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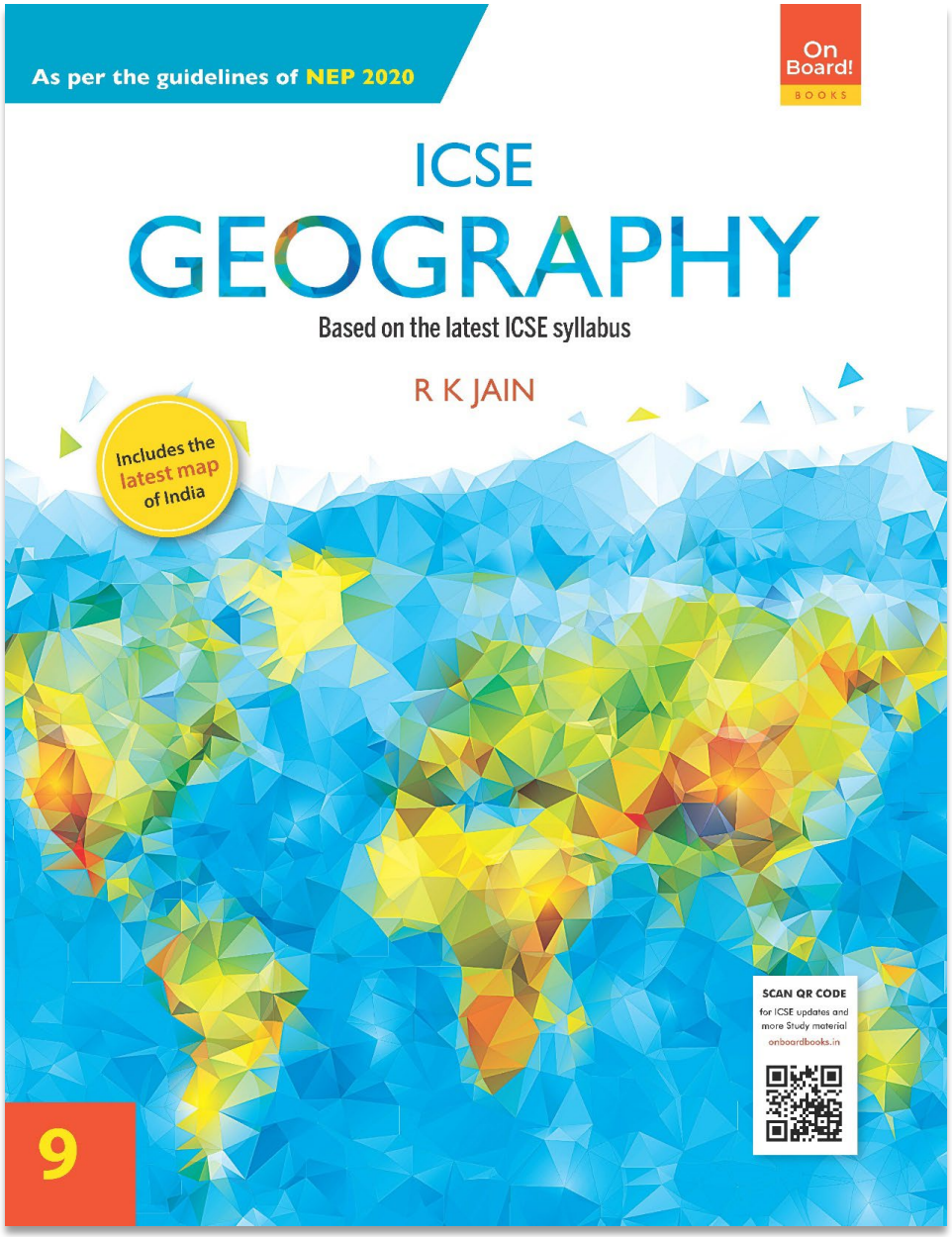
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9

