Note: Try and do objectives given at the end of the chapter. Answers will be shared later.

5 Motions of the Earth

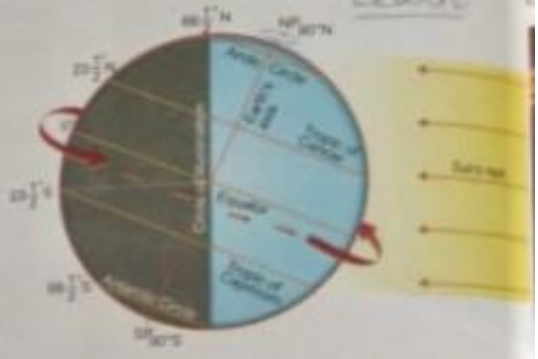
When we look out from a moving train we find that all objects — trees, houses, fields, pillars — seem to move past us while we are stationary. But actually it is we, inside the train, who are moving, not the objects outside. Similarly, the Earth and along with it, everything on it including us, is in motion.

The Earth may seem to be still beneath our feet but it is actually moving. It is spinning around its own axis as well as circling around the Sun along an **elliptical orbit**. These two **motions of the Earth** are known as **rotation** and **revolution respectively**.

ROTATION

The daily **spinning movement** of the Earth from west to east on its own axis is termed as **rotation**. The imaginary line, axis of the Earth, is tilted at an angle of 23½° to the vertical plane. It makes an angle of 66½° to the orbit or path of Earth's revolution around the Sun, known as **orbital plane**.

This tilt of the Earth remains fixed even when it revolves round the Sun. This is called the **inclination of the Earth's axis**. The northern tip of the axis is called the North Pole while the southern point is called the South Pole.



Day and Night

EFFECTS OF ROTATION

If you wake up early in the morning, you will notice that the darkness of the night gradually fades away with the break of the dawn. Gradually, the Sun rises in the east and

In the morning, the Sun looks as though it is rising your part of the Earth gradually turns to face it.

stationary — not moving
beneath — below or under something
vertical — perpendicular line
dawn — the time of day when light first appears in the sky, just before sunrise

lights up the Earth for the entire day. In the evening, the Sun sets in the west and night comes after dusk. In truth, however, it is the Earth that changes its position and not the Sun.

This important *phenomenon of day and night* is an outcome of the spherical shape of the Earth and its rotation on its axis.

In the evening, the Sun seems to sink down in the sky, as your part of the Earth turns away from it.

STAR FACT

The Earth takes 23 hours, 56 minutes, 6 seconds, *i.e.*, approximately 24 hours, to complete one rotation. This is termed as the Earth Day.

The portion of the Earth that faces the Sun receives the Sun's rays and experiences day while the other half, which is on the other side, away from the Sun, experiences darkness or night. The imaginary line that separates the lighted portion of the Earth (day) from the dark one (night) is termed as the **circle of illumination**.

In between day and night is a period of diffused light termed as dawn and dusk or twilight. When the Sun has not yet appeared on the horizon, but there is faint light in the surroundings at daybreak, it is termed as **dawn**. The Sun's rays are slanting at this time. Noon is the period of maximum heat as the Sun rays are vertical at this time of the day. After the Sun sets in the evening, there is a period of faint light before total darkness of night. This is termed as **twilight** or **dusk**.

As the Earth rotates from west to east, the sun, the moon and the stars seem to move from east to west. The concept of sunrise and sunset also gives us a sense of direction based on the position of sun as viewed from Earth. The sun rays are vertical at noon and slanting in the morning and evening. You can understand this by observing your shadow during the daytime.

REVOLUTION

The annual movement of the Earth around the Sun along a fixed path is called revolution. The fixed elliptical path along which the Earth revolves is called its orbit.

The Earth revolves along its orbit at a speed of 29.6 km per second. It takes 365 days 5 hours 48 minutes 46 seconds (approximately 365¼ days) to complete one revolution. For the sake of convenience 365 days is taken as a single year. The extra quarter of a day adds up to make a whole day in a period of four years.

Thus, we have a year with 366 days every four years. It is termed as a leap year. February 29 is the additional day added to compensate the difference of the common year (365¼).

The year 2016 was a leap year. Can you say which was the first leap year of this century? When will you again have a leap year?

dusk – the time of day when the light has almost gone, but it is not yet dark
faint – that can not be clearly seen
convenience – something that can make things easier, quicker or more comfortable
compensate – to reduce the effect of loss

CHECK YOUR KNOWLEDGE

Distinguish between dawn and dusk.

Dawn	Dusk

EFFECTS OF REVOLUTION

The revolution of the Earth along with its inclined axis determines the **primary distribution of the Sun's energy** throughout the Earth. Its primary effect is the **occurrence of different seasons** throughout the Earth. The **varying lengths of day and night** throughout the Earth are a result of this.

