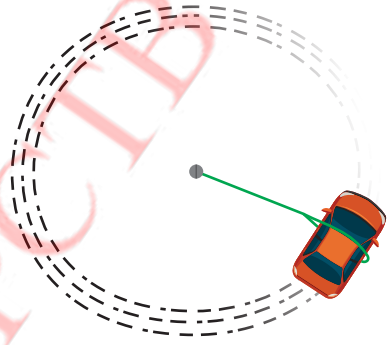
The gravitational force or gravity of our Earth pulls the objects, which are within its gravitational field towards its centre. Thus due to the Earth's gravity, the things dropped from some height, fall to the ground.

Informative

The Earth takes one year to move once around the Sun and Moon takes 29 days to move once around the Earth.

Activity 12.1

1. Take a battery operated toy car.
2. Tie a string around it.
3. Tie the other end of the string to a nail fixed on the floor.
4. Switch on the car and observe its motion.
5. What will happen to the toy car when the fixed end of the string is made free.
6. Observe its motion by making it free.
7. Relate your observation with the orbital motion of the moon around the Earth.



12.2 MASS AND WEIGHT

Anything that has mass and occupies space is called **matter**. **Mass** is a measure of the amount of matter in an object. Its value does not depend on its location. The gravitational force acting on an object is called its **weight**. The value of weight can be changed with location of the object on the Earth's surface, on the Moon, or on other planet and in the space. Mass and weight are measured in different units. The unit for mass is kilogram (kg). As weight is a force, its unit is newton (N).

The weight of an object in the Earth's gravitational field depends on two factors:

- Mass of the object
- Acceleration due to gravity

The stronger the gravity, the greater the acceleration due to gravity (g). If acceleration due to gravity (g) is constant, then weight (w) increases with the increase in mass (m). If mass (m) is constant then weight increases with the increase in gravity (g).

Mathematically we can write:

$$W = mg$$

Where, W = weight of the object

m = mass of the object

g = acceleration due to gravity

Thus at the position where the same force of gravity acts on two objects of different masses, the object with bigger mass has the greater weight.

Difference between mass and weight.

Mass	Weight
(i) The quantity of matter in an object is called its mass.	(i) The gravitational force acting on an object is called its weight.
(ii) The mass of an object remains constant everywhere, whether it is measured at a point far away from the centre of the Earth or very close to its centre.	(ii) Weight of an object is not a constant quantity as its value is different at different distances from the centre of the Earth.
(iii) Mass of an object cannot be zero.	(iii) Weight of an object may be zero.

Informative

The weight of an object of mass 1 kg on Earth surface is about 10 N.

12.3 WEIGHTLESSNESS

The weight of an object is due to the gravitational force acting on it which may vary from place to place. An astronaut when leaves the Earth for traveling in space, gets changes in his weight. As he goes far from the Earth, its weight decreases. If he lands on the Moon's surface, his weight will be less due to smaller gravity of the Moon as compared to that of the Earth. Gravity of the Moon is six times less than that of the Earth.

Weightlessness is a situation where a mass has zero weight. Things float around in a satellite and spaceships orbit the Earth as they have no weight **(Figure 12.2)**. In fact, gravity of the Earth causes the satellite or the spaceship to circle the Earth. Hence, all objects inside a satellite become weightless. Therefore, all objects are to be fixed inside the satellite, otherwise they will float away. Astronauts have foothold to keep them still while they are working. They sleep in sleeping bags strapped to the walls of the cabin so that they do not bump into other objects when they are asleep. Sometimes, it looks as if they are standing along the wall of the cabin.

Figure 12.2 Astronaut in space

Activity 12.2

Take a plastic bottle filled with water. Hold it upside down at certain height. Remove its lid and drop it. Observe what happens. Why does it happens so?

Activity 12.3

Teacher Guide

Facilitate students to conduct the activity as under:

- Arrange a visit to a high rise building in a town having an elevator.
- Carry along a scale for weighing.
- A group of 3 or 4 students should enter the elevator.
- One student should stand on the scale. Note the weight of student on the scale as the elevator just starts moving. Also note the weight while coming back just before stopping.
- Conduct an interactive discussion on weight:

1. While just moving upwards.
2. While just before stopping.

Informative

What will be the weight of the objects falling freely from certain height?