CONTENTS

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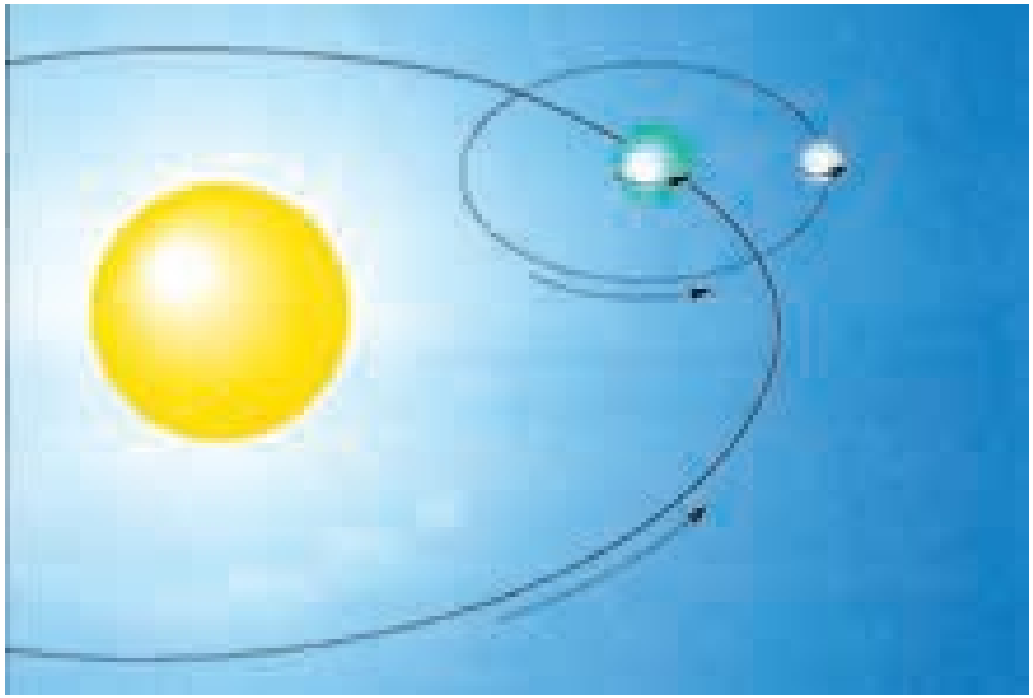
Class 9

Chapter 3: Rotation and Revolution

Nicolaus Copernicus, a Polish astronomer, in the sixteenth century proved that the Earth only appeared to be stationary. Actually, it not only spins on its axis, but also moves around the Sun. Thus the Earth experiences two types of motions:

1. **Rotation** is the movement of the Earth on its axis.
2. **Revolution** is the movement of the Earth around the Sun.

