Motions of the Earth

Summary

- **1.** Rotation of the Earth is the spinning of the Earth on its axis from west to east, resulting in the occurrence of day and night on the Earth.
- **2.** Revolution is the movement of the Earth around the Sun in a fixed elliptical orbit over a period of one year.
- **3.** The axis of the Earth is inclined at an angle of 23.5° from the vertical line and 66.5° from its orbital plane.
- **4.** The Earth's revolution and the tilt of the earth's axis, cause seasons on the Earth.
- 5. The summer solstice in the Northern Hemisphere occurs on June 21, when the Sun is directly over the
- **6.** Tropic of Cancer. It results in longest day.
- **7.** The winter solstice in the Northern Hemisphere occurs on December 22, when the Sun is directly over the Tropic of Capricorn. It results in longest night
- **8.** Equinox occurs on March 21 and September 23, when the Sun is directly over the Equator and length of days and nights are equal in both the hemispheres.

The idea of moving around in space and viewing the wonders of the universe may excite you. But do you know, actually we all are space travellers. Our spaceship is the Planet Earth. It is constantly in motion spinning like a top on its axis. That is why we see the Sun rise and set, and day change into night. While rotating on its axis the Earth is also revolving around the Sun in a fixed path called orbit. Hence, we have change of seasons and different climates in different regions.

Earth has two types of motions—rotation and revolution.

ROTATION

The spinning of the Earth on its axis from west to east is termed as the Earth's rotation. An axis is an imaginary line running through the middle of an object. The Earth's axis is not exactly vertical, but inclined at an angle of 23.5° from the vertical. It thus makes an angle of 66.5° with its orbital plane. The plane formed by the orbit is known as orbital plane. One rotation of the earth takes exactly 24 hours and is called a solar day. The Earth's surface moves at the equator at a speed slightly over 1,675 km per hour.

Geography Reveals

If you could look down at the Earth's North Pole, from the space, you would notice that the direction of the Earth rotation is anti-clockwise. If the earth is viewed from above the South Pole, the earth's rotation is clockwise.



Due to the Earth's rotation, the Sun appears to move across the sky from east to west. The Earth's rotation is also responsible for the daily cycle of day and night. The Sun, as you have learnt, is our main source of heat and light. Due to the spherical shape of the Earth, only one half of it gets light from the Sun at a time, while the other half remains in darkness. The circle that divides the lighted part of the Earth from the part in darkness is known as the circle of illumination.

EFFECTS OF THE EARTH'S ROTATION

- It gives us a day of 24 hours.
- The apparent movement of the Sun seems to be from east to west—it is actually stationary.
- It has caused the bulging of the earth at the equator and flattening at the poles.



• It causes day and night.

- It gives us a sense of direction as we see the Sun rise in the east and set in the west.
- It causes the deflection1 of winds and ocean currents.
- It causes tides2 twice a day.

• It also causes dawn and dusk. The period of diffused light before you actually see the Sun in the morning is dawn, and that before total darkness creeps in is dusk or twilight.

Q. What do you think would happen if the earth did not rotate?

Activity

To understand the apparent motion of the Sun

While travelling in a car or a bus, look out of the window. You will feel that the outside world—the trees, buildings, people and everything—moving backwards. But we ' know that it is the car or bus that is moving and not the things outside.

In the same way, when we see the Sun's position changing in the sky, it is in fact the earth that is moving and not the Sun.

Debate

Now that we know that the Sun is stationary and it is the earth that is in motion, is it right to say that the Sun rises in the east and sets in the west?

REVOLUTION

The motion of the earth around the Sun on a fixed path or orbit is called earth's revolution. The orbital speed of the earth around the Sun averages about 30 km/s. It takes 365 days and 6 hours to complete one revolution. This time period is what we call a year.

APHELION AND PERIHELION

Earth's orbit around the Sun is not circular, but oval or elliptical (see figure below). An elliptical orbit causes the distance between the earth and the Sun to vary over the year throughout its orbit the earth is inclined in the same direction. On January 3, the earth is closest to the Sun, at a distance of 147.3 million km. The earth is said to be in Perihelion—pere meaning near and Helios meaning Sun. The earth is the farthest from the Sun on July 4 at a distance of 152.1 million km. The earth is said to be in Aphelion—ap meaning away from, and helios meaning the Sun. The average distance of the earth from the Sun over a one-year period is about 149.6 million km.