12.4 TIDES

Tides are the waves that move through oceans in response to gravitational force exerted by the Moon or the Sun. The winds push the surface water in the oceans into ripples called **waves.** These waves move towards the sea shore. When they go back after striking the seashore, it is noticed as the sea shrinks away at the shore and then gradually regains its water level. Such daily changes in the level of ocean water are known as tides. These are caused by the gravitational force of the Moon and the Sun as well as the rotation of the Earth on its axis.

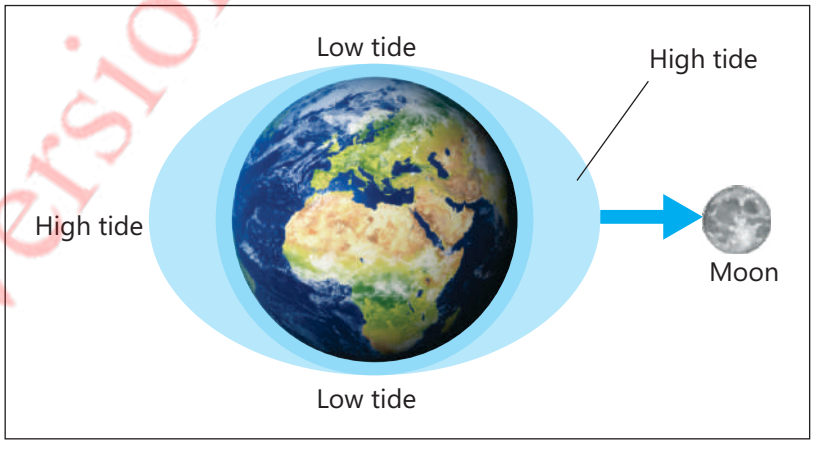


Figure 12.3 Tides due to gravitational pull of the moon

The Moon is closer to the Earth than the Sun. It pulls the ocean water more strongly. At high tide, the water level rises up the shore. At low tide, it recedes back at regular intervals. As the Earth spins, each place has a high tide twice a day. The water bulges out on both sides of the Earth as shown in **Figure 12.3**.

Informative

When the Sun and Moon lined up with the Earth, their combined gravitational pull creates higher tides called spring tide. It happens when the Moon is in its new phase or full phase.

Informative

- The Moon's pull is strongest on the part of the Earth directly facing the Moon.
- Low tides help the fishermen move forwards in the sea and high tides help them come back more easily.

Do you know?

- The use of tides as a renewable energy source to generate electricity is called tidal energy
- The Moon creates tides also in our atmosphere. They are called lunar winds. Lunar winds move eastwards in the morning and westwards in the evening.

12.5 ANNUAL REVOLUTION OF THE EARTH AROUND THE SUN

We have different seasons in different parts of the world in a year. The seasons on the Earth are due to its revolution around the Sun and that it tilts on one side. The Earth moves around the Sun. Such movement of the Earth is called its **revolution** around the Sun **(Figure 12.4)**. The path the Earth takes to revolve around the Sun is called its **orbit**. The Earth completes one revolution around the Sun in 365 days. We call it one year.