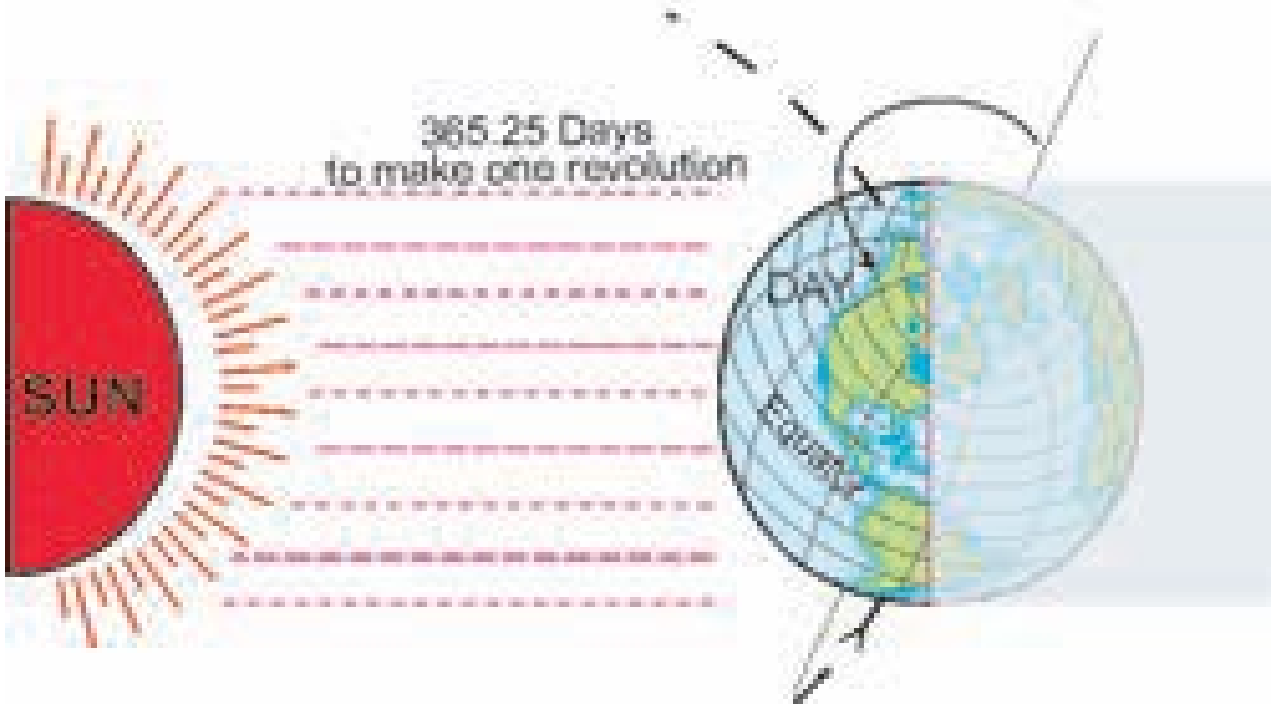


Motions of the Earth

ROTATION OF THE EARTH

- The Earth rotates on its axis from west to east. The **axis** is an imaginary line passing through the centre of the Earth.
- The two end points of the Earth's axis are called the **North Pole** and the **South Pole**.

- The time taken by the Earth to complete one rotation on its axis constitutes a day.
- The rotation of the Earth can be counted in the same way as a rider on a merry-go-round counts his rotations by noticing a fixed object which is outside the merry-go-round.



Rotation of the Earth

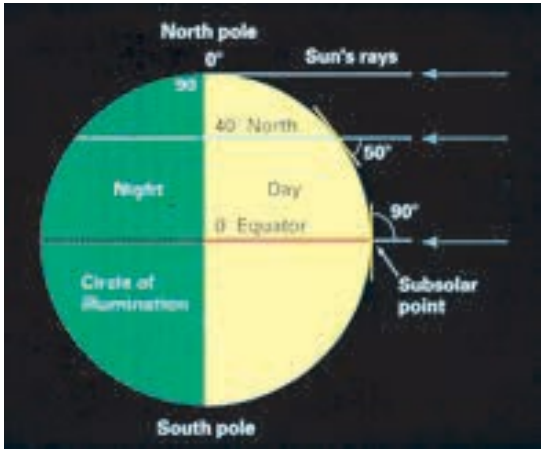
- Due to the rotation of the Earth, half of the Earth's surface receives light from the Sun and experiences day, the other half of the Earth's surface is turned away from the Sun and is in darkness, thus experiences night.

- There are more hours of sunlight during the summer season than during the winter season, especially in places located far away from the equator.

- The poles experience six months of complete daylight followed by six months of darkness. The answer lies in the inclination of the Earth's axis, which is inclined at an angle of 66½° from the plane of ecliptic or 23½° from the vertical. other stars from

Rotation at the pole and at the equator

- This inclination of Earth's axis is always in the same direction, i.e. towards the Pole Star in the celestial sphere.
- The apparent movement of the celestial or heavenly bodies like the Sun, the Moon and other stars from east to west is an illusion created by the rotation of Earth on its axis from west to east.
- The Earth takes about 24 hours or one day to complete one rotation on its axis. Thus the rotation of the Earth is also known as its **daily motion**.



