

## Earth Movements and Seasons

### Changing Seasons

Human beings live along with a large community of plants and animals. We can observe constant change in the course of the year - the flowering and fruiting of trees and plants changes in the animal activity in our surroundings. As months pass by you would have noticed that trees shed leaves, stand bare, new shoots come forth, they flower and fruit. You may have also noticed that in different times of the year you get different kinds of vegetables and fruits. In some months it is very hot and in some it is cold or wet.



- Can you relate what are the major seasons you have seen?
- Can you describe what happens in each – how hot it gets, how much it

rains, what happens to the plants and trees and animals, what food you get to eat etc.

- Find out if there is anyone in the class who has lived in distant places where the seasons are different. Get them to describe what happens there.

Observe the picture given below carefully (Fig 3.1).

- Do you think the trees observed in the pictures are same or different?
- What are the changes you can see in the trees?

In the first picture you can see that the tree and its surroundings are covered by snow (a kind of soft ice). In the third picture



Fig 3.1: A tree in Lancaster USA in four seasons

you can see the same tree sprouting leaves (there is no snow). In the second picture the same tree has fully grown leaves. In the last picture ripe red leaves are falling from the same tree. Do you know why these changes are occurring? Yes that's right, seasons.

Have you ever seen your surroundings covered by snow? You may have seen it flooded by water during rains but never snow. Some parts of the earth get so cold during some months that they get snowfall instead. This picture is of Ohio in USA. It snows heavily in the Northern countries during winter; in summer months it is not so cold but still much cooler than in our state. However, the funny thing is that in those countries the day is much longer in summer – so much so that you can see the Sun even at midnight!

Find out which country is called the 'land of midnight Sun' and locate it on the globe. Find out its latitude and compare it with the latitude of Andhra Pradesh.

Locate Australia, South Africa and Chile on the globe. These are also called the countries of the Southern Continents, that is continents that are South of the Equator. In these countries the cycle of seasons is different. They have winter when we have summer and when we have winter they have summer! In fact this is the pattern in all places in the south of the Equator.

- Look at the globe and find out the names of countries which are south of equator.

Asia : .....

Africa : .....

Europe : .....

North America : .....

South America : .....

Australia : .....

- Did you find any continent which is entirely to the North of the Equator?
- Did you find any continent which is entirely to the South of the Equator?
- Did you find any continent which is spread both to the North and South of the Equator?
- Can all students of the class write down three questions regarding this magic of seasons? We will try to find answers for them.

You are not the only ones with such questions. For thousands of years human beings have been curious about these matters and over time have worked out the answers. Let us try to understand why seasons happen, why we have some parts that are warm and some cold and why are the seasons opposed in the Northern and Southern hemispheres.

To understand these we have to understand the complex interaction between several factors. These are:

- 1) The spherical shape of the Earth and the curvature of its surface.
- 2) Daily rotation of the Earth on its own Axis.
- 3) The tilt of the Axis of rotation compared to the plane on which the Earth moves.
- 4) The Earth's movement around the Sun once a year (revolution).

## 1. Curvature of the Earth

You have already studied the impact of the spherical shape of the Earth and how this causes different distribution of heat over the Earth's surface, how the region around the Equator becomes warmer than those near the Poles.

## 2. Earth's Rotation on its Axis

The Earth rotates or goes around just like a 'top' spins. What does it go around? It actually rotates around an imaginary line which joins the North Pole and the South Pole. This line is called the Axis of the Earth's rotation. All parts of the earth go around this line once a day. In other words the Earth takes about 24 hours to rotate or go around its own axis. It moves from the west to the east – if a globe is facing you it rotates from your left to the right side. You can see the Western portion moves towards the east.

When the Earth rotates, the air around us, the clouds and the birds move along with the Earth. That is why we don't feel the movement in the manner when we travel on a train or bus.

This is the reason why the Sun, the Moon and the stars appear to rise in the east and set in the west. This is, of course, an illusion created by the eastward spin of Earth.

The first and foremost effect of earth's rotation is the daily alternation of day and night, as portions of Earth's surface are turned first toward and then away from the Sun. This variation in the exposure to sunlight greatly influences local temperature and wind movements.

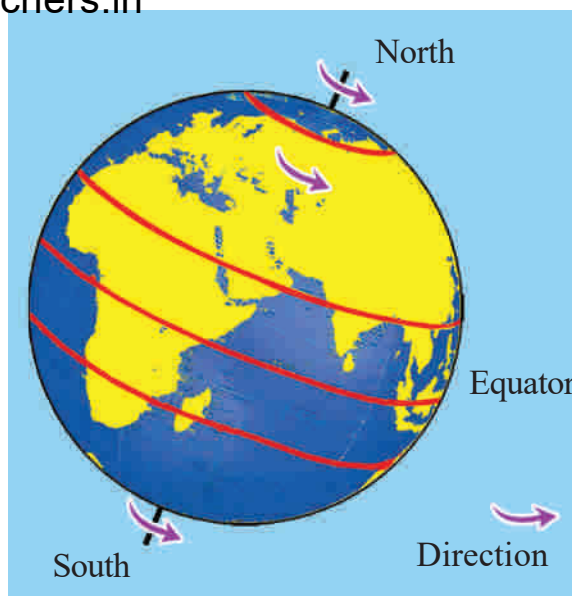


Fig 3.2: Rotation of the earth from west to east

### Activity :

Take a globe and focus a torch light on it from a small distance. The torch illuminates one half of the globe. If you rotate the globe in front of the light, then also only half the circumference of the globe is illuminated.