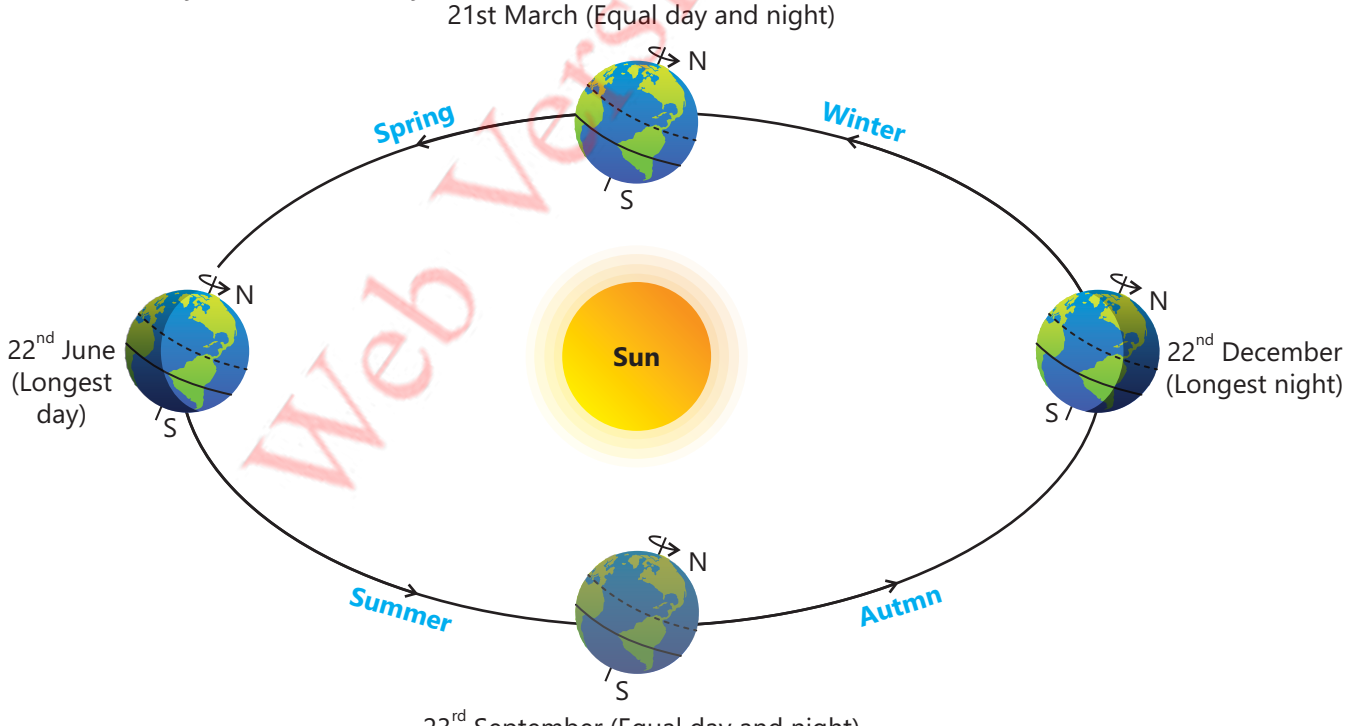


Figure 12.4 Earth's revolution around the Sun

How do Seasons Change?

The Earth's axis of rotation is tilted at certain angles with respect to its plane of rotation around the Sun. Due to this axial tilt, different regions of the Earth change their distance from the Sun during revolution around the Sun. This causes the change in seasons on the Earth. Pakistan lies in the northern hemisphere of the Earth. Let us see how seasons change in the northern hemisphere of the Earth.

As shown in **Figure 12.4**, on 22nd June, the Earth's northern hemisphere is close to the Sun and is hot as compared to the southern hemisphere which is away from the Sun and is cold. Thus, there is summer season in northern hemisphere of the Earth and winter season in its southern hemisphere in the months of June and July.

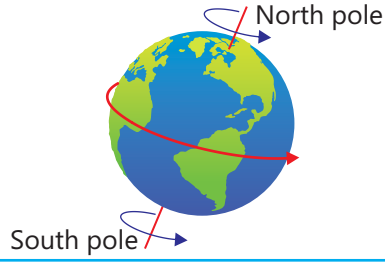
On 22nd December, the Earth's northern hemisphere is away from the Sun and is cold as compared to the southern hemisphere which is close to the Sun and is hot.

Thus, there is winter season in northern hemisphere of the Earth and summer season in its southern hemisphere in the months of December and January.

On 21st March and 23rd September, no hemisphere of the Earth is tilted towards the Sun, hence, there are moderate seasons in northern and southern hemispheres, i.e., spring in northern hemisphere and autumn in southern hemisphere.

Do you know?

- In polar region of the Earth, the Sun never sets in midsummer. It is known as midnight Sun. While in midwinter, the Sun never rises for many days.
- There is summer on the hemisphere leaning towards the Sun while there is winter on the other hemisphere.



