CHAPTER

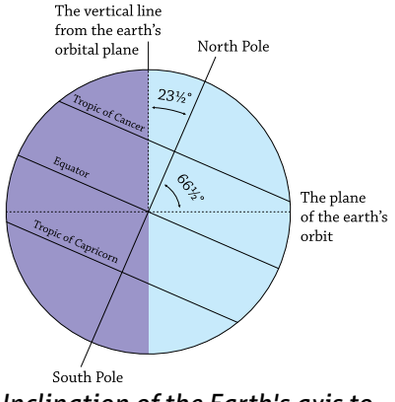
3 MOTIONS OF THE EARTH

GEOGRAPHY

All the planets move on their own axes, spinning like a top. We call this movement as **rotation**. Besides rotating, they move around the Sun on their fixed path or orbit. This movement is called as **revolution**. Our planet Earth also spins on its axis while revolving round the Sun.

Rotation of Earth

The daily movement of the Earth on its axis from west to east is called rotation of Earth. It is similar to the spinning of a top. It takes about 24 hours to complete one rotation. The period of rotation is known as the *earth day*. This is the daily motion of the Earth. The axis of the Earth is an imaginary line joining the North Pole to the South Pole. **This axis is tilted at an angle of 66½° to the plane of the Earth's orbit around the Sun**. The tilt is in the same direction and at the same angle throughout the year. Tilt means inclination. The Earth moves west to east, so the Sun appears to be moving east to west.



Inclination of the Earth's axis to its orbital plane

Rotation of Earth Causes Day and Night

Activity : Put a globe in a dark room in front of a lighted torch. We can see that only the half of the globe facing torch is lit up. The other half is in darkness. Rotate the globe slowly from left to right. We find that gradually the part that was in darkness, moves into the lighted area.

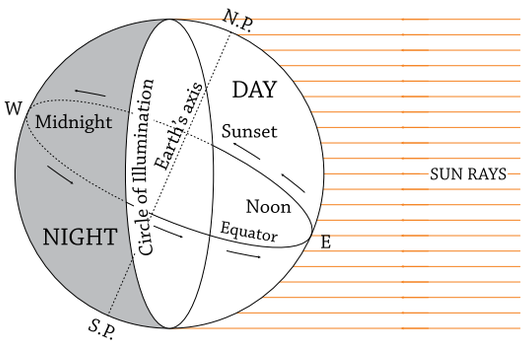
Similarly, when the Earth rotates on its axis, one half of it faces the Sun and has day. The other half remains in darkness and has night. When the Sun is directly overhead at any point on the Earth's surface, the time *at that place* is twelve noon. The time of the day after twelve noon when the same area has moved eastwards, is said to be **afternoon**. The brief period of diffused light between Sunset and complete darkness is called **dusk**. The time before noon is called **morning**. The brief period of diffused light between Sunrise and full day is called **dawn**.

The Sun's rays are slanting in the morning and evening. Slanting rays spread over a longer area and give less heat per unit area. The Sun's rays are vertical at noon. Vertical rays fall over a small area and give more heat per unit area.

If the Earth would not have rotated daily, one half of it facing the Sun would have permanent daylight and would be extremely hot. The other half of it away from the Sun would have permanent darkness (night) and would be freezing cold. Life would not be possible in such extreme conditions.

Effect of Inclination of the Earth's Axis

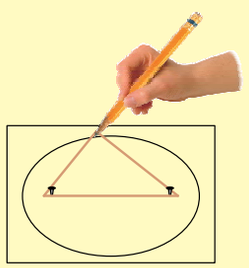
As a result of the inclination (tilt) of the Earth's axis, the circle of illumination (the circle dividing the lighted part of the Earth from the dark half is not from pole to pole. Therefore, the length of days and nights is not equal throughout the year.



If the axis of the Earth would have been vertical to the plane of the Earth's orbit, the Sun's rays would have fallen in *the same manner all year round at any particular place*. Thus, the length of days and nights would have been equal throughout the year. But at the Equator they are of the same duration as the sunrays fall always vertical there. In areas located away from the Equator, there are more hours of sunlight on summer days than on winter days. The poles alternately have continuous daylight for six months followed by darkness for six months.

