

UNIT 1 — OUR WORLD

CHAPTER

1

Earth As a Planet

Syllabus

Earth as a Planet: Shape of the earth. Earth as the home of humankind and the conditions that exist.

Earth, our home planet, is the third planet from the sun and the fifth-largest planet in the solar system. It is the only planet which supports life. From space, the earth looks blue because 70 per cent of its total area is covered by water. Hence, it is also called the *watery planet*. The family of the sun is called the *Solar System*. The members of the solar system are at a certain distance from the sun. The chief members of the solar system are the *planets*, the *satellites* that revolve around the planets and other celestial bodies called *asteroids*, *comets* and *meteorites*. The planets in order of their distance from the sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

THE SHAPE OF THE EARTH

The earth is not a perfect sphere. It bulges slightly at the centre and is flattened at the poles. In the olden days, the earth was considered to be a flat disc with steep edges. Aryabhata, the 5th century Indian astronomer and mathematician, believed in the round shape of the earth. He said that the earth was spherical in shape and rotated on its axis. In the 6th century, Greek philosopher Pythagoras said the same thing. Today, we have convincing evidence to prove that the earth is spherical in shape.

Proof that the Earth is Spherical in shape

(i) **Sighting of a ship:** While standing at seashore, watching an approaching ship, we first see only its mast. Then, as it comes closer, we can see the deck in the middle, then its funnel, and finally the hull comes into full view. This can happen only when the earth's surface is curved (Fig. 1.1). If the earth were flat, the entire ship would have been visible at once.

(ii) **The Bedford Level Experiment:** An experiment was carried out in the Bedford Level canal area in England. Three poles of equal length were fixed at intervals of 5 km. It was ensured that the poles had the same height above the water in the canal. When the poles were viewed from one end of the canal, the

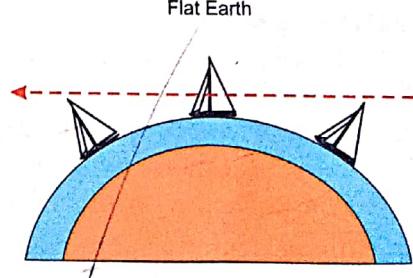
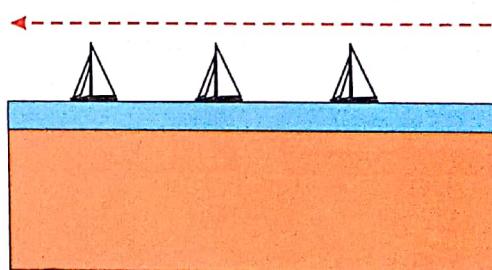


Fig. 1.1. Sighting of a ship

middle pole looked slightly higher. It could not have happened if the earth had a flat surface (Fig. 1.2). A similar experiment was repeated at different places with the same result. This experiment demonstrated that the surface of the earth was curved.

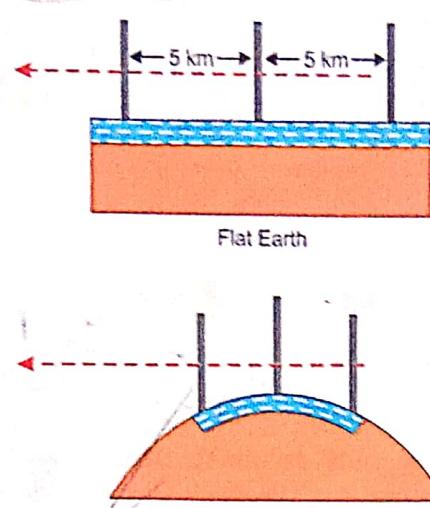


Fig. 1.2. Bedford level experiment

(iii) Pole Star: The Pole star can be seen at an angle of 90° at the North Pole. It lies in line with the axis of the earth, and its angle decreases towards the Equator. At the Equator, the angle is 0° . This can happen only in an arc of a circle. (Fig. 1.3). If the earth were flat, the Pole Star would have the same height for all latitudes.