Activity 12.4

Arrange a globe in front of a shining lamp. Name the countries where:

1. There is summer season._____
2. There is winter season._____
3. You can see the midnight Sun._____
4. You cannot see the Sun rise for many days._____

Occurence of Day and Night

The half of the Earth's surface faces solar radiations and looks bright on this side of the Earth, there is day. The other half of the Earth's surface remains dark and there is night **(Figure 12.5)**.

During spin, as the dark region of the Earth moves into Sun's light, it gets Sunrise. The Sun comes

into view and there occurs day. On the other side, as the bright region of the Earth moves out of the Sun's light, it gets sunset. The Sun disappears and there occurs night. In this way day and night occur on the Earth. Since the Earth completes its one rotation about its axis in 24 hours, the total duration of one day and one night is 24 hours.

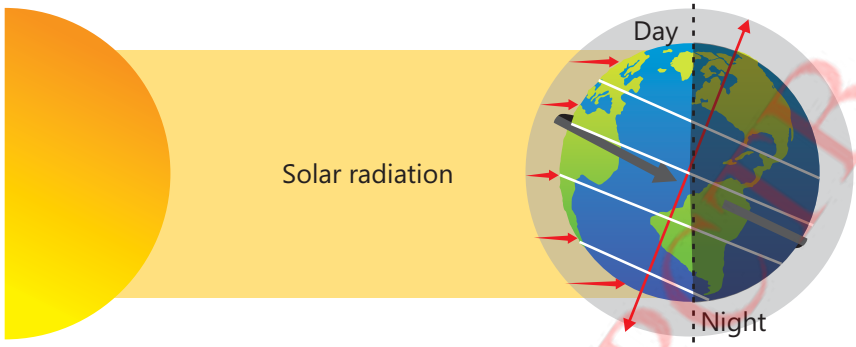


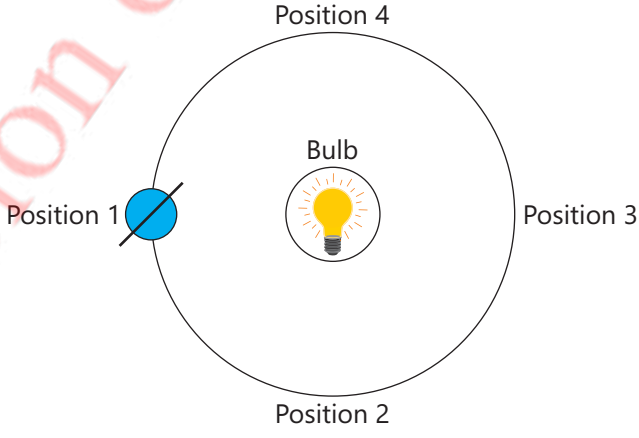
Figure 12.5 Spin of the Earth and occurrence of day and night

Activity 12.5

Teacher Guide

Facilitate students conduct an interactive discussion on:

- Occurence of day and night.
- Observe which part the ball is lighted strongly and will be hot.
- Also observe which part of the ball is away from the bulb and will be cold.
- Make the observations (as above) by placing the ball at position 2, 3 and 4.
- Consider the ball as the Earth, the bulb as the Sun and predict seasons on different parts the Earth at position 1, 2, 3 and 4 during its revolution around the Sun.



12.6 CONSTELLATIONS

At night we see countless number of stars in the sky. Some groups of stars look forming a specific pattern or shape. This specific pattern of stars is known as **constellation**. The constellations are helpful in mapping the sky. Earth's revolution around the Sun causes the constellations appear during certain part of the year. It is easy to recognize a star by constellation. Ursa Major, Great bear, Leo, and Orion are some famous constellations.

Ursa Major or big dipper: Ursa Major or big dipper constellation **(Figure 12.6)** consists of seven stars. Four stars make the bowl and three stars form its handle. A bright star on the end of the bowl points to the **pole star**. It is an area of the sky which can be used for reference purpose for the

whole sky.

Leo: Leo **(Figure 12.7)** is another famous constellation which is seen on th sky from March to May each year.

Orion: The pattern of star in Orion is shown in the **Figure 12.8**.

Great bear: The pattern of star in Great bear is shown in the **Figure 12.9**.