Revolution

The movement of the Earth in its orbit around the Sun **in an anti-clockwise direction** is called **revolution**. The Earth performs its rotation and revolution simultaneously. Orbit is the fixed route which the Earth follows while revolving around the Sun. The period taken by the Earth to complete one revolution is 365 days and 6 hours. 365 days is known as a calendar year for the sake of convenience These 6 hours add up to one extra day in four years. This one day is added to the fourth calendar year so that it has 366 days.



Elliptical Orbit of the Earth : The Earth is going around the Sun in an elliptical (elongated) orbit. Elliptical orbit means an orbit the shape of which is an ellipse. An ellipse is not a complete circle. To draw an ellipse take a pencil, two pins and a loop of thread. Fix the pins on a paper. Put the loop so that it incloses the two pins inside the loop. Now hold the pencil and draw the line keeping the thread tight and moving the pencil along it.

A year having 366 days is called a leap year. The surplus day is added to the month of February. Every fourth year the month of February has one extra day i.e. it has 29 days instead of the usual 28 days.

Effects of Revolution of the Earth

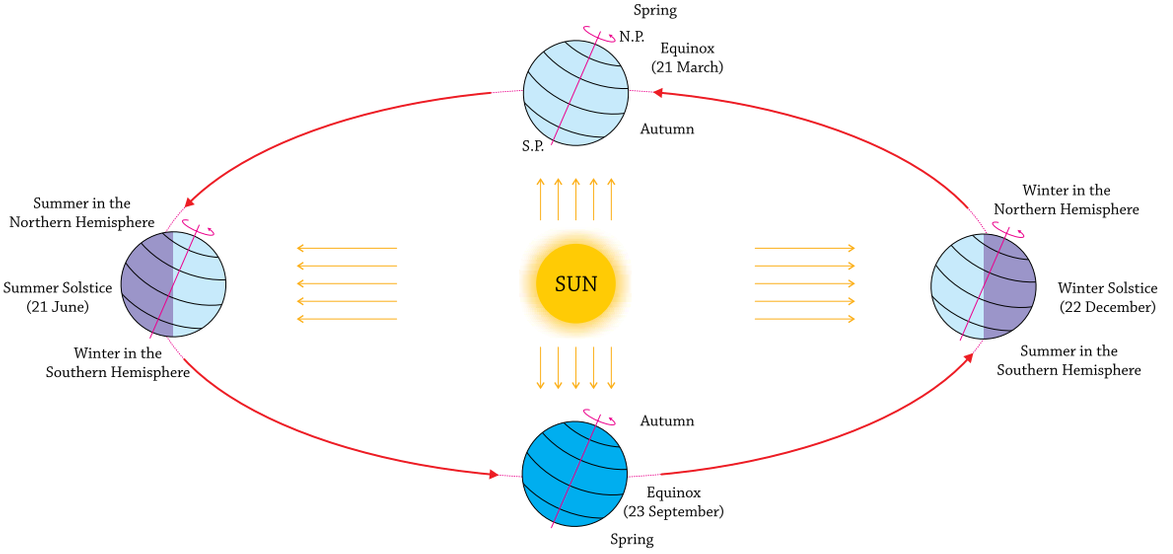
Seasons are parts of the year marked by temperature differences and particular daylight hours and weather. The revolution of the Earth and the tilt or inclination of the Earth's axis in the same direction throughout the year result in the change of seasons. The year is divided into four

seasons — spring, summer, autumn and winter. Seasons change due to the change in the position of the Earth around the Sun. The seasons are each of 3 months' duration in **mid latitudes**. In **subtropical areas** only three seasons are experienced. These are summer, winter and rainy season. **Around the equator** only two seasons summer and winter are experienced that too with small changes. **Around the poles** summer and winter are each of 6 months duration. While winter is very cold, summer is not much warm in polar regions.

Look at the figure, how the Earth is placed in relation to the Sun on four days of the year — 21 June, 23 September, 22 December and 21 March.