The Circle of Illumination on a vertical Earth

EFFECTS OF THE EARTH'S ROTATION

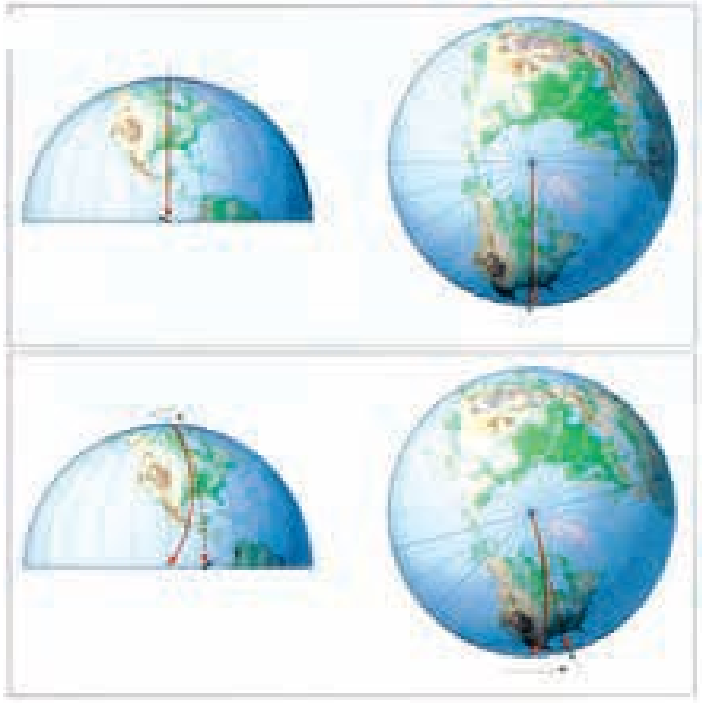
1. From any point on the surface of the Earth, the Sun, the Moon and other heavenly bodies appear to move from east to west. This is comparable to the experience of a person sitting in a moving train and getting the impression that objects such as trees, buildings, etc. are moving in the opposite direction.

2. The alternate occurrence of day and night is experienced everywhere on the Earth's surface. The Earth does not have any light of its own. The rays of the Sun on reaching the Earth illuminate the side facing the Sun, while the other half which is turned away from the Sun, lies in darkness.

3. The rotation of the Earth has resulted in the flattening of the Earth at the poles and bulging at the equator. Thus the shape of the Earth is not a perfect sphere, but an **oblate spheroid**.

4. The Earth rotates on its axis from west to east and so the Sun appears to rise in the east. Once the direction of the rising Sun is known, it is easy to find out other directions such as west, north and south.

5. The Earth's rotation deflects the air and the ocean currents towards the right in the Northern Hemisphere and towards the left in the Southern Hemisphere. Such deflections are due to the **Coriolis effect**



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The Coriolis effect

REVOLUTION OF THE EARTH

Apart from rotating on its axis, the Earth also revolves around the Sun on a fixed path. This motion of the Earth around the Sun is called **revolution**. The Earth takes about one year to complete one revolution. Thus, it is also called the **annual motion** of the Earth.

Leap Year

The time taken by the Earth to complete one revolution around the Sun is 365.242 days, i.e. about one-fourth day more than the calendar year of 365 days. So after every four years, the extra one-fourth day add up to about one full day. This day is added to the month of February and the year consists of 366 days. This year and the extra day are called the **leap year** and the **leap day** respectively.

Elliptical Path

The fixed path along which the Earth revolves around the Sun is called the **orbit** of the Earth. The shape of the Earth's orbit is not circular, but is **elliptical**

Position of the Earth

The Earth is nearest to the Sun on or about 3 January and the distance between the Earth and the Sun is about 146 million km. This position is called **perihelion** (**peri** means near and **helios** means Sun). The Earth is at its farthest point from the Sun on about 4 July and the distance between the Earth and the Sun is about 151 million km. This position is called **aphelion** (**ap** means away from and **helios** means Sun).