Similarly, the Sun illuminates one-half of the earth at any given movement. The edge of the sun-lit hemisphere, called the circle of illumination, is a great circle that divides earth between a light half and a dark half.

What would happen if the earth did not rotate on its own axis? Then one portion of the earth which is in front of the Sun would constantly get Sun's heat and light and the other portion would remain cold and dark. This would make both portions unfit for life - the bright half would be too hot and the dark half would be too cold. Thus rotation helps the entire earth to get heat and light on a daily basis.

### 3. Earth's 'Tilt' and Revolution Around the Sun

The earth revolves round the Sun while rotating round its own axis. That is, it spins like a top and at the same time keeps moving forward around the Sun. The motion of the earth round the Sun is called 'revolution'. Each revolution takes about 365 days and 5.56 hours. This is the length of a year on the Earth. How does this cause the formation of seasons on the Earth?

Had the Earth just gone around the Sun – it would have meant that all places would have had the same season throughout the year. The portions that get more sunshine would keep getting it throughout the year in the same way and the vice-versa. But this is not so because the Axis of Earth's rotation is inclined (slanting) and points in the same direction throughout the year. What do we mean by 'inclined axis'?

The earth goes around the Sun – on a regular path (also called Orbit) on a level plane in open space. This is called the Orbital Plane. The earth's axis of rotation

does not stand vertical (that is forming a  $90^\circ$  angle) on this plane but is tilted on it so as to form a  $66.5^\circ$  angle. In other words it is tilted by  $23.5^\circ$  ( $90^\circ - 66.5^\circ = 23.5^\circ$ ). To understand this idea, look at the following pictures.

Actually if we see the Earth from the sky, we will not be able to see any tilt or axis. It will appear just as the Moon or Sun appears to us – a round disc. The 'tilt' is the tilt of an imaginary line – the axis, and therefore can't be seen visually.

As earth revolves around the Sun, Earth's axis remains tilted in the same direction throughout the year. It keeps pointing to the Pole star (which can be seen in the Northern sky in the night) and this is called the Polarity of Axis.

In the pictures you can see what happens when the Earth goes around the Sun in this manner. During some months (June) the Northern Hemisphere is tilted

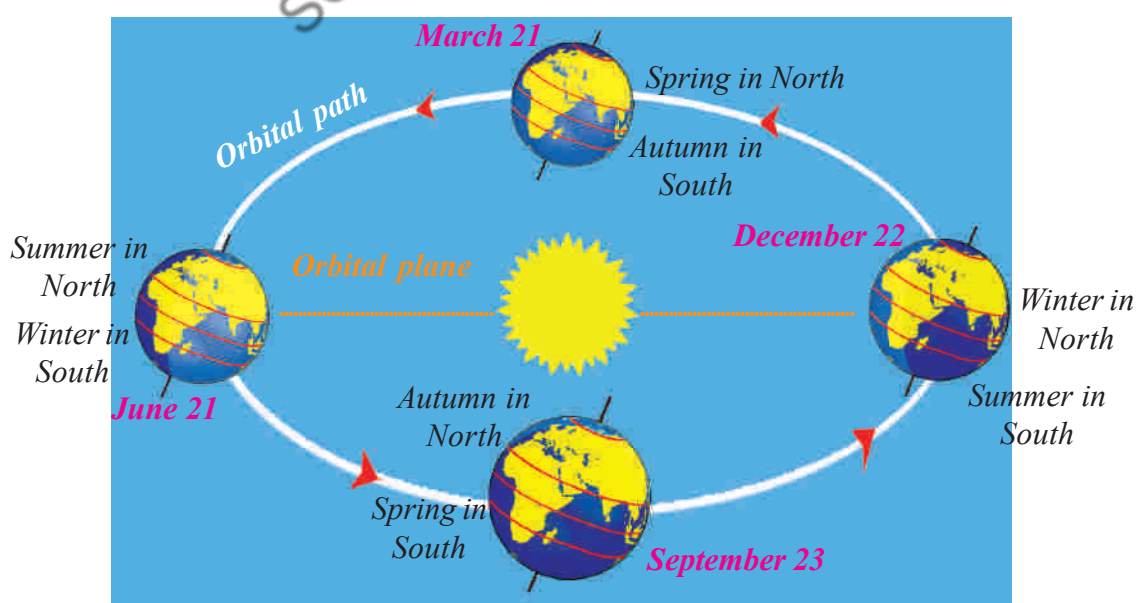


Fig 3.3: Seasons in the North and South hemisphere

## Temperature Belts on the Earth



Fig 3.4: A view of the earth from the Moon

towards the Sun while in some months the Southern Hemisphere faces the Sun. As a result when the Northern Hemisphere has summer, Southern Hemisphere has its winter. When six months later (December) the position changes, Northern Hemisphere has winter and Southern Hemisphere has summer. You can also see that in some months like March and September it is the Equator which faces the Sun directly and both the Northern and Southern Hemispheres get similar amount of energy from the Sun.