Summer Solstice for the Northern Hemisphere

On 21st June, the Northern Hemisphere is tilted towards the Sun. The rays of the Sun fall directly (vertically) on the Tropic of Cancer. As a result, these areas receive more heat. The areas near the poles receive less heat as the rays of the Sun are slanting. As the North Pole is inclined towards the Sun; the region from the North Pole to the Arctic Circle is under the continuous sunlight for 24 hours. Norway and Sweden are the two countries where the phenomena of **Midnight Sun** is seen. The region experience continuous daylight for about six months. Since a large portion of the Northern Hemisphere is getting light from the Sun, it is summer in the regions of the north of the Equator. This position of the Earth is called the **Summer Solstice** for the Northern Hemisphere. The longest day and the shortest night at these places occur on 21st June.



Revolution of the Earth causes Seasons

At this time, all these conditions are reversed in the Southern Hemisphere. The South Pole is away from the Sun in total darkness. There is winter in the Southern Hemisphere. This position of the Earth is called winter solstice for the Southern Hemisphere. It is the shortest day and the longest night in the Southern Hemisphere on 21st June. The region from the South Pole to the Antarctic Circle experiences darkness for 24 hours.

Fact File

Australia lies in the Southern Hemisphere. On 25th December, it is summer season in the Southern Hemisphere. Obviously, people celebrate the Christmas in Australia in the summer season!

Winter Solstice for the Northern Hemisphere

On 22nd December, the Tropic of Capricorn receives direct rays of the Sun as the South Pole tilts towards the Sun. In this way, a larger portion of the Southern Hemisphere gets light. Therefore, it is summer in the Southern Hemisphere with longer days and shorter nights. The reverse happens in the Northern Hemisphere. This position of the Earth is called **Winter Solstice** for the Northern Hemisphere. On this day it is the shortest day and the longest night in the Northern Hemisphere.

The Earth is farthest from the Sun in the Solstice position, 21st June and 22nd December.

Equinox

On 21st March and September 23rd, direct rays of the Sun fall on the equator. At this position, neither of the poles is tilted towards the sun, so, the whole earth experiences equal days and equal nights. This is called an equinox. There are two equinoxes called **autumnal equinox** and **spring** or **vernal equinox**.

On 21st March, it is spring season in the Northern Hemisphere and autumn season in the Southern Hemisphere. The opposite is the case on 23rd September, when it is autumn season in the Northern Hemisphere and spring season in the Southern Hemisphere.

From the position of 21st June, the day in the Northern Hemisphere begins to decrease and nights begin to increase, till it is 23rd September, when it is autumnal equinox in the Northern hemisphere, i.e., day and night are of equal duration. Opposite is the case in the Southern Hemisphere.

Thus, the rotation and revolution of the Earth on its tilted axis causes day and night of different durations and changes in the seasons.

Adaptation of Animals to Different Climates

The climate of a place influences its vegetation, animal life, crops, food, clothing, occupation, housing and activities. People and animals adapt to climatic conditions in different ways. This is how the people and animals in different regions have different ways of living.

Animals like polar bears, reindeers and dogs living in cold climate generally have thick fur (polarbears) or a thick layer of fat below their feathery coat (penguins). This keeps the body warm. When there is winter in the Northern Hemisphere, many birds migrate to Southern Hemisphere to escape unfavourable cold weather conditions. They return after the winter is over.

Some animals like frogs, snakes, snails and bats go in a state of dormancy (inactivity) to escape the biting cold or summer heat in mud burrows or caves. They breathe slowly and their heart also beats slowly. During winter they get the energy from the fats stored in their bodies before winter. They get up from their sleep after winter or summer.

Key Words

- Equator : circular line around the globe halfway between the poles.
- Rotation : the movement of the Earth on its axis west to east.
- Inclined Axis : the tilt of the Earth at an angle of 66½° to its orbital plane.
- Circle of Illumination : the circle dividing the lighted part of the Earth from the dark half.
- Revolution : movement of the Earth around the Sun.
- Solstice : each of the two times in the year on 21st June (Summer Solstice) and 22nd December (Winter Solstice) when Earth is at its highest and lowest duration of the day in the Northern Hemisphere respectively.
- Equinox : each of the two times in the year on 23rd September (Autumn Equinox) and 21st March (Spring Equinox for Northern Hemisphere) when duration of days and nights is equal throughout the world.