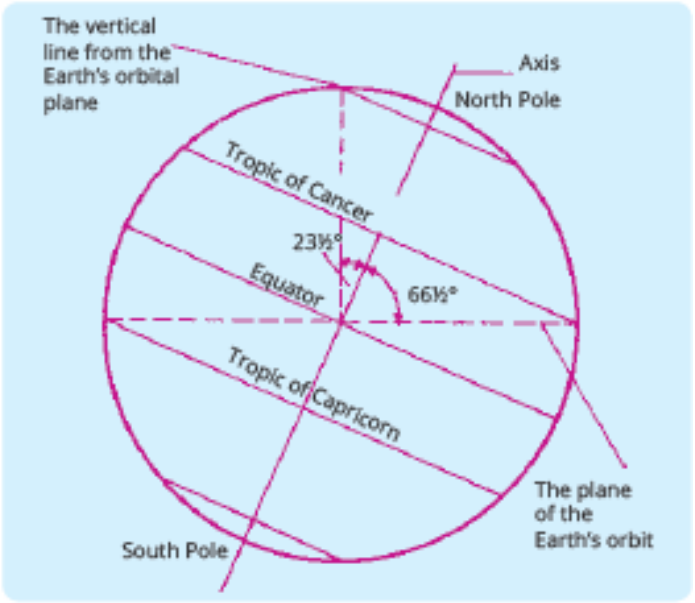
The position of the Earth with respect to the Sun

INCLINATION OF EARTH'S AXIS

The axis of the Earth always maintains two peculiar properties:

a. Its inclination with the plane of ecliptic is at an angle of 66½o or tilted at about 23½o away from the perpendicular to the plane of ecliptic.

b. The axis always points towards the Pole Star. As the Pole Star is at an infinite distance from the Earth, the axis of the Earth always remains inclined in the same direction.



The inclination of Earth's axis

The following observations are noted in course of the Earth's revolution:

a. The Earth receives perpendicular rays of the Sun on the Tropic of Cancer on 21 June. At this time the Northern Hemisphere receives more heat and light. The days are longer and the nights are shorter in the Northern Hemisphere. This position is called **summer solstice** in the Northern Hemisphere and **winter solstice** in the Southern Hemisphere.

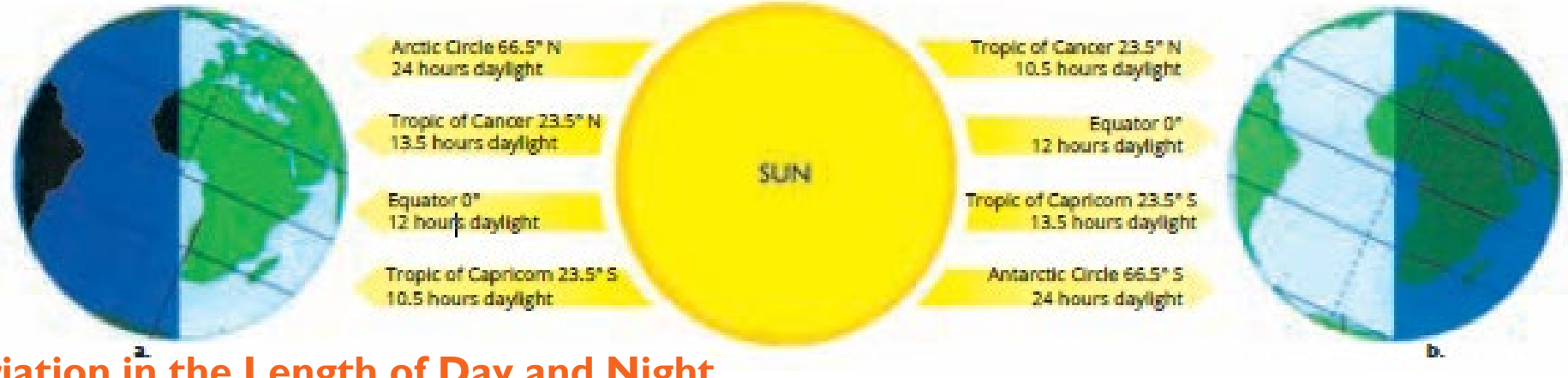
b. On 22 December the position of the Earth is reversed. The Sun shines vertically over the Tropic of Capricorn. Now the Southern Hemisphere is inclined towards the Sun while the Northern Hemisphere is away from the Sun. This position is known as the **summer solstice** in the Southern Hemisphere. At this time the Northern Hemisphere enjoys the winter season and is known as the **winter solstice** in the Northern Hemisphere.

c. The Earth maintains its position towards the Sun in such a manner that the Sun shines vertically over the equator on 21 March and 23 September. The Earth is said to be in the **spring** and the **autumnal equinoxes** respectively on these dates.