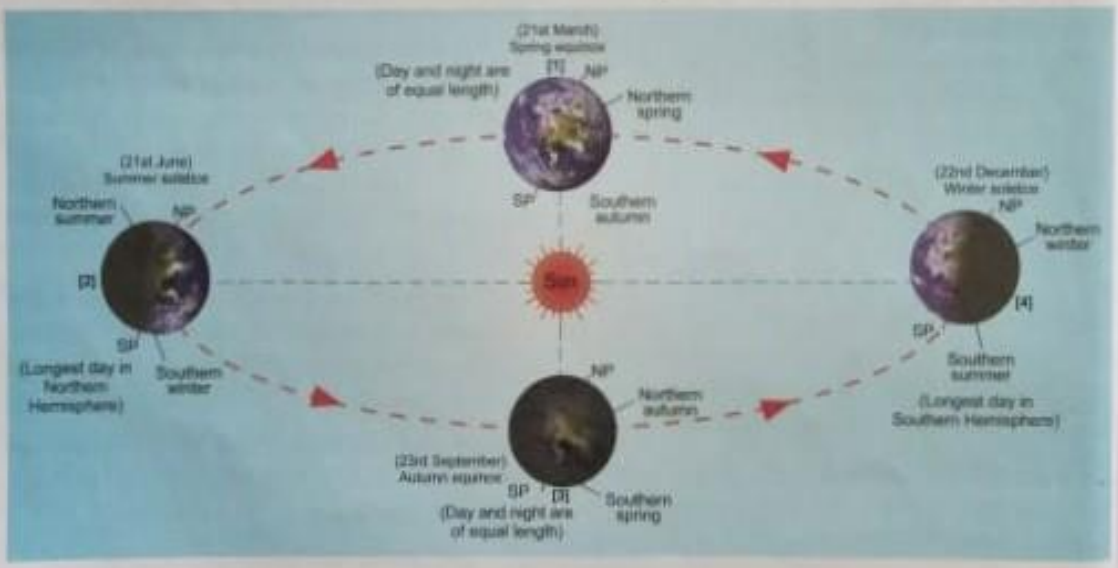
PHENOMENON OF SEASONS

The entire year is divided into four seasons – spring, summer, autumn and winter. It is based on the tilt of the Earth's axis and revolution which positions the places nearer or farther from the Sun. It determines the intensity of Sun's energy received by that place at a particular time of year, and hence warm or cold weather.

The given figure shows the position of the Earth in its annual journey around the Sun. The main reason why we experience seasons is because the Earth's rotational axis is not perpendicular to the orbital plane. Because of the axial tilt, the angle of the sun's rays hitting a point on the Earth's surface, changes with time in a year.

EQUINOX

On **21st March** and **23rd September** the Sun shines vertically overhead on the equator at midday. (Position 1 & 3 in given figure). The day and night are of equal duration throughout the world. These two days are termed as '**equinoxes**' meaning 'equal nights'. **21st March** is termed as



Revolution of the Earth and the phenomenon of seasons

autumn — the season of the year between summer and winter

equator — an imaginary line around the earth at an equal distance from the North and South Poles

the **Spring** or **Vernal Equinox**. The Northern Hemisphere experiences spring at this time, while the Southern Hemisphere experiences autumn.

On **23rd September**, termed as **Autumn Equinox**, the Northern Hemisphere experiences autumn, while the Southern Hemisphere experiences spring. It is neither very hot nor very cold in any hemisphere.

DO AND LEARN

Name four seasons.

_____, _____.

_____, _____.

SOLSTICE

A solstice is the day when the midday Sun shines vertically overhead at one of the tropics, i.e., Tropic of Cancer and Tropic of Capricorn, and the duration of the day is the longest in that hemisphere. Two solstices are: Summer solstice (Position 2) and Winter solstice (Position 4).

On 21st of June, the Tropic of Cancer (23½°N) receives the direct rays of the Sun. The Northern Hemisphere receives maximum warmth and sunlight and experiences summer season. Days are longer than nights during this period. Places in the Northern Hemisphere experience longest day and shortest night on 21st June (Summer solstice).