Figure 12.6 Ursa Major

Figure 12.7 Leo

Figure 12.8 Orion

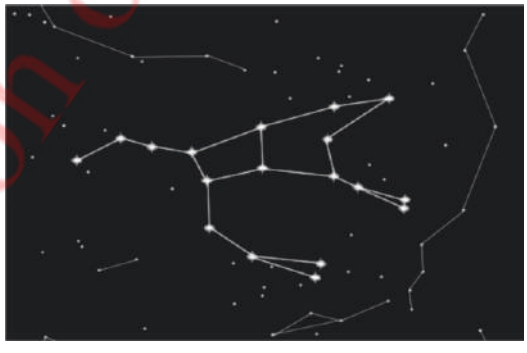


Figure 12.9 Great bear

Informative

- ***Where stars are born***

There are huge clouds of dust and gas spread out across the universe. These clouds are called nebulae. A nebula may form from the gas and dust produced when a star explodes in a supernova. It may also be developed as gravity pulls together the gas and dust in intergalactic space. In this type of nebula, the forces of gravity between the atoms and molecules of helium and hydrogen gas bring them together into a huge ball. The force of gravity continues to act between the gas particles and squashes them closer and closer together, and the pressure inside the ball increases. Eventually, the pressure pushing on the hydrogen atoms becomes so great that they fuse together to make helium atoms and release energy as heat and light. Gradually, the ball begins to glow and eventually, as the pressure continues to increase and more hydrogen is converted into helium, the ball starts to shine and becomes a star. The star is then said to be "born". As this " birthing" process takes place inside nebulae, They are called stellar nurseries and many stars can be forming inside them at the same time.

- ***Astronomy across the world***

  Even the earliest humans would have looked up at the night sky and wondered at it. As time went on, human civilisations began to explain the night sky in a variety of ways and related it to events taking place on the Earth. Today we are still fascinated by the night sky, and scientists study it to find out more about it and our place in the universe. This in turn helps us try to understand to existence, and for many, this means trying to conserve the conditions on Earth which sustain life by maintaining ecosystems and trying to control climate change.

  Astronomy is the study of objects found in space, such as stars, planets, moons and asteroids. It is also the study of phenomena that occur in space, like the formation of stars, the movement of galaxies and the formation of planets. Scientists who study astronomy are called astronomers and many of them work in observatories around the world, collecting data from huge telescopes which use light or radio waves to look into space. There are major observatories all around the world - some of the biggest can be found in the USA, the Canary Islands and Chile. Most observatories are built away from cities, where the sky is not as polluted, so a clearer view of space can be seen.

Do you know?

There are 88 constellations covering the whole sky. In old days they were used to set direction for navigation in the sea.

Activity 12.6

Learn about the constellations using your library and internet resources.

KEY POINTS

- Gravitational force of the Earth pulls all objects towards its surface.
- The Earth moves around the Sun due to the gravitational force.
- The Moon revolves around the Earth due to the Earth's gravity. The gravity of Earth keeps the artificial satellites move around it.
- Weight is the gravitational force of the Earth acting on an object.
- The tilt and orbital motion of the Earth around the Sun cause different seasons.
- The gravitational forces of Moon and the Sun cause the tides in the oceans.
- Tides are also a source of energy called tidal energy.
- The seasons in the northern part of the world are different from southern part of the world.
- When there is summer season in the northern hemisphere, there is winter in the southern hemisphere.
- Specific patterns of stars on the sky are known as constellations.

QUESTIONS

12.1 Encircle the correct option.

1. An object is attracted towards the Earth due to:

a. pull
b. push
c. gravity
d. friction

2. Which of the following is the major cause of tides?

a. heating oceans by the Sun
b. gravitational pull of the Moon
c. earthquakes on the surface of the ocean floor
d. change in the wind direction.

3. Seasons on the Earth's surface are caused by:

a. spin motion of the Earth about its own axis
b. orbital motion of the Earth around the Sun
c. tilt of Earth on its axis
d. the tilt of Earth and orbital motion of the Earth around the Sun.