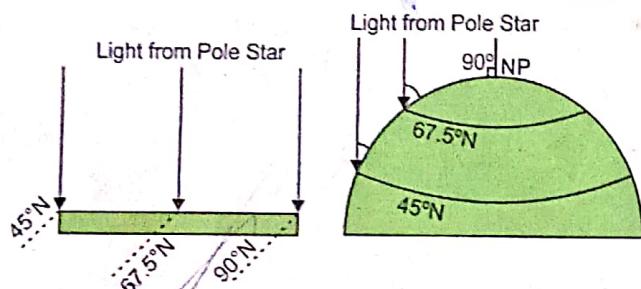


Fig. 1.3. Position of the Pole Star.

(iv) Satellite Pictures: Jean Baptiste Delambre (1749–1822), the French astronomer, discovered the flattening of the earth at the poles. In the 20th century, when satellite pictures of earth were fed into computers, its spherical shape with the flattened poles was confirmed (Fig. 1.4).

The conclusive evidence for the proof the earth's spherical shape is obtained from the photographs taken from space.



Fig. 1.4. A satellite picture of the Earth

(v) Lunar Eclipse: The shadow of earth on the surface of the moon is clearly visible from earth during lunar eclipse. It appears as an arc of a circle. Since the earth is bigger than the moon, it is rarely oriented in the same position as the moon but the shadow is always circular.

(vi) Circular Horizon: The view of the earth's surface as seen from a height is circular. With increase in altitude the circular horizon also widens. Had the earth's surface been flat the

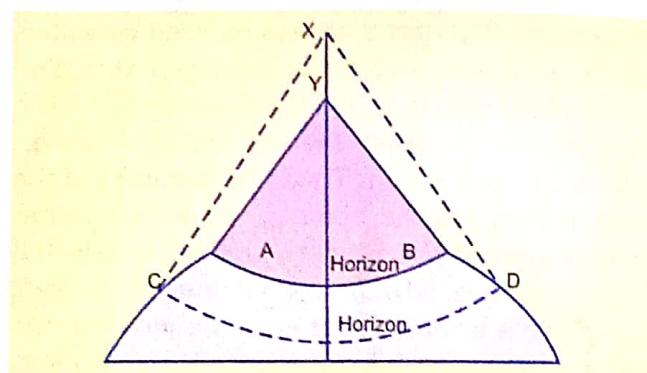


Fig. 1.5(a). Spherical Earth: The higher the altitude, the wider the circular horizon. The circular horizon AB widens to CD as you move up from Y to X.

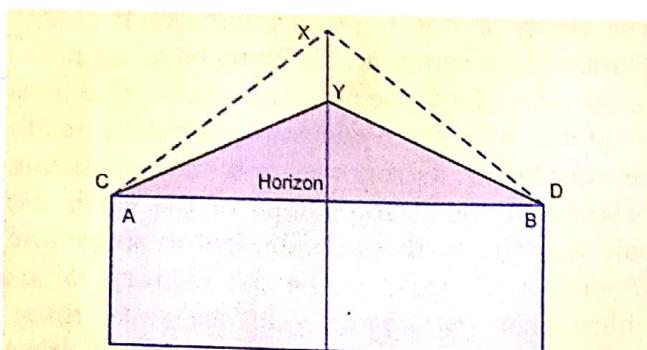


Fig. 1.5(b). Flat Earth: Irrespective of the altitude, the visible horizon is the same.