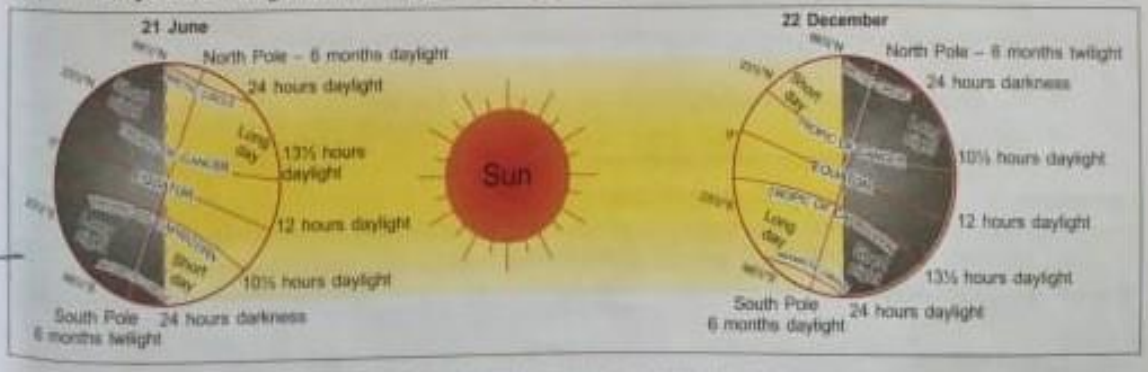
The North Pole is tilted towards the Sun and places beyond the Arctic Circle experience daylight for 24 hours for six months at the North Pole. Conditions are reversed in the Southern Hemisphere which experiences winter during this period.

On 22nd December, the Tropic of Capricorn (23½°S) receives the direct rays of the Sun.

The Southern Hemisphere experiences summer with longer days and shorter nights. The South Pole is tilted towards the sun. Places beyond Antarctic Circle have continuous daylight for 24 hours on this day, while places beyond Arctic Circle in the Northern Hemisphere have 24 hours darkness on this day. The South Pole receives six months of daylight during this period while the North Pole has continuous darkness for six months. This day is termed as Winter Solstice with the Northern Hemisphere experiencing winter.

DISCUSS

The sun rises in the east and sets in the west. Why?



Position of the Earth on 21 June and 22 December

solstice — the two days in a year when the sun's rays fall vertically on the Tropic of Cancer and Tropic of Capricorn
tilt — position with one side or end higher than the other

LET US RECALL

- The daily spinning movement of the Earth from west to east on its own axis is termed a rotation.
- The Earth rotates at a speed of about 1600 km per hour at the equator, 1200 km per hour at 45 °N and 45°S, and the speed further decreases at the Poles.
- 21st March is termed as the Spring or Vernal Equinox.
- On 23rd September, termed as Autumn Equinox, the Northern Hemisphere experiences autumn while the Southern Hemisphere experiences spring.

THINK & ANSWER

A. Tick (✓) the right answer.

1. The annual movement of the Earth around the Sun is called
   (a) Rotation (b) Revolution (c) Orbit
2. The phenomenon of change of seasons is caused due to
   (a) Rotation (b) Revolution (c) Movement of the Sun
3. A leap year has
   (a) 365 days (b) 365¼ days (c) 366 days
4. Which of the following was not a leap year?
   (a) 2008 (b) 2012 (c) 2010
5. On which of the following days, the day and night are of equal duration throughout the w
   (a) 21st March and 23rd September
   (b) 28th March and 21st September
   (c) 3rd March and 1st September
6. The Tropic of Capricorn receives the direct rays of the Sun on
   (a) 21st June (b) 22nd December (c) 21st March

B. Match the following.

1. Motions of the Earth	(a) Season
2. Noon	(b) Equal day and night
3. February	(c) Time of maximum heat
4. Spring	(d) 28 or 29 days
5. Equinoxes	(e) Rotation and Revolution

C. Fill in the blanks. Choose words from the box.

east	four	leap	23½°	29.6

1. The entire year is divided into _____ seasons.
2. The Earth revolves along its orbit at a speed of _____ km per second.
3. The Earth rotates from west to _____.
4. The imaginary line, axis of the Earth, is tilted at an angle of _____ to the vertical plane.
5. The year 2016 was a _____ year.

D. Write (T) for the true and (F) for the false statements.

1. The equator experiences six months of daylight during summer. _____
2. On Summer Solstice the rays of the Sun fall vertically on the Tropic of Cancer. _____
3. February in a leap year has 29 days. _____
4. Direct rays of the Sun fall on the equator on 21st March. _____
5. The speed of the Earth's revolution along its orbit is 29.6 km per second. _____

E. Answer the following questions.

1. Name the two motions of the Earth.
2. Which motion of the Earth causes the phenomenon of day and night?
3. What is the direction of rotation of the Earth?
4. What is the exact time taken by the Earth to complete one revolution?
5. When do the Summer and Winter Solstices occur?
6. Describe the main effects of the Earth's rotation.
7. Describe the main effects of the Earth's revolution.

ACTIVITY

1. Make a diagram to show the inclination of the earth.
2. Perform an experiment to demonstrate the phenomenon of day and night.
3. Go on a trip to a seaside or a hill station with your parents. Take photographs of sunrise and sunset. Calculate the total duration of day and night. Link it with the date of the year and the season. Draw conclusions and share them with your friends.