EFFECTS OF THE EARTH'S REVOLUTION

The following are some of the effects caused by the revolution of the Earth.

1. Variation in the length of day and night.
2. The phenomenon of seasons.



Variation in the Length of Day and Night

The variation in the length of days and nights on the Earth's surface is due to the inclination of the Earth's axis.

- On **21 March**, the Sun shines vertically over the equator and all places along the equator experience day and night of equal duration, i.e. 12 hours.
- From **22 March** to **20 June**, the length of the day increases in the Northern Hemisphere and is always more than 12 hours. In the Southern Hemisphere, the length of the night increases and is always more than 12 hours.
- On **21 June**, the Sun shines vertically over the Tropic of Cancer.

- From **22 June** to **22 September**, the days become shorter in the Northern Hemisphere, but they are still longer than the nights (the day time is more than 12 hours).
- On **23 September**, the Sun shines vertically over the equator and all places along the equator experience day and night of equal duration, that is 12 hours.
- From **24 September** to **21 December**, the days start becoming shorter and are less than 12 hours in the Northern Hemisphere. The nights are longer than the days, i.e. more than 12 hours. In the Southern Hemisphere, the days continue to become longer and remain longer than the nights, i.e. more than 12 hours.
- On **22 December**, the Sun shines vertically over the Tropic of Capricorn. All places in the Southern Hemisphere experience the longest day. The Antarctic Circle at 66½° S experiences daylight for 24 hours. The Northern Hemisphere experiences the shortest day and the Arctic Circle at 66½° N experiences complete darkness for 24 hours.
- From **23 December** to **20 March**, the days start becoming longer in the Northern Hemisphere, but are still shorter than the nights, i.e. less than 12 hours of daylight. In the Southern Hemisphere the nights start becoming longer, but are still shorter than the days, i.e. the days have more than 12 hours of daytime.