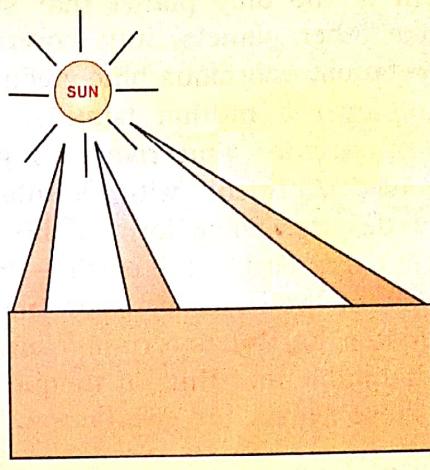
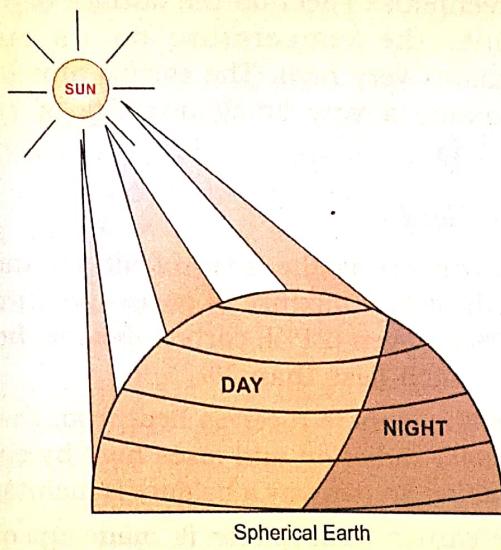


Fig. 1.6. Sunrise and Sunset occurs at different times at different places

horizon would have been the same irrespective of altitude.

In modern days, all radio waves that travel over the earth's surface, can be heard only within a certain horizon. Beyond this, the signal is not received. This is because of the spherical shape of the earth.

(vii) Sunrise and Sunset: The sun rises from the east and sets in the west. Sunrise and sunset occurs at different times at different places. This is because the earth rotates from west to east and therefore, people in the east can see the sun earlier than those in the west. Had the earth been flat, the sunrise and sunset would have occurred at the same time all over the world. (Fig. 1.6)

(viii) Circumnavigation: Magellan's ship Victoria completed a round-the-world voyage in 1522. His ship returned to the same place from where it had started (Spain). It proved beyond doubt that the earth's surface is round (Fig. 1.7).

(ix) The Earth as a Heavenly Body: The earth belongs to the Solar system. All planets in this system are spherical in shape. It is because of their continuous rotation. So the earth being the member of the Solar system cannot be an exception.

THE EARTH AS A PLANET

Earth, as a planet, is a spherical object in space that moves around the Sun (a star) and receives

light from it. The planets do not have light of their own. They move around their stars in fixed paths called orbits.

Earth an Oblate Spheroid

The earth is said to be spherical; but it is not a perfect sphere. Its diameter varies at the Equator and at the Poles. Its diameter at the Equator is 12,756 km while its Polar diameter is 12,714 km. This difference in diameter is due to the centrifugal force of earth's rotation at a great speed which forms a bulge at the Equator and a compression at the Poles. Thus, the earth is said to be an **Oblate Spheroid**. The shape of the earth is also described as **Geoid**, which means **earth shaped**.

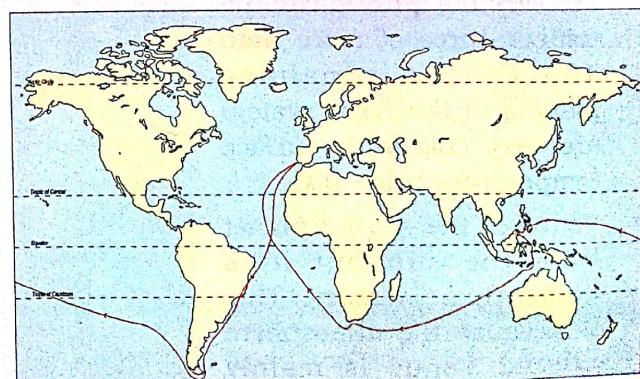


Fig. 1.7. Circumnavigation—the route taken by Magellan.

EARTH AS THE HOME OF HUMANKIND

Our Earth is the only planet that supports life. Unlike other planets, it is covered with green vegetation, enormous blue-green oceans containing over a million islands, a large number of streams and rivers, huge land masses called continents with mountains, ice caps and deserts. Some form of life thrives virtually in every part of the earth — from the coldest part of the Poles to the warmest part of the Equator. Earth has certain features that make it habitable and thus, a unique planet. Some of these features are given below.

Distance from the Sun

- The earth is at an optimum distance from the sun. Hence, it is neither too hot nor too cold.
- The distance between the earth and the sun makes life possible on the earth. If it was closer to the sun, any life present would get burnt from too much heat of the sun. If it was farther from the sun life would freeze because of lack of heat.