4. What is the season on 22nd June in the southern hemisphere?

a. spring
b. autumn
c. summer
d. winter

5. The weight of an object on Earth's surface is 600 N. What will be its weight on the Moon's surface?

a. 600 N
b. 300 N
c. 200 N
d. 100 N

6. The tides are highest during:

a. day
b. night
c. half Moon
d. full Moon

12.2 Answer the following questions briefly.

1. An athlete can jump 5 metre up on the Earth, how high he can jump on the Moon?
2. A person can throw a shot put 2 metres away. How long will be his throw on the Moon's surface?
3. Which of the Sun or Moon has a greater pull on the ocean's water? Give reason of your answer.

4. Differentiate force exerted by the Moon on the waters at the near surface and that exerted on the water of far surface.
5. What will be the season in Australia when there is summer in Pakistan?

12.3 Constructed response questions.

1. What happens to mass and weight of an astronaut when he leaves the Earth and travels to the Moon?
2. Comment on the statement: The tides wash in and out of beaches, shores and harbours twice a day.
3. If tides are caused by the gravity of the Moon, why other objects on the Earth are not affected by it?
4. What kind of seasons will be on our Earth, if it was not tilted about its axis?

12.4 Investigation:

Select some constellation patterns from internet or library. Paste their images in your notebook. Try to explore those constellations on a clear night sky and share your findings with class.

12.5 Project

- Make your own weighing machine using a spring. You need a spring, a stand, an object of known weight, an object of unknown weight. Using the principle that extension in the spring is proportional to the weight, design your spring balance. Using mathematics, find the unknown weight.
- Make the following studies using library and internet resources.
    1. Why the life of blue stars is less than yellow or red stars?
    2. How does a constellation differ from a galaxy?
    3. Does life exist on other stars?
    4. Do other star have planets revolving around them?

DENGUE FEVER

INTRODUCTION

The mosquito is considered as an important vector for human diseases. The *Anopheles* mosquito is responsible for the spread of malaria while *Aedes* mosquito is responsible for spreading dengue.

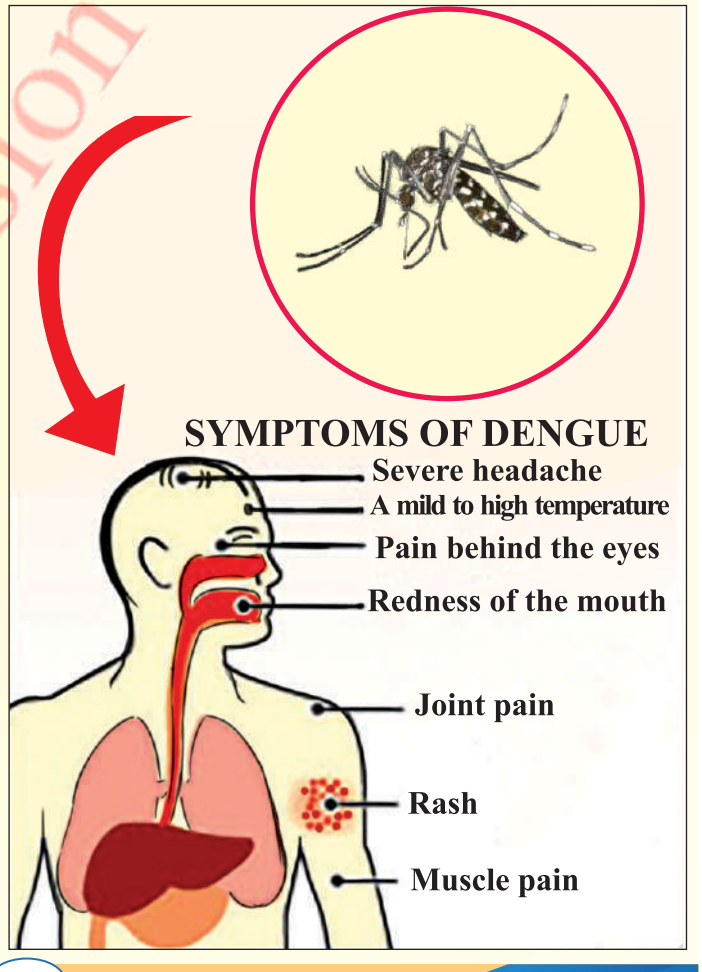
The mosquito hides itself in a variety of places e.g. in the dark corners, behind the picture frames, curtains and under the furniture. It bites human beings almost all the time, but different mosquito species have different feeding times (some feed at night and some feed during the day time, etc) .When an infected female *Aedes* mosquito bites the human being, it transfers the virus into his body which causes Dengue fever. It is an infectious disease of warm and humid parts of the earth.