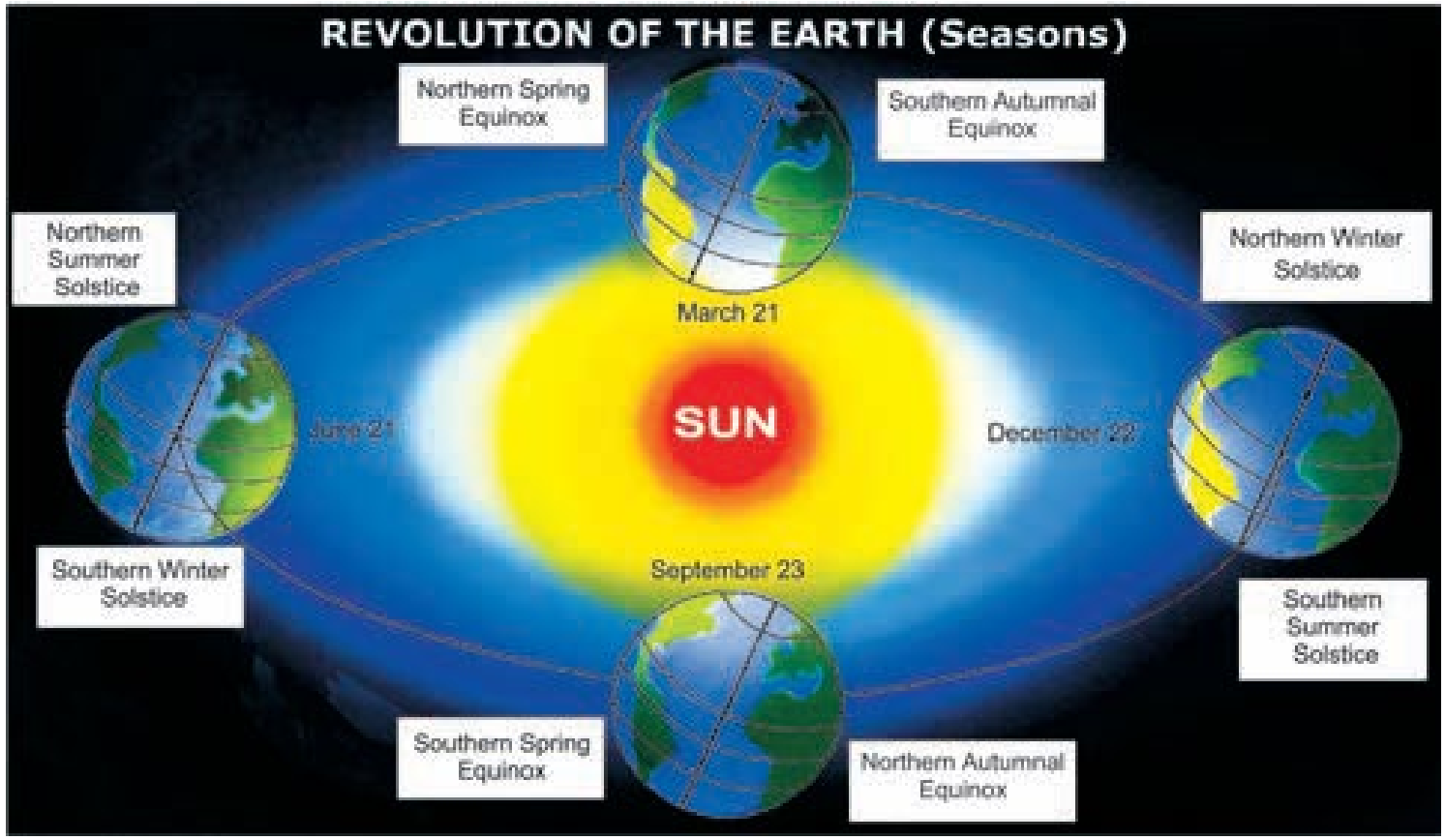
Phenomenon of Seasons

We observe that there is a change of seasons almost everywhere in the world. This is due to:

a. the **rotation** of the Earth,
b. the **revolution** of the Earth,
c. the **inclination** of the Earth's axis and
d. the **parallelism** of the Earth's axis.

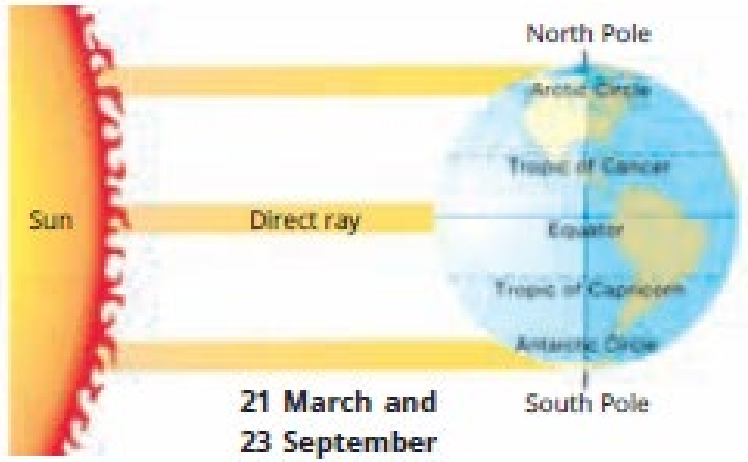
Equinoxes

The term **'equinox'** means equal days. In Figure 3.9, the Earth occupies position numbers 1 and 3 on 21 March and 23 September respectively. These are the positions of equinoxes. In the Northern Hemisphere 21 March is **vernal** or **spring equinox** and 23 September is the **autumnal equinox**. The seasonal terms are reversed in the Southern Hemisphere.