Temperature

- Temp of earth
- The earth is the third planet from the sun. It has an average temperature of 17°C which is suitable for life to exist.
 - If the average temperature on the earth's surface changes by only a few degrees, many species would perish due to extreme heat or cold.
 - The other two terrestrial planets, Mercury and Venus are very hot with maximum temperatures of more than 400°C . The remaining planets in the Solar system are very cold with surface temperature below 0°C .
 - Venus is the second planet from the sun but it is hotter than Mercury. This is because the atmosphere around Venus is mainly composed of carbon dioxide. The carbon dioxide produces

Greenhouse effect on the surface of Venus. Thus, the temperature on its surface remains very high. The earth's atmosphere contains a very small quantity of carbon dioxide.

Atmosphere

- Atmosphere is the layer of air around the earth. It is a mixture of gases like nitrogen (78%), oxygen (21%), carbon dioxide, helium and argon (less than 1%).
- The atmosphere receives heat from the sun by solar radiation and loses heat by earth's radiation. In this way a balance is maintained.
- The earth's atmosphere is made up of life supporting gases like nitrogen, oxygen and carbon dioxide. Other gases include Helium and Argon.
- Ozone present in the earth's atmosphere absorbs the harmful ultraviolet rays of the sun.
- The atmosphere also prevents loss of heat from the earth's surface and helps to keep the earth warm.

Water

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- Earth is a watery planet with 70 per cent of the earth's surface being covered by water.
- Distribution of water is responsible for moderating the climate and surface condition of the earth.

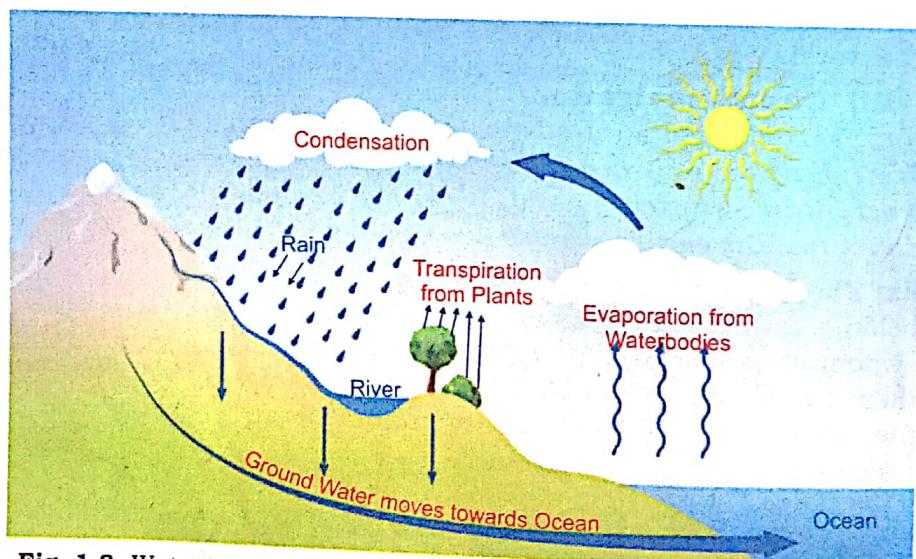


Fig. 1.8. Water cycle — the movement of water between the Atmosphere, Hydrosphere and Lithosphere

what is ecosystem.

food web

- The self-regulating and self-sustaining structural and functional unit of the biosphere is called the **Ecosystem**. This system depends upon the sun for its energy. A pond, a lake, desert, grassland, meadow, forests are common examples of ecosystems.

- There is an exchange of materials and energy within the ecosystem as well as between adjoining ecosystems. They are all interconnected and hence, interrelated. *The vast network of all interconnected ecosystems constitute the biosphere.*

biosphere. Thus, biosphere is that part of the earth's terrestrial system — including air, land and water — in which life develops and where life processes in turn get transformed. *It is the life zone of the earth.*

- Water from seas, rivers and lakes evaporates into the atmosphere where it condenses and falls back as precipitation. Most of the water on land flows back to the oceans. Thus, water moves in a continuous cycle — the hydrological cycle, as shown in Fig. 1.8. There is a proper balance between evaporation, condensation and precipitation without which life would not be possible.