DENGUE MOSQUITO

The dengue virus multiplies in the body of the female *Aedes* mosquito. The *Aedes* mosquito is of dark brown in colour with white spots and stripes on its body. The mosquito is responsible for the transmission of the diseases like malaria and yellow fever. In order to save oneself from these diseases, it is very important that various preventive measures, including destruction of the breeding sites should be adopted.

DENGUE VIRUS

Four different types of dengue viruses are responsible for Dengue Fever. One or more than one type of virus can enter into female *Aedes* mosquito while biting an infected person and when this mosquito bites other human being, injects virus along with saliva. Recovery after infection with one type of virus can produce lifelong immunity to that type but severe complications can occur on secondary infection by other serotype of virus, serious disease can occur.



SYMPTOMS OF DENGUE FEVER

The salient features of this disease are

- High fever usually above 102°F.
- Severe headache and pain behind the eyes.
- Weakness and fatigue.
- Pain in the muscles and joints because of which it is also called "Break Bone Fever".
- Chill, nausea or rash on the skin may also occur.
- Gradually the white blood cells (WBC) and

the platelets count decrease.

- Majority of the patients recover after 5-7 days.

COMPLICATION OF DENGUE FEVER

Dengue fever, in severe cases, can develop into Dengue Haemorrhagic Fever (DHF).Patients can present with bleeding. In such cases the patient should be immediately admitted to the hospital. In case of severe disease, it can develop into a more severe form known as Dengue Shock Syndrome (DSS). The initial symptoms of Dengue fever, Dengue Haemorrhagic fever and Dengue Shock Syndrome (DSS) may be similar and difficult to differentiate.

Diagnostic Tests

The diagnosis of this disease is based upon careful observations of the symptoms accompanied with various blood tests.

PREVENTIVE MEASURES AND CONTROL

This disease can be controlled by following the famous saying that "Prevention is better than cure". The best way to avoid this disease is to minimize the chances of contact between the mosquito and the human being. For this purpose people should wear clothes with long sleeves, use mosquito nets and coils, mosquito repellents to keep themselves secure from the mosquito bites.

At household level, every corner of the house should be sprayed with some suitable insect killer and the principles of hygiene should be strictly observed. The water should not be allowed to stand at any place such as flower pots, air cooler, flower vases and the places where animals drink water. Work at community level for spray of insecticides all around your houses, streets etc.

PATIENT MANAGEMENT

The patient is a person who suffers from a disease. A complete understanding of the symptoms of the disease as it progresses through different phases is very important in this regard.

Early Phase

Since this phase is marked by high fever, care should be taken to prevent the rise in temperature. In case of high grade fever sponging with moderately cold water should be done. Paracetamol should be given to the patient on doctor's advice to subside temperature and pain.

Later Phase

The later phase is characterized by the rapid decrease in the fluid level of the patient; therefore the appropriate level of fluid should be maintained in the body of the patient by giving fresh juices or ORS (Oral Rehydration Salt).

In severe cases the patient enters into a condition of unconsciousness or shock. He should be immediately admitted to a hospital and instructions of the doctor should be strictly followed.

EXERCISE

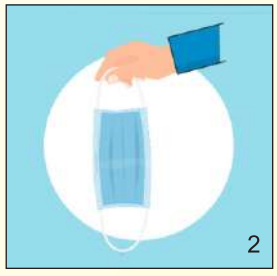
Q.1: What are the symptoms of dengue fever ?

Q.2: Which preventive Measures should be taken against dengue ?

CORONA VIRUS

Use of mask protect the normal person from corona patient. You should use mask when you are out side the house in market, banks, or any public place. Proper use, and cleaning of masks also affects how well they protect you. Follow these steps for putting on and taking off your mask:

Wash your hands before touching the mask.



Inspect the mask for tears or holes.

Adjust the mask to your face without leaving gaps on the sides.

Cover your mouth, nose and chin.