The elliptical orbit of the earth causes Aphelion and Perihelion

EFFECTS OF THE EARTH'S REVOLUTION AND THE TILT ON ITS AXIS

Leap Year

As we know, it takes 365 days and 6 hours to complete one revolution, and we call it a 'year7. This fraction of a year 1/4 year was a problem. So, the quarter day adds an extra day to the year every four years Q4 x 4 = 1). Every fourth year has 366 days and is called a leap year. The month of February in a leap year has 29 days.

Change of the Seasons

You know that the axis of the Earth is tilted slightly. This causes one part of the Earth to lean towards the Sun, and the other part to lean away from it. Hence, different parts of the Earth's surface receive varying amounts of sunlight and heat, and we have change in seasons.

The part of the year, when the southern half or the Southern Hemisphere leans towards the Sun, it gets more light and heat, and this causes it to be warmer. Hence during this time of year, the Southern Hemisphere experiences summer.

At the same time, the northern half of the Earth, or the Northern Hemisphere leans away from the Sun. It receives less light and heat, and hence it is cooler. Thus, while the Southern Hemisphere enjoys summer, the Northern Hemisphere is in the midst of winter. As the Earth continues along its orbit around the Sun, eventually, the Northern Hemisphere faces the Sun, and the Southern Hemisphere leans away

from it. During this time of the year, the Northern Hemisphere enjoys summer and the Southern Hemisphere has winter.

VARYING LENGTHS OF DAYS AND NIGHTS

The length of the days and nights vary from place to place even at the same time of the year. This is again due to the tilt of the Earth's axis. When the North Pole is inclined towards the Sun, as one goes towards the pole from the equator, the days become longer and nights are shorter. Places beyond the Arctic Circle (see figure showing varying lengths of days and nights) experience continuous daylight for 24 hours for about six months. It is the summer season in the Northern Hemisphere. The Southern Hemisphere, which is tilted away from the Sun experiences winter. The lengths of the days are shorter and the nights are longer. Beyond the Antarctic Circle, where the Sun's rays do not reach, there is continuous darkness for 24 hours for about six months.



Q. Why is Norway known to tourists as the "Land of the Midnight Sun"?

Varying lengths of days and nights

Solstices and Equinoxes

Solstice means the Sun standing still. Solstice occurs twice each year, when the tilt of the earth's axis is most inclined toward or away from the Sun, causing the Sun's apparent position in the sky to reach its northernmost or southernmost extreme.

Summer Solstice— Earth is positioned in its orbit such that the North Pole is leaning 23.5° towards the Sun. The Sun is directly overhead at shortest night of the June 21 in the Northern Summer solstice Hemisphere is called summer solstice. The Southern Hemisphere experiences the reverse conditions as it is tilted away from the Sun. On 21st June, the Tropic of Capricorn has the longest night.



Summer solstice

Winter Solstice— In the Northern Hemisphere, the winter solstice usually falls on December 22 when the North Pole is tilted away from the Sun. It is the shortest day of the year in the Tropic of Cancer. The Southern Hemisphere has summer at this time. Earth is positioned in its orbit such that the South Pole is leaning towards the Sun. The Sun appears directly over the Tropic of Capricorn. It is the longest day of the year in the Southern Hemisphere.



Q. Can you tell why Christmas is celebrated in summer in Australia?

Equi means 'equal' and nox means 'night', hence the word Equinox is formed. Equinox is the time when we have night and day of equal length all over the earth. Equinox occurs twice a year, when the earth's axis is neither tilted away from the Sun nor towards it and the centre of the Sun is in the same plane as the earth's equator.

Autumn Equinox— **Autumn equinox** in the Northern Hemisphere occurs on 23^{rd} **September** when the 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 day and night of equal lengths. The Southern Hemisphere has spring season at this time.

Spring Equinox— Spring equinox in the Northern Hemisphere occurs **on 21st March** when the direct rays of the Sun falls on the equator again. The whole Earth once again experiences day and night of equal length. The Southern Hemisphere has autumn season at this time.



Seasons, Solstices and Equinoxes

Date	Northern	Northern	Southern	Southern
	Hemisphere	Hemisphere	Hemisphere	Hemisphere
	(Season)	(length of day and	(season)	(length of day and
		night)		night)
21 March: Equinox	Spring	Equal	Autumn (Fall)	Equal
21 March: Solstice	Summer	Longest day	Winter	Shortest day
23 September:	Autumn (fall)	Equal	Spring	Equal
Equinox				
22 December:	Winter	Shortest day	Summer	Longest day
Solstice				