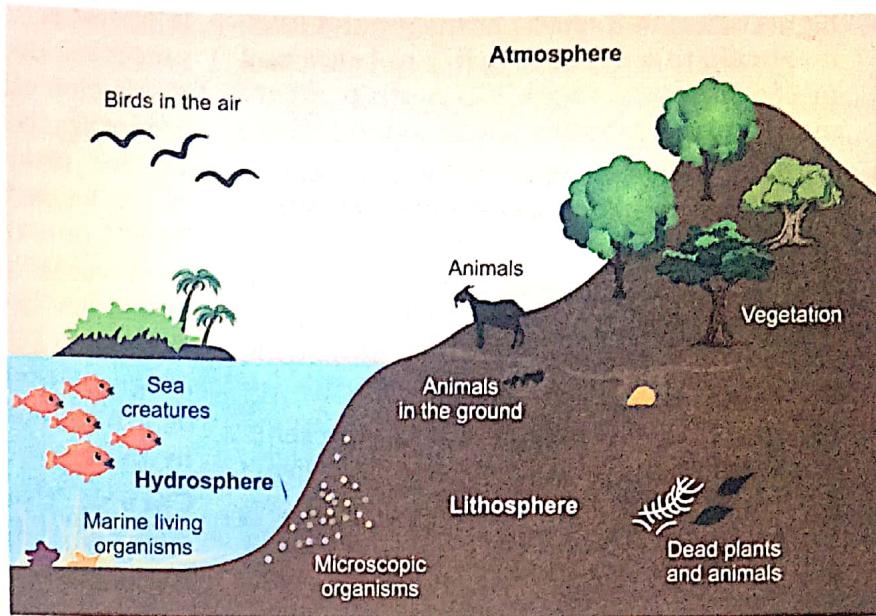


Fig. 1.9. (b) Biosphere: The Life Zone

- waters bodies reduce the day night temp variation*
- Water can absorb enormous amount of heat without causing much change in its temperature. During the day, waterbodies rapidly absorb enormous amount of heat; thus, the earth remains fairly cool. At night the waterbodies release vast amounts of heat that they absorbed during the day, which along with other atmospheric effects, keep most of the surface from freezing at night. But for the tremendous amount of water on the earth, far greater day and night temperature variations would exist.

Solid Crust (Lithosphere)

Earth has a solid crust (Lithosphere). Due to the weathering of the rocks, the surface of the earth has been formed, which provides soil layer essential for supporting plant life. Soil also provides various nutrients necessary for the growth of plants, which in turn support all forms of animal life directly or indirectly.

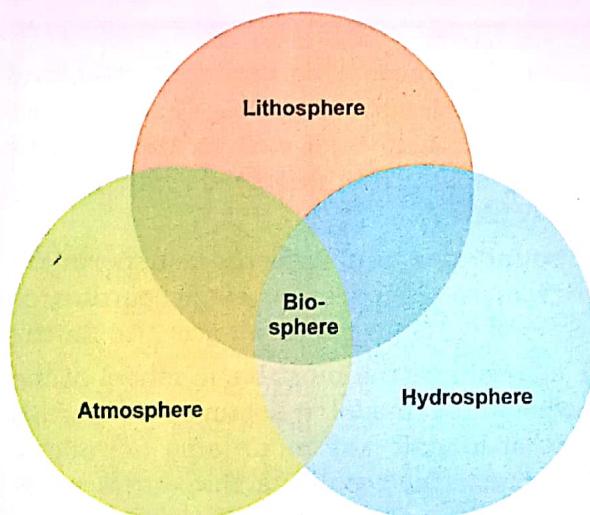


Fig. 1.9. (a) Biosphere

Biosphere What is Biosphere

- Biosphere is the narrow realm of contact and interaction between the atmosphere, lithosphere and hydrosphere.
- Biosphere provides all the necessities for all the species living on earth, i.e., light, heat, water, food and habitats.
- Biosphere is a thin layer of approximately 15 km from the deepest ocean trench to the

highest mountain peak. At the ground level, it extends to a depth of just 3 m below and in ocean waters about 200 m deep, where marine and freshwater life is found.