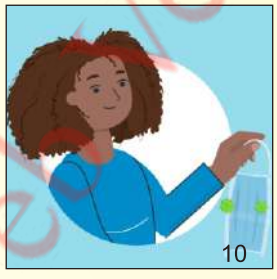
Find the top side where the metal piece or stiff edge is.

Place the metal piece or stiff edge over your nose.

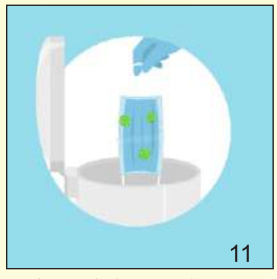
Ensure the colored-side faces outwards.

Avoid touching the mask.

Romove the mask from behind the ears or head.



Keep the mask away from you while removing it.



Discard the mask immediately after use preferably into a closed bin.

Wash your hands after discarding the mask.

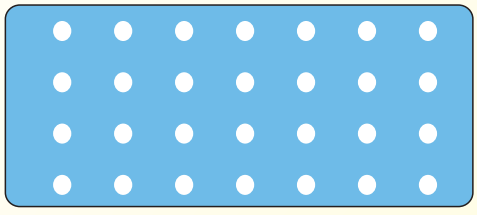
Be careful

Don't put masks on anyone who has trouble breathing or is unconscious or otherwise unable to remove the mask without help.

Don't put masks on children under 2 years of age.

THE METHOD OF MAKING MASK

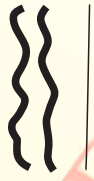
Materials



Cloth

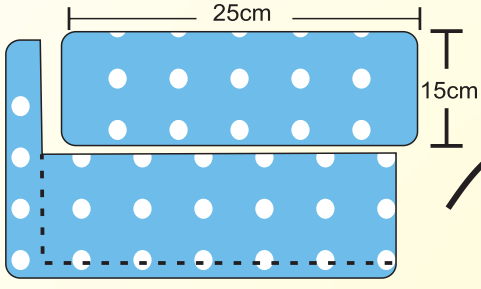
Scissors

Needle and thread

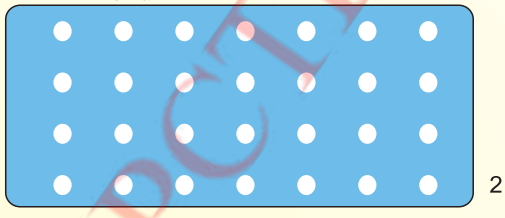


Elastic

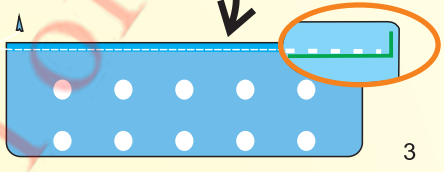
Kitchen paper



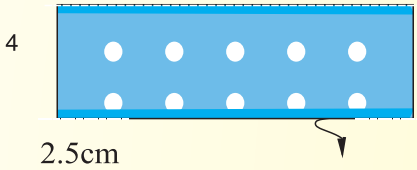
Cut two cloth rectangles 25cmx15cm



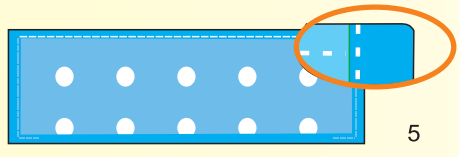
Place on top of each other, lengthways



Fold over the top of the fabric 0.6cm and stitch all the way across

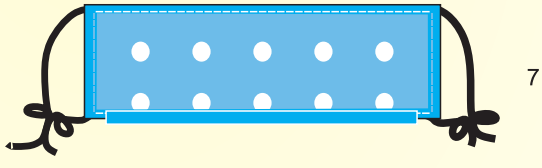


Fold the bottom up and stitch 2.5cm inwards from the edge on either side - this will create a filter pocket



Fold the shorter sides in about 1cm and stitch - leaving a gap to thread elastic

Thread a 15cm piece of elastic through the hem on one side and tie the ends. Repeat on the other side



Put kitchen paper inside pocket as filter

Gather the side of the mask on the elastic and adjust so the mask fits your face. Then, stitch the elastic in place.

Activity : The student should make the mask at home and then bring it to the class to show it to the teacher.

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