SUMMARY

- The Earth takes about 24 hours to rotate once upon its axis.
- The rotation of the Earth causes day and night.
- The Earth moves west to east, so the Sun appears to be moving from east to west.
- The Earth's movement round the Sun on its orbit is called the revolution.
- The Earth's orbit is elongated, which is called the ellipse.
- The Earth takes 365 days and six hours in one revolution. The six hours add up to 24 hours, i.e., one extra day in four years. This extra day is added to February every fourth year, called the leap year.
- The Sun rays fall vertically over the Tropic of Cancer in Summer Solstice for the Northern Hemisphere and over the Tropic of Capricorn in Winter Solstice for the Northern Hemisphere too.
- In equinoxes, the Sun shines over the Equator making the days and nights of equal duration all over the world.

Exercise Time

A. Tick (✓) the only correct choice amongst the following :

1. The movement of the Earth around the Sun is known as :
   a. Illumination b. Inclination c. Rotation d. Revolution
2. Cycle of seasons is caused due to :
   a. Rotation b. Revolution c. Gravitation d. Illumination
3. Christmas is celebrated in summer in :
   a. Britain b. Japan c. India d. Australia
4. Direct rays of the sun fall on the equator on :
   a. 22 December b. 25 December c. 21 March d. 21 June
5. On which period does the Sun rays fall vertically over the Tropic of Cancer :
   a. Summer Solstice b. Winter Solstice c. Spring Equinox d. Autumnal equinox

B. Match the following :

1. 21st June	a. Spring Equinox for Northern Hemisphere
2. 21st March	b. Summer Solstice for Northern Hemisphere
3. 23rd September	c. Winter Solstice for Northern Hemisphere
4. 22nd December	d. Autumnal Equinox for Northern Hemisphere

C. Fill in the blanks :

1. The daily motion of the Earth is _____.
2. The Earth travels around the Sun in _____ orbit.
3. The Sun's rays fall vertically on the Tropic of _____ on 22nd December.
4. The tilt of the Earth's axis is in the _____ direction and at the _____ angle throughout the year.
5. The revolution and tilted axis of the Earth cause _____.

D. Write true (T) or False (F) against the following statements in given brackets :

1. The Earth revolves round the Sun in 365 days and 8 hours. [ ]
2. The direction of the revolution is from east to west. [ ]
3. On 22nd December it is Summer Solstice in Southern Hemisphere. [ ]
4. The axis of the Earth is tilted at an angle of 66½° to its orbital plane. [ ]
5. The circle of illumination is from pole to pole. [ ]

E. Answer in one word or one pharse :

1. What is the angle of inclination of the Earth's axis with its orbital plane ?
2. What is a leap year ?
3. When are the days and nights equal throughout the Earth ?
4. Name the elongated orbit of the Earth round the Sun.
5. When will be the next leap year ?

F. Answer these questions briefly :

1. What is the earth day ?
2. Why do Northern and Southern Hemispheres experience summer solstice in different times of the year ?
3. Why do the poles experience about six months day and six months night ?
4. How is summer caused in the Northern Hemisphere ?
5. What happens on the autumnal equinox ?
6. When is the spring season caused in the Southern Hemisphere ?
7. How are days and nights caused ?

G. Answer these questions in detail :

1. What do you understand by two kinds of movement of the Earth ? Discuss effects of rotation of the Earth.
2. What are the effects of the revolution of the Earth ?
3. Why does the Southern Hemisphere experience Winter and Summer Solstice in different times than that of the Northern Hemisphere ?
4. Why is noon warmer than morning or evening ?

PROJECT WORK

1. Make a drawing to show the inclination of the Earth.
2. Spin a top. Notice its two motions, moving forward while rotating on its own axis.
3. Draw a chart showing the movement of the Earth in its orbit and change of seasons.