- Within the biosphere, life is found chiefly in two forms—the *plant kingdom* and the *animal kingdom*.

Life-Giving Cycles

Various life-giving cycles operate in nature, balancing the factors necessary for life.

Nutrition Cycle: The nutrition cycle represents a relationship between living and non-living things in our environment (Fig. 1.10). It shows the interdependence of all living things on earth.

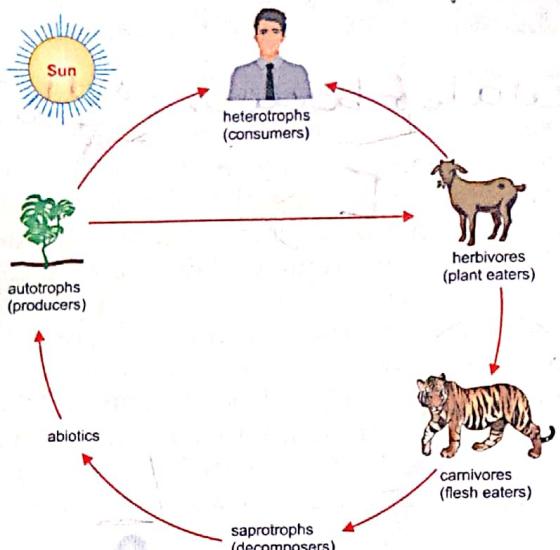


Fig. 1.10. Nutrition Cycle

It operates through the food chain and other processes like photosynthesis, transpiration, respiration etc. The living things are divided into producers, consumers and decomposers. Plants are the producers of food through a process of *photosynthesis*. Energy has its origin from here. Then there are categories of consumers (herbivores and carnivores) who live on the producers. At the top of all is man who can modify his own environment and create changes at the bottom or in the middle level of the food chain. All living beings undergo decomposition by the action of saprotrophs or decomposers.

Carbon Cycle: Carbon is the basic raw material of all life (Fig. 1.11). All living things contain carbon. Atmospheric carbon dioxide is used by plants in the presence of sunlight and chlorophyll to make their own food by

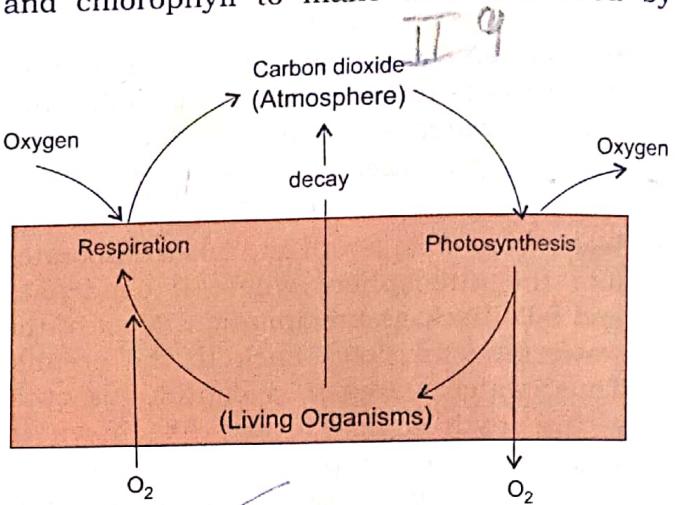


Fig. 1.11. Carbon Cycle



Geodesy is the science of accurately measuring and understanding three fundamental properties of the Earth: its geometric shape, its orientation in space, and its gravity field—as well as the changes of these properties with time. By using GPS, geodesists monitor the movement of a site continuously (24×7).

Geodesy is used to map shorelines, determine land boundaries, and improve transportation and navigation safety. To measure points on the Earth's surface, geodesists assign coordinates using space-based tools like the Global Positioning System (GPS) to points all over the Earth.