The revolution of the Earth around the Sun, causes the phenomenon of seasons

- The Northern Hemisphere experiences spring season on 21 March and autumn season on 23 September. The situation is reversed in the Southern Hemisphere.
- The dates of the equinoxes coincide with the tim of sunrise at one pole and sunset at the other po
- The date of 21 March coincides with the **New Year's Day** of the Indian National Calendar

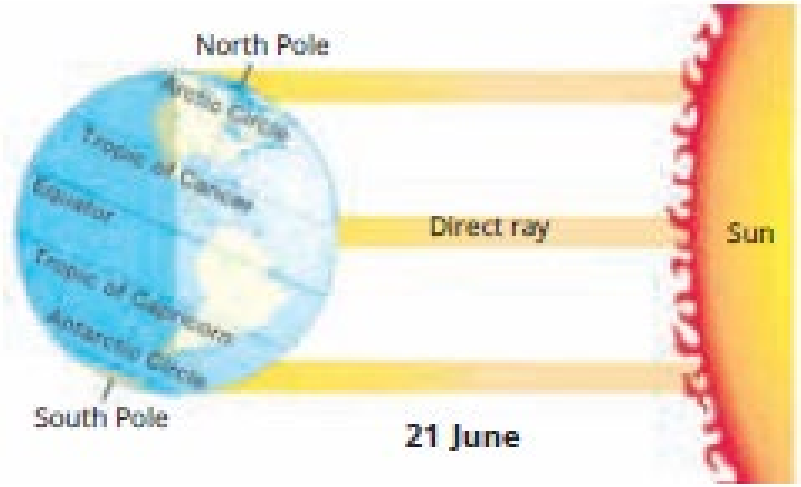


The spring and autumnal equinoxes

Summer Solstice

On 21 June, the Sun shines vertically over the Tropic of Cancer. On this day the North Pole is inclined towards the Sun, while the South Pole is turned away from it.

The circle of illumination touches the Arctic Circle on the far side of the Earth and the Antarctic Circle on the near side of the Earth



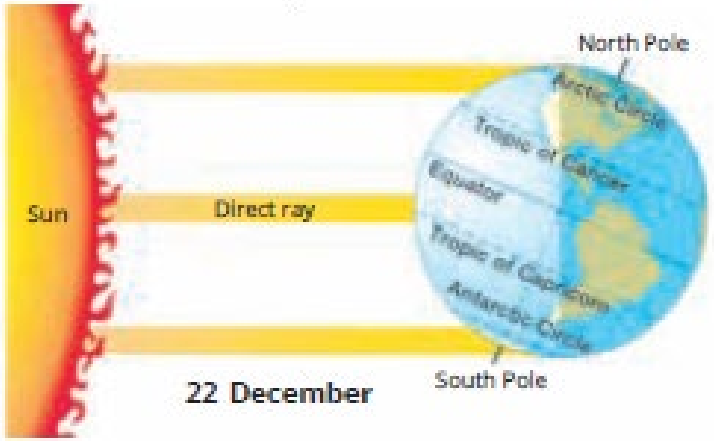
The summer solstice in the Northern Hemisphere

Winter Solstice

On 22 December, the Sun shines vertically over the Tropic of Capricorn. On this day the South Pole is inclined towards the Sun, while the North Pole is turned away from it.

The following characteristics prevail due to this inclination:

- The Southern Hemisphere receives the maximum amount of heat and thus experiences summer season.



The summer solstice in the Southern Hemisphere

- The Northern Hemisphere receives the minimum amount of heat and thus experiences winter season.
- The circle of illumination touches the far side of the Antarctic Circle and the near side of the Arctic Circle on the Earth.
- We can experience the longest day and the shortest night in the Southern Hemisphere and the length of the day increases with the increasing latitude, towards the South Pole.
- In the Northern Hemisphere, the nights are longer than the days. The length of the day decreases with the increasing latitude, towards the North Pole.
- The region from the Antarctic Circle to the South Pole experiences 24 hours of daylight, while the region from the Arctic Circle to the North Pole experiences 24 hours of darkness.
- The equator experiences 12 hours of day and 12 hours of night.

THANK YOU