- Imagine that the Earth goes around the Sun but its axis is not tilted. How will it affect the change in seasons in Andhra Pradesh? How will it affect the change in seasons in the northern region whose photograph you saw in the beginning of the chapter?



Let us see how this effect of the tilt of the Axis combines with the spherical shape of the Earth to influence distribution of solar heat over the

Earth. We saw earlier that when the solar rays strike the Earth's surface, they fall straight in portions which face the Sun directly and fall at an angle as you move away from that portion.

The angle keeps increasing as we move towards the two Poles. As a result it is hotter in the areas which face the Sun directly and less hot in the areas that receive the Sun rays at an angle.

As a result of the tilt of the axis the area which faces the Sun directly keeps shifting throughout the year. In March the Sun shines directly over the Equator, while in June it shines directly over the Tropic of Cancer in the Northern Hemisphere. Then in September as the Earth travels further around the Sun, the Sun shines directly over the Equator. In December it shines over Tropic of Capricorn in the Southern Hemisphere.

Thus you can see that there is a belt within which the direct rays of the Sun fall at some time of the year or the other. This belt extending from the Tropic of Cancer to the Tropic of Capricorn is called the Tropical Belt. This belt gets the maximum heat energy from the Sun.

June 21 – Sun on the Tropic of Cancer

March 21, Sept. 23 – Sun on the Equator

December 22 – Sun on the Tropic of Capricorn

On March 21 and September 23 throughout the world day and night are equal in size, so these are called **equinoxes**.

As we move northwards or southwards of the Tropical Belt we reach a region where it gets warm in summers but also very cold in winters. This is the Temperate Zone. The northern portions of this region get snowfall in winters.



- Find out if Andhra Pradesh is in the Tropical Belt or in the Temperate Belt.
- Will the Sun shine directly on our heads in Andhra Pradesh during any month? If yes, in which month?
- Find out in which belt is Delhi and if it will get snowfall in winters.

If you move further north or south of the Temperate Belt you will reach the Polar Region. The seasons in this region are very peculiar. This region is away from the Sun during winter months – and does not even

get any sunshine in the day! That is, for six months there is no Sun on the Poles. The next six months it constantly faces the Sun throughout the 24 hours of a day - there is no night or darkness! A place which has six months of day and six months of night! Even during the ‘day’ it gets very slanting rays of the Sun. The Sun does not rise high in the sky but only stays just above the sunrise point (also called the horizon). So it never gets very hot. So for six months it is freezing cold – so cold that an entire ocean – the Arctic Ocean remains frozen throughout the year. So cold that the soil becomes frozen like a hard rock and roots of trees can’t penetrate them. So trees just can’t grow in this region. When the Sun appears for six months, the snow melts, part of the sea too melts. Small plants like moss, lichen and some flowering plants grow.



Fig 3.5:

*Northern Lights, visible in Northern polar region, occur during the seasons when the sun does not rise above the horizon*

### Key words

- |              |                           |                 |
|--------------|---------------------------|-----------------|
| 1. Seasons   | 2. Curvature of the Earth | 3. Earth’s Tilt |
| 4. Snow Fall | 5. Temperature belts      | 6. Horizon      |



### Improve your learning

1. Do you think there is any correlation between the crops grown in your region and the seasons? Find out by discussing with your elders and friends and write a short essay on it. AS<sub>4</sub>
2. Why do you think Andhra Pradesh does not receive any snowfall during winter months? AS<sub>1</sub>
3. We have a rainy season. How do you think it is related to the movement of the Earth and the pattern of Sun's rays? Does it occur in the summer or winter or in the season in between? AS<sub>1</sub>
4. Collect information about time of Sunrise and Sunset for different months of the year in your place (you can look up the local newspaper for this). Calculate the duration of day and night – how many hours every day – for every month. Do you see any pattern in this? AS<sub>3</sub>
5. Explain the idea of rotation of the Earth to your parents or sisters or brothers. Write down their questions or doubts and try to answer them. AS<sub>4</sub>
6. Imagine that the Earth does not rotate but goes around the Sun around the year. What difference will it make to the seasons and distribution of temperature? AS<sub>4</sub>
7. Identify a country in the Temperate Belt in both Northern and Southern Hemisphere. Compare the seasons in those countries and your place. Which will be warmer in May-June and which will be cooler in December-January or in March or September? AS<sub>5</sub>
8. What are the six seasons of Indian climate? AS<sub>1</sub>
9. Read the first paragraph of this chapter and answer the following question: AS<sub>2</sub>  
What is the impact of seasons on the lives of human beings?