To measure the Earth, geodesists have adopted the ellipsoid as the most basic model of the Earth. But the ellipsoid is based on a very simple mathematical model, it assumes the earth's surface is smooth like the oceanic surface and does not include any mountains or valleys. When additional detail of the Earth is needed, geodesists use the geoid—a shape that exists over the whole globe.

the process of photosynthesis. During this process CO_2 is fixed as starch by plants. From the plants, carbon moves along the food chain through consumers at different levels. After the death of plants and animals, the carbon present in their bodies is decomposed and absorbed as food by saprophytic bacteria and fungi. When plants die and get buried in the soil, they undergo slow degradation and compaction. This results in the formation of fossil fuels containing huge amounts of carbon.

During respiration, plants, animals and humans, use atmospheric oxygen and release carbon dioxide back into the atmosphere. The burning of carbon containing fuels also results in the release of CO_2 in the atmosphere.

Thus, carbon from CO_2 taken by green plants from the environment through photosynthesis is returned to the environment through respiration, decomposition and through burning of fuels.

This cyclic movement of carbon from the atmosphere to the organisms and from organisms to the atmosphere is known as

carbon cycle. The carbon cycle helps in maintaining carbon balance in nature.)

Any imbalance of carbon in the atmosphere heats up the earth and leads to Global Warming. Excessive use of gases that produce undue heat and global warming has to be avoided to maintain a healthy atmosphere.

Nitrogen Cycle: Atmosphere is the largest reservoir (78% approximately) of free nitrogen. Plants take nitrogen in the form of nitrates from the soil and it moves through the food chain to animals. Nitrogen is returned to the soil through manure, excreta and earthly remains of plants and animals, and micro-organisms.

Oxygen Cycle: Living things take in oxygen from the atmosphere. They use it to release energy from the food they eat. Oxygen is also used together with carbon, hydrogen and nitrogen to build new molecules in their bodies. Oxygen is released back into the atmosphere by green plants during photosynthesis and by plants and animals as part of carbon dioxide.

These cycles are nature's mechanism to maintain balance in the ecosystem.

Terms to Remember

| | |
|--------------------------|---|
| Lithosphere | : The layer of rocks on the surface of the earth. |
| Satellite | : A body that revolves around a planet. |
| Circumnavigation | : Navigation around the globe. |
| Atmosphere | : The blanket of air surrounding the earth. |
| Photosynthesis | : The process by which green plants make their own food using sunlight, carbon dioxide and water. |
| Greenhouse Effect | : The trapping of the sun's radiation by gases present in the lower atmosphere. |

EXERCISES

I. Choose the correct option:

- At the Bedford level canal area a famous experiment was carried out. How many poles were used and at what distance apart?
(a) 3 poles, 5km
(b) 2 poles, 10km
(c) 4 poles, 5km
(d) 3 poles, 10km
- The view of the earth's surface as seen from a height is
(a) square
(b) rectangular
(c) circular
(d) triangular

Earth As a Planet

which along with others at night
absorbs during the day and thus feel the earth fairly cool
2) At night the water bodies release vast amount of heat
which along with others at night
absorbs during the day and thus feel the earth fairly cool
13

