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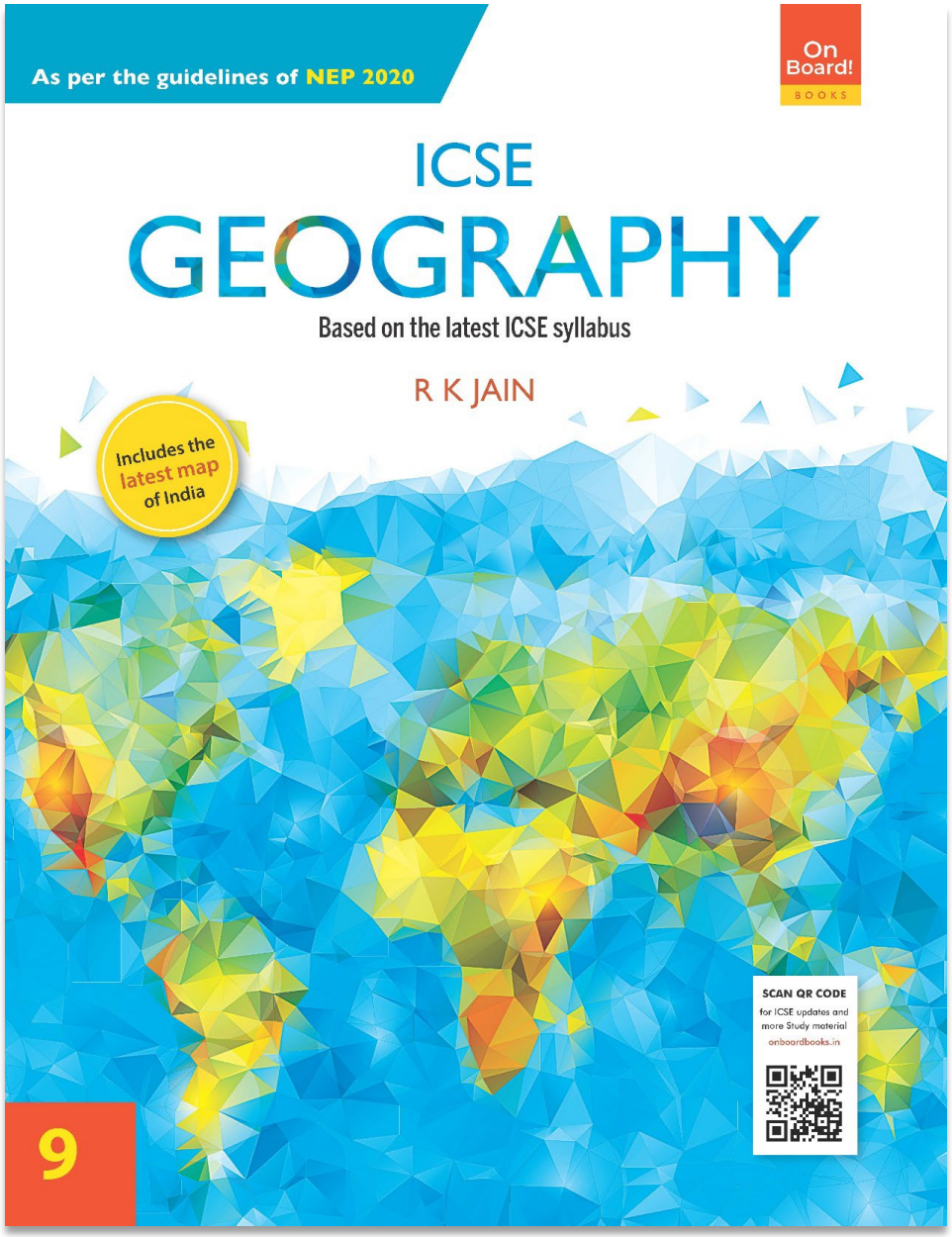
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CONTENTS

ICSE GEOGRAPHY

Class 9

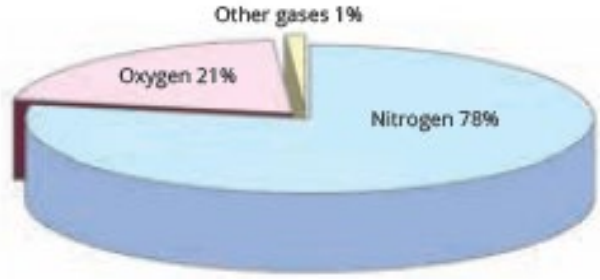
Chapter 12: Composition and Structure of the Atmosphere

The envelope of air which surrounds the Earth is called the **atmosphere**. The atmosphere is held close to the Earth by the force of gravity.

The atmosphere contains life giving **oxygen** for human beings and animals, and **carbon dioxide** for plants.

COMPOSITION OF ATMOSPHERE

The atmosphere is a mixture of colourless, odourless and tasteless gases, water vapour, smoke, dust particles, etc. The main gases present in the atmosphere are nitrogen (78 per cent), oxygen (21 per cent), carbon dioxide, hydrogen, argon, helium, etc.



Composition of air

1. Oxygen is mainly confined to the lower layers of atmosphere. It is the most important gas in the atmosphere as it is needed by all living organisms for breathing. It is also essential for combustion.

2. Nitrogen is the most prevalent gas in the atmosphere and is essential for the growth of plants. The plants cannot have it directly from the air, but get it from the soil. Nitrogen can dilute oxygen and slows down the process of oxidation. The atmospheric nitrogen can be directly used in the making of chemical fertilizers, nitric acid, ammonia, etc.

3. Carbon dioxide is a heavy gas and found only in the lower layers of the atmosphere. It is used by the plants during the process of **photosynthesis**. Carbon dioxide present in the atmosphere is responsible for the **greenhouse effect**. Without the greenhouse effect, the Earth would be too cold to sustain life.

4. Ozone is found in the upper part of the stratosphere. It acts as a filter and absorbs most of the harmful ultraviolet rays coming from the Sun. Thus the ozone gas prevents the Earth from becoming too hot.

5. Water vapour comes in the atmosphere due to evaporation and transpiration. The amount of water vapour present in the air depends on the temperature. Thus it decreases with increase in height above the sea level.

6. Dust particles and others: The atmosphere has large quantity of tiny solid particles suspended in it. They include dust particles, salt particles, pollens, smoke, volcanic ashes, etc. These are found in the lower layers of the atmosphere.

STRUCTURE OF ATMOSPHERE

The present day knowledge about the atmosphere is based on the information received through radars and satellites. The density and temperature of the atmosphere is not the same everywhere. The density of air decreases rapidly upwards.

The total extent of the atmosphere can be roughly divided into four layers – the troposphere, the stratosphere, the mesosphere and the thermosphere (ionoshere and exosphere).

TROPOSPHERE

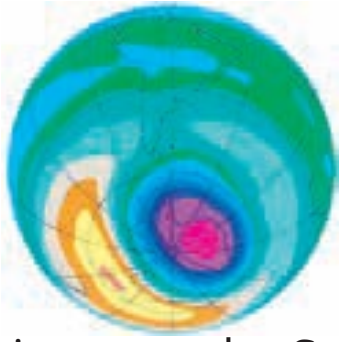
- The troposphere is the lowest layer of the atmosphere and its average height is about 18 km near the equator and about 8 km over the poles.
- The height of the troposphere increases during the summer season and decreases during the winter

STRATOSPHERE

- The stratosphere lies above the troposphere and extends up to a height of about 50 km.
- In the stratosphere, temperature increases with the increase in altitude due to the absorption of ultraviolet radiations from the Sun. But at about 50 km, the temperature begins to fall.
- It is the home of strong winds called jet stream which blow from west to east.

Ozone Layer

- The upper part of the stratosphere which has the maximum concentration of ozone is called the **ozonosphere**. It absorbs almost all the ultraviolet rays coming from the Sun. Thus it protects us from **harmful ultraviolet rays of the sun**.



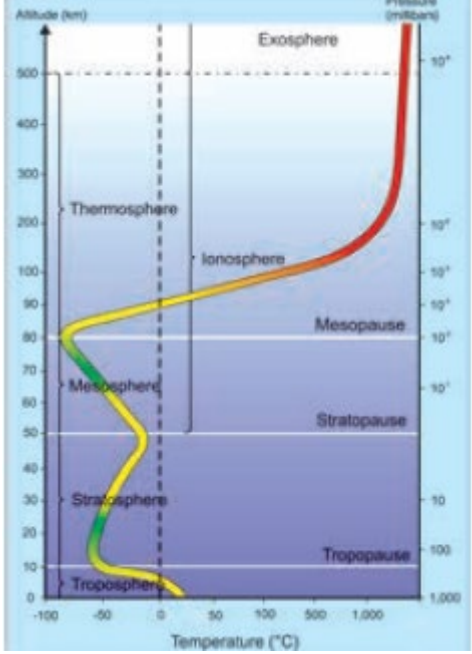
Ozone distribution over the Southern Hemisphere. The area of greatest depletion, called the **Ozone Hole** is formed over Antarctica.

- A study of the ozone layer shows a **decline** in the total global ozone. The scientists have discovered a **hole** in the ozone layer over the continent of Antarctica .

- The depletion of ozone layer is mainly due to the release of 'chlorofluorocarbons' or **CFCs**, from the Earth's surface into the atmosphere.

- CFCs are widely used as cooling fluids in the refrigerating systems, and air conditioners. Many households all over the world also use CFCs charged **aerosol spray cans** as propellants.

- The ozone depletion results in the rise of temperature on the Earth's surface. This causes **global warming**, acid rain, melting of continental glaciers, rise in sea level, skin cancer, poisonous smog, decrease in photosynthesis, ecological instability and disaster.



Thermal structure of the atmosphere

MESOSPHERE

Mesosphere lies beyond the stratosphere and extends from about 50 km to about 80 km above the mean sea level. In this layer, the temperature decreases with increase in height above the mean sea level. It is the **coldest layer** in the atmosphere

THERMOSPHERE

- Thermosphere lies beyond the mesosphere. In this layer, the temperature increases rapidly with the increase in height above the mean sea level. It is estimated that temperature at the upper limit of the thermosphere reaches up to more than 1500 °C.

- The air is very thin and holds little heat. One does not feel warm even at such a high temperature. The thermosphere protects us from meteors and obsolete satellites, as the high temperatures can burn nearly all the debris coming towards the earth.

- Thermosphere can be divided into two parts – the lower part is the **ionosphere** and the upper part is the **exosphere**.

Ionosphere

- Some molecules in the thermosphere absorb so much ultraviolet energy that they become ionized (an ionized molecule is one that has gained or lost one or more electrons). The layer, within the thermosphere, containing **ionized molecules** is called the **ionosphere**.
- The colourful light seen in the night sky near the two poles of the Earth is due to the interaction of ionosphere with the lower atmospheric layer. Near the North Pole, this phenomenon is known as **Aurora Borealis** or the northern lights and near the South Pole this phenomenon is called **Aurora Australis** or the southern lights.

Exosphere

- Exosphere is the uppermost layer of the atmosphere. Our knowledge about this layer is extremely limited. The density of air in this layer is very low and it is in a rarified form.
- The exosphere merges gradually into the outer space.

SIGNIFICANCE OF ATMOSPHERE

The atmosphere is of great significance for the survival of human beings and other life forms on the Earth. Some of them are as under:

1. The atmosphere prevents the Sun's harmful ultraviolet rays from reaching the Earth's surface.

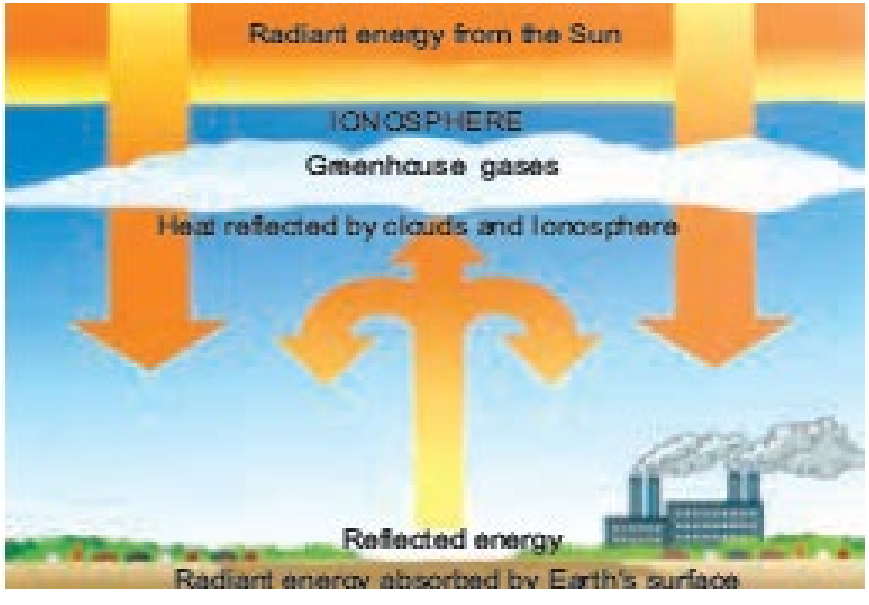
2. It shields us from the meteors which are continuously coming towards the Earth from the outer space.

3. It acts like a greenhouse by trapping the heat and thus controls the extremes of temperature during day and night.
4. It softens the Sun's glare during daytime.
5. The atmosphere has weight and exerts pressure, which depends upon the air temperature.

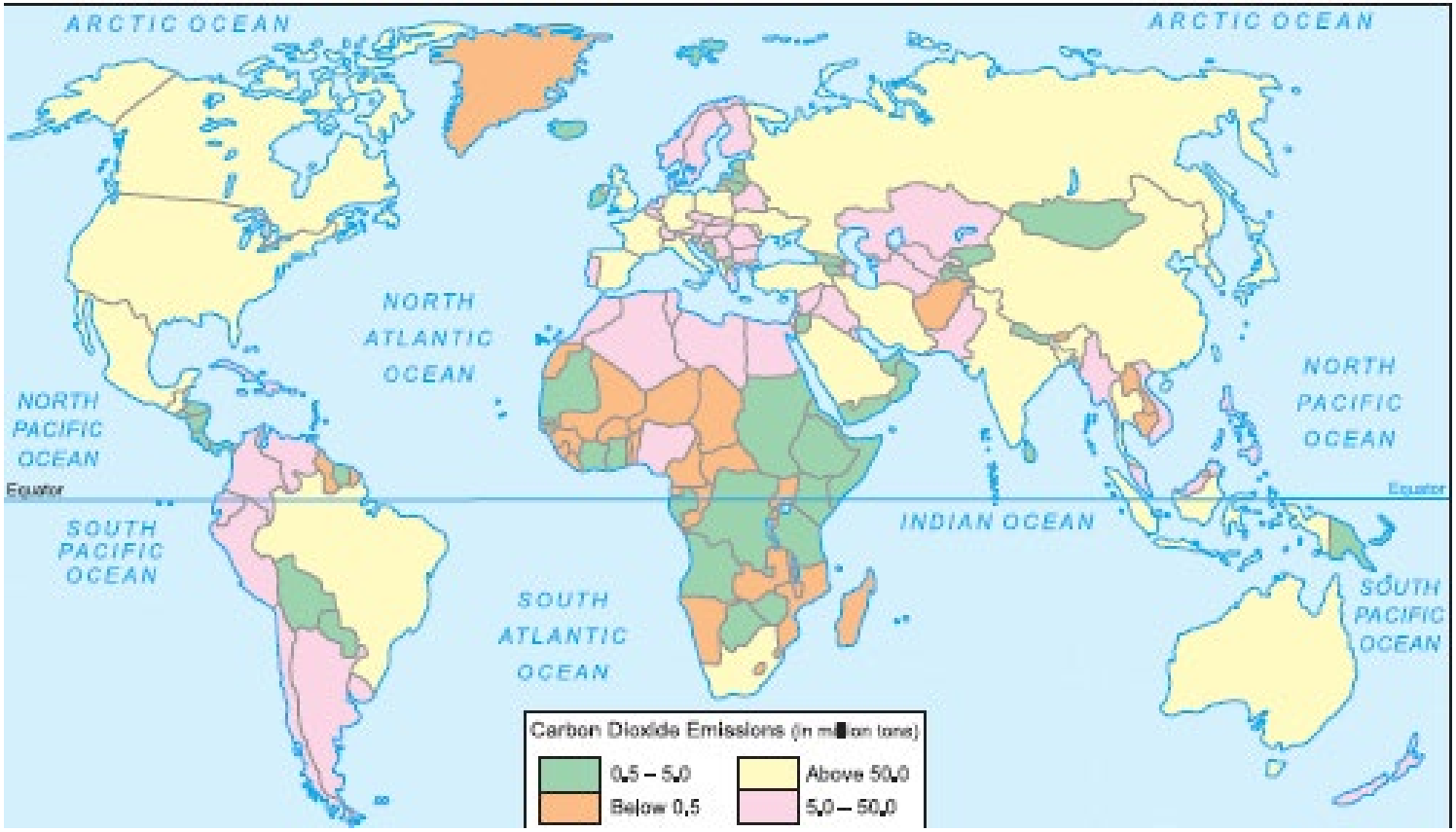
GLOBAL WARMING

The concept of global warming suggests that there will be an increase in temperature on the Earth's surface and atmosphere. This is due to increase in the amount of carbon dioxide and other greenhouse gases in the atmosphere.

The Sun is the main source of heat on the Earth. Some of the heat that reaches the Earth from the Sun is reflected back into the atmosphere. Gases in the atmosphere like carbon dioxide do not allow this heat to escape into space. Instead, the heat is held back and it warms the atmosphere.



Greenhouse gases prevent reflected energy from leaving the atmosphere.



World map showing Global Warming due to carbon dioxide emissions

Carbon dioxide in the atmosphere helps to regulate the temperatures on the Earth by preventing the heat energy near the Earth's surface from escaping into the space. This is known as the **greenhouse effect.**

Sources of Carbon Dioxide

Much of the carbon dioxide in the atmosphere is produced through the natural processes, which include respiration in living organisms, decomposition of plant and animal remains and chemical break down of matter. Volcanic eruptions also release large amount of carbon dioxide in the air.

However, other processes like the burning of fossil fuels (coal, petroleum and natural gas), smoke from vehicles, factories, etc. also increase the amount of carbon dioxide in the atmosphere. Another source of increased carbon dioxide in the atmosphere is deforestation.

EFFECTS OF GLOBAL WARMING

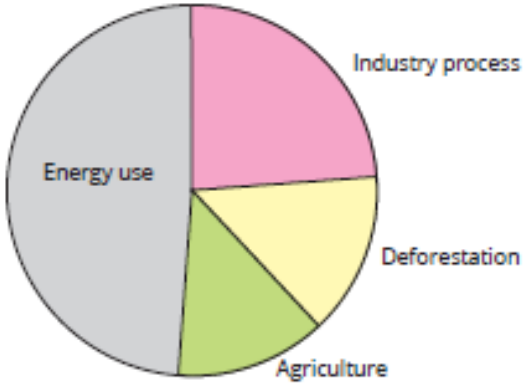
- Global warming would adversely affect the **ecosystems** on the Earth and the weather patterns around the world in the following ways:
- If the temperature of the atmosphere increases, the temperature of the oceans, which are involved in various weather phenomena, would also increase. As the ocean water becomes warm, severe storms like **hurricanes** would become more common.
- Many areas in the world would experience changes in their rainfall pattern. Such changes would affect agriculture.
- The increase in temperature would speed up the melting of glaciers, ice caps and icebergs in the far northern and southern parts of the world. This would cause flooding of the land in the coastal regions.
- The rise in temperature can cause changes in the ocean currents. Water in lakes and rivers on the Earth's surface would evaporate faster.
- Such changes would change the habitats of organisms. Those unable to adjust to these rapid changes may not be able to survive.

CONCERN OVER GLOBAL WARMING

Many scientists believe that human activities affect global warming, while others feel that global warming is a natural process, quite similar to those processes that have caused the Ice Ages of the past.

However, some measures have been taken to retard the global warming process, such as:

- Use of alternative energy sources in place of fossil fuels to meet the energy demands of the ever-increasing world population.
- Reduce deforestation, especially of the tropical rainforests, which use much of the carbon dioxide in the atmosphere to carry out photosynthesis and thus act as areas of **carbon sinks**.
- Plant trees and shrubs in areas which have been cleared for the construction of houses, factories, parks, etc. This helps in decreasing the carbon dioxide levels.
- Find alternative materials for use in polystyrene foam and solvents to reduce the amount of CFCs released in the environment.
- Reduce the quantity of chemical fertilizers for growing crops. This will reduce the amount of nitrogen oxide that enters the atmosphere.



Major activities producing greenhouse gases

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