- ~~3. At what angle can the Pole Star be seen at the Poles and at the Equator?~~
(a) 60° , 30° (b) 90° , 0° (c) 45° , 45° (d) 0° , 90°
- ~~4. Magellan's ship Victoria after completing a round-the-world voyage in 1522 returned to which country?~~
(a) France (b) Spain (c) London (d) United States of America
- ~~5. Earth's diameter at the Equator is _____ and at the poles is _____.~~
(a) 12,750 km, 12,715 km
(b) 12,752 km, 12,726 km
(c) 12,714 km, 12,755 km
(d) 12,756 km, 12,714 km
- ~~6. What is the shape of the earth?~~
(a) Sphere (b) Oblate (c) Oval (d) Oblate Spheroid
- ~~7. What is the shape of earth called?~~
(a) Oblate (b) Spherical (c) Geoid (d) Spheroid
- ~~8. The atmosphere of Venus has maximum concentration of which gas?~~
(a) Oxygen (b) Carbon dioxide (c) Nitrogen (d) Helium
- ~~9. Name the gas that absorbs the harmful ultraviolet rays of the sun.~~
(a) Ozone (b) Oxygen (c) Carbon dioxide (d) Nitrogen
- ~~10. What is the thickness of the Biosphere?~~
(a) 20 km (b) 19 km (c) 15 km (d) 25 km
- ~~11. What term refers to a self-regulating and self-sustaining unit of the biosphere?~~
(a) Ecosystem (b) Food cycle (c) Biome (d) Ecology
- ~~12. Name the cycle through which solar energy moves from non-living to living organisms and back~~
(a) Carbon cycle (b) Nitrogen cycle (c) Nutrition cycle (d) Energy cycle
- ~~13. Name the basic raw material for life~~
(a) Nitrogen (b) Carbon (c) Oxygen (d) solar energy
- ~~14. Name the genius mathematician astronomer from the ancient world who was the first proponent of the round shape of the earth.~~
(a) Pythagoras (b) Aryabhatta (c) Brahmagupta (d) Bhaskara
- ~~15. You are standing at a beach looking towards the horizon. You hear the horn of a ship. Which part of the ship will you see first?~~
(a) Hull (b) Deck (c) Mast (d) All of them.
- ~~16. Where was the Bedford Level Experiment carried out?~~
(a) England (b) France (c) India (d) Canada

II. Short Answer Questions

- How can you prove that the earth is a sphere by looking at the horizon?
- Briefly describe the shape of the earth.
- What is the earth's mean temperature? State its one advantage.
- Why is the earth called a watery planet?
- What is 'biosphere'?
- Name the conditions necessary for life on earth.
- Give any two features of the earth that make it a 'Unique Planet'.

8. What would happen if the average temperature of the earth increased by half a degree?
9. Trace the cyclical movement of carbon in the three realms of the earth.

All life
would get
burnt

III. Structured Questions

1. (a) How does the sighting of a ship from the seashore prove about that the earth its round in shape?
 - (b) Use a 1m long table to replicate the Bedford Level Experiment. Briefly mention how did you carry out the experiment to prove the shape of the earth.
 - (c) Give a geographical reason for each of the following:
 - (i) The sunrise and sunset occur at different times at different places.
 - (ii) The earth is not a perfect sphere.
 - (iii) Venus is hotter than mercury.
 - (d) Draw a well labelled diagram to show that the horizon of the earth is circular in shape.
2. Describe the role of each of the following in making earth a habitable planet.
- (a) Atmosphere (b) Water → Distribution of water
(c) Temperature (d) Distance from the Sun is responsible for
3. (a) How does each of the following prove the circular shape of the earth:
 - (i) Lunar Eclipse; (ii) Pole Star
- (b) What is an ecosystem? Give an example.
- (c) Give a geographical reason for each of the following:
 - (i) Earth is a habitable planet.
 - (ii) From space Earth looks blue.
 - (iii) Water bodies reduce the day-night temperature variations.
- (d) Draw a well labelled diagram to show the cyclic circulation of water between the three realms of the earth.
- moderating the climate & surface conditions on the earth*

IV. Thinking Skills

1. You have gone from Delhi to Arunachal Pradesh on a study tour with your school during the winter vacation. As you woke up in the morning at 6 o'clock, you noticed the sun has risen whereas at Delhi sun rise is around 7.30 a.m. Similarly around 4.30 it was sunset while sunset is around 6 p.m. in Delhi. What do you think could be the reason for the sun rising and setting earlier than Delhi? Which feature of the earth can you relate to from this?
2. The earth depends upon the sun for its energy. Imagine a day, when the sun would not rise. Write down the consequences for the earth and its inhabitants.

V. Project/Activity

Prepare a project on *Natural Creation and Destruction*. State the conditions essential for the maintenance of life on our planet. Give a description of how new species have evolved and of how many species of plants and animals have become extinct. Look around your environment. Describe natural forces of creation and destruction that